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Social cognition and social influence in the time of coronavirus disease (COVID-19)

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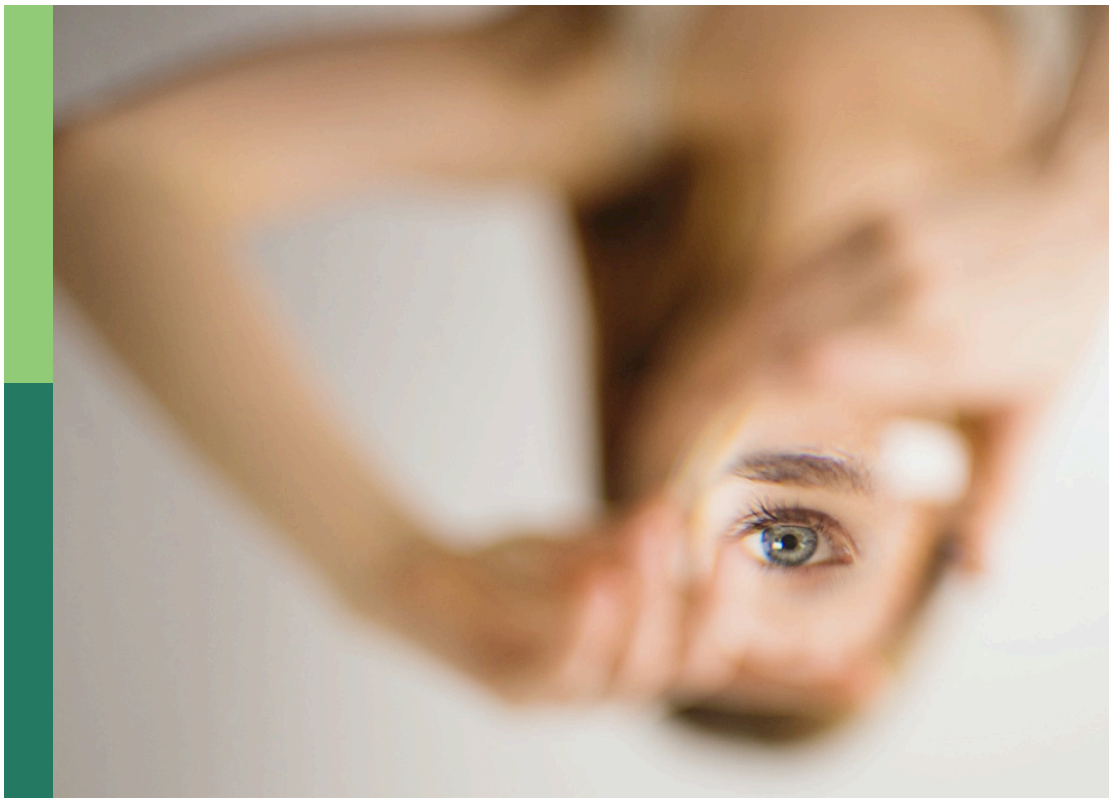

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Social cognition and social influence in the time of coronavirus disease (COVID-19)

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Forced Social Isolation and Mental Health: A Study on 1,006 Italians Under COVID-19 Lockdown

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Most countries have been struggling with the spread of the COVID-19 pandemic imposing social isolation on their citizens. However, this measure carried risks for people's mental health. This study evaluated the psychological repercussions of objective isolation in 1,006 Italians during the first, especially strict, lockdown in spring 2020. Although varying for the regional spread-rate of the contagion, results showed that the longer the isolation and the less adequate the physical space where people were isolated, the worse the mental health (e.g., depression). Offline social contacts buffered the association between social isolation and mental health. However, when offline contacts were limited, online contacts seemed crucial in protecting mental health. The findings inform about the potential downsides of the massive social isolation imposed by COVID-19 spread, highlighting possible risk factors and resources to account for implementing such isolation measures. Specifically, besides some known factors such as physical space availability, the local contagion rate is critical in moderating the link between social isolation and mental health issues, supporting national policies implementing regional tiers of restriction severity.

Keywords: COVID-19, social isolation, offline contacts, online contacts, mental health, space adequacy, virus local spread

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INTRODUCTION

Since early 2020, the COVID-19 pandemic caused about 4 billion people to be confined to their homes. Physical distancing has been adopted by most of the affected countries, including Italy, the first western country hit by the virus. The restrictions followed the health situation trend, for which a series of lockdowns alternated with less restrictive phases. However, particularly in the Italian context, no lockdown was comparable with the first one regarding the strictness of the measures taken to confine citizens to their homes.

The rapid spread of the COVID-19 forced the Italian government to apply drastic measures to tackle the contagion. The government enacted a decree at the beginning of March 2020, imposing a lockdown on the whole country, aimed at preventing the coronavirus from spreading in areas where the contagion was already extremely critical (e.g., the Lombardy region) and in those with only a few cases. Schools and universities closed for the entire semester, all the non-essential activities (e.g., bars and restaurants) were closed, and public gatherings were forbidden. Most people were forced to stay at home when the government prohibited people from leaving their houses unless for proven necessity, otherwise meeting harsh sanctions. Even city parks were closed, and outdoor physical activity was banned. Local police passed through the city streets, reiterating the need for citizens to stay at home over the loudspeakers. The failure to comply with the dispositions was

punishable with fines or even imprisonment (Lattanzi, 2019). In this sense, the characteristics of the first Italian lockdown were unique for western countries. It was totally unexpected and implemented in an extremely harsh and unprecedented way compared with both the first lockdowns of other western countries and the following lockdowns enacted in Italy.

Most importantly, such severe restrictions were applied uniformly across the entire country, regardless of the contagion's local spread (high vs. low). For instance, while in the Lombardy region, the spread of the infection was very high, with about 40% of all the Italian positive cases registered in March 2020; in the Calabria region, it was almost non-existent, representing only 0.6% of all the positive cases (Dipartimento della Protezione Civile, 2020). Despite this, the first lockdown characteristics in terms of social isolation were uniform throughout the national territory.

Despite the efforts of many scholars during the last few months, the research on the negative psychological repercussions of social isolation is still underway and many questions remain unanswered. The present study focused on the first phase of the COVID-19 pandemic in Italy, investigating the link between forced isolation and mental health by accounting for the role of the regional contagion rate, offline and online social contacts, and the adequacy of living space.

The Impact of Social and Physical Isolation on Mental Health

Social isolation refers to an objective physical separation from others and is different from loneliness, which is a subjective feeling of disconnectedness (Cacioppo and Patrick, 2008). It is known that brief forms of social disconnections can induce negative emotions (such as anger and sadness), and decrease satisfaction of basic psychological needs (e.g., self-esteem) and cognitive abilities. On the other side, prolonged social disconnection experiences have been linked with an increased risk of depression, suicidal thoughts, and risk of early mortality (Baumeister and Leary, 1995; Holt-Lunstad et al., 2010). The Temporal Need-Threat Model (Williams, 2009) suggests that people exposed to long-lasting instances of social exclusion—defined as the experience of being kept apart from others physically or emotionally (Riva and Eck, 2016)—enter a stage of psychological resignation, characterized by feelings of depression, alienation, unworthiness, and helplessness. Other theoretical models associated social withdrawal behaviors with prolonged rejection (Smart Richman and Leary, 2009). However, such exclusion-related implications for mental health have been found predominantly either in persistently marginalized social groups—such as immigrants (Marinucci and Riva, 2020a)—or in individuals with ostracism experiences that could last for years (Zadro, 2004). Moreover, the literature on loneliness has highlighted a significant relationship with mental health (Cacioppo and Patrick, 2008). However, besides being a subjective perception, loneliness refers to a stable individual disposition, hence a construct that again persists over time. Thus, investigating the effects of loneliness on psychological well-being differs much from addressing whether forcing the general population to remain isolated for a limited period (a few days or weeks) could produce a drop in mental health levels.

The available literature highlights that the quantity and quality of face-to-face social connections could influence the psychological health of individuals exposed to persistent conditions of exclusion (Baumeister and Leary, 1995). For instance, a study in the prison setting showed that inmates attending in-person group meetings presented significantly better mental health than prisoners who did not join the group sessions (Aureli et al., 2020). Similarly, face-to-face interactions with native people protected immigrants' psychological health from the harm of social exclusion (Marinucci and Riva, 2020b). Besides in-person relationships, also online social interactions via information and communication technologies (e.g., social networking sites) could protect from the mental health impact of persistent exclusion and isolation. Waytz and Gray (2018) emphasized that digital technologies could foster sociability and human relatedness when objective constraints impede face-to-face interactions. Concerning the COVID-19 pandemic, a study conducted in Italy during the first lockdown in 2020 showed that using technologies to relate with other people (from multiplayer videogames to leisure meetings and work-related video calls) was positively associated with psychological well-being via perceived social support (Gabbiadini et al., 2020). Hence, the research suggests that the quantity and quality of face-to-face and online social interactions could buffer from the harm of prolonged conditions of social isolation, as in COVID-19 lockdown.

Isolation Length, Virus Local Spread, and Adequacy of the Living Space

The first Italian lockdown occurred between March 9 and May 3, 2020, offering the possibility to explore whether the effects of social disconnection on mental health may occur even for relatively short periods. Moreover, the lockdown permitted the empirical investigation of the effects of the following objective conditions on the general population: the length of the social isolation period and the possible moderating effect of the pandemic's local severity.

The length of the isolation period, measured by assessing the number of days since the beginning of the lockdown, would allow controlling for confounding correlation between the individual subjective perception of social disconnectedness (e.g., loneliness) and mental health. Previous research on people under quarantine showed that such an experience could have significant downsides (Barbisch et al., 2015; Rubin and Wessely, 2020). In 2020, many studies focused on the impact of COVID-19 quarantine on mental health, especially in China, the site of the first outbreak of the virus. These studies suggested detrimental effects of the lockdown on various indicators of mental health, such as life satisfaction, psychological distress, and insomnia (Torales et al., 2020; Wang H. et al., 2020; Zhang and Ma, 2020; Zhang et al., 2020), and similar results were also obtained on the Italian population (Gualano et al., 2020; Rossi et al., 2020). A Spanish study on helpline psychological counselors observed that the lockdown generated/aggravated people's family and mental health problems, increasing their

anxiety and feeling of loneliness (Hervalejo et al., 2020). Similarly, a multi-country study showed a wide range of psychological consequences of home confinement, including poor sleep quality and unhealthy lifestyle behaviors, such as physical and social inactivity (Ammar et al., 2020). However, no measures of lockdown length were taken into account. Wang C. et al. (2020) made an effort in this direction, conducting a longitudinal study in China with two waves, one during the initial outbreak and the second 4 weeks later. Although the researchers identified some protective factors for mental health during the lockdown (e.g., confidence in doctors, risk perception), they did not observe any worsening in mental health: psychological distress did not change between the first and the second wave, whereas post-traumatic disorder decreased over time, even though this reduction was not clinically relevant. Conversely, an Italian longitudinal study conducted at the beginning and the end of the first lockdown showed small to medium worsening in the levels of depression and stress, but not in anxiety (Roma et al., 2020).

A recent systematic review (Brooks et al., 2020) revealed that quarantined people reported various psychological issues, such as acute stress symptoms, anxiety, insomnia, and emotional exhaustion. However, the review included studies with heterogeneous samples, such as individuals quarantined for being in contact with infected people, individuals only living in outbreak sites, and nurses and physicians directly involved in tackling the infection. Moreover, only three studies out of 24 considered the quarantine length as a predictor of mental health. Thus, the review does not account for the psychological impact of the lockdown length imposed on the general population. Indeed, the authors highlighted that the length of the quarantine and the disruption of social connections might be responsible for the quarantine's negative psychological repercussions, calling for further studies directly assessing the role of these potential mechanisms.

Beyond the length of social isolation, the virus local spread might represent a key factor in determining people's mental health issues during a lockdown. According to WHO, particular attention should be devoted to mental health in areas strongly affected by COVID-19 (World Health Organization, 2020). People living in high-contagion areas might perceive and experience the threat differently from those living in low-contagion areas. However, the literature on the relationship between the local spread of the virus and people's psychological well-being is limited and provided mixed results. A recent study on the COVID-19 pandemic showed that anxiety (but not depression) was more prevalent in Hubei province (China's worst-hit province) than in other areas of the country (Gao et al., 2020). Similarly, a large Italian study conducted during the first lockdown showed that people living in the south of the country were more likely to experience mental health issues (e.g., depression, anxiety, insomnia) than those living in the north (Rossi et al., 2020). Although the authors did not measure the actual contagion rate, southern Italy had a lower local spread than northern, suggesting a link between contagion rate and mental health. Opposite results were obtained by Ahmed et al. (2020), who observed severe depression symptoms (but not anxiety) in Hubei inhabitants more than twice as frequently as in people living in other Chinese areas.

Finally, the restrictions confining people to stay home for several consecutive days may represent an additional risk factor for mental health. Indeed, the living space's characteristics, including its size, luminosity, and the possibility of privacy, may crucially moderate people's experience of isolation (WHO/Europe, 2007). Literature suggests that an inadequate home environment (e.g., tiny apartments, low levels of natural light) can lead to both physical (e.g., respiratory morbidity) and psychological (e.g., negative feelings) consequences, compromising psychological well-being (Jones-Rounds et al., 2014). Although spending time outside might help people to cope with inadequate living spaces, the lockdown limits this opportunity and, therefore, inappropriate dwellings may worsen mental health.

The Present Study

The present study aimed to test the relationship between the length of forced isolation and the adequacy of living space on mental health during the first wave of the COVID-19 pandemic in Italy, considering the key role of differences in the local spread of the virus. We focused on mental health outcomes (e.g., depression) that previous research linked with prolonged exclusion and isolation experiences (Williams, 2009). Specifically, we tested whether

1. The longer the forced isolation (measured objectively as the number of days between the beginning of the lockdown and the day of completion of the survey), the more negative mental health outcomes.
2. The number of offline contacts available could mediate the relationship between forced isolation and mental health. Specifically, fewer face-to-face relationships due to forced isolation could worsen mental health. Differently, online contacts could buffer the negative relationship between days of isolation and mental health.
3. Being confined in inadequate physical spaces would be associated with worse mental health.

All the associations mentioned previously were tested separately for people living in high- vs. low-contagion areas to account for the high variability in the infection rate in Italy during the first wave of the pandemic. Indeed, the gap between the harshness of the restrictions and the actual contagion spread could constitute an additional source of burden in an already distressful condition. Specifically, we split the sample into two sub-samples according to the official data about the regional level of contagion (Dipartimento della Protezione Civile, 2020), comparing the associations among the focal variables between the two groups.

MATERIALS AND METHODS

Participants and Procedure

The present study was approved by the Ethics Committee of the Department of Psychology at the University of Milano–Bicocca (approval number: RM-2020-263). Written consent was obtained

by all the participants included in the data analysis. The survey was set up using Qualtrics (2020). The study was advertised on various social media with a brief post explaining our general aim (i.e., investigate habits and psychological well-being during the COVID-19 pandemic), trying to cover the whole country by posting on pages of different regions. The post included the link to the online survey. Once clicked on the link, participants were initially presented with the information sheet and consent form. Data were collected after the enactment of the lockdown by the Italian government (March 9), specifically between March 12 and 27, 2020. All data and the codebook are available at https://osf.io/xb8yj/?view_only=966abafccc844b99924da85be3f76272.

Overall, a convenience sample of 2470 persons accessed the online study. However, 328 participants only opened the link, and 22 did not give their consent; thus, they did not fill in any questions, reducing the sample size to 2120. Among these participants, 783 did not complete one or more independent variables (i.e., gender, age, space adequacy), further reducing the sample to 1337 individuals. Then, metadata on location were not automatically collected for 91 participants, whereas 11 participants compiled the survey abroad (i.e., outside Italy); thus, the sample was further reduced to 1,235 cases.

A final reduction was made based on the answers to offline and online contacts. Specifically, we asked participants to list up to 10 offline and online contacts (i.e., 20 contacts at the most) and to rate the closeness with each of them during the previous week (for further details, see section Offline and Online Social Contacts). For both offline and online contacts, cases were excluded if at least one of the following conditions was met: (1) at least one entry of the list clearly referred to multiple persons (e.g., "relatives," "friends," "colleagues"); (2) at least one entry that missed either the reference to a specific person or closeness rating; (3) all the entries were left blank and the participant declared it was not done on purpose. Forty-nine participants did not meet at least one of the aforementioned criteria for offline contacts, 105 for online contacts, and 75 for both offline and online contacts. Thus, the final sample on which the analyses were conducted consisted of 1,006 participants.

The sample size ($N = 1006$) was considered appropriate for the planned analysis, given that it largely exceeded the recommendation of 20 cases for each estimated parameter in a structural equation model (Kline, 2015). The sample was unbalanced for gender, including 807 females (80.2%), with an age range between 18 and 75 years, $M = 29.57$, SD = 10.89, and consisted of 984 participants of Italian nationality (97.8%). Concerning occupational status, 581 participants were employed (57.8%). Concerning education, 508 participants (50.5%) had a bachelor's degree or a higher education level, 463 (46.0%) a high school degree, and 35 (3.5%) a lower education level. The number of people living with participants ranged between 0 and 9, $M = 2.22$, SD = 1.31 (two participants did not answer this question).

Materials

The Qualtrics platform automatically gathered the date of survey completion and the geographical area in which the survey was compiled. The date of completion of the survey was used to compute the number of days since the official lockdown, which was considered the main proxy for social isolation length. Thus, the first day of data collection (March 12) was coded 4 (4 days from the beginning of the lockdown on March 9), and the last day (March 27) was coded 20. The location was used to objectively assess the level of contagion in the region where participants lived on the date of survey completion. Specifically, for each participant, we computed the daily percentage of regional COVID-19-positive individuals over the total infected in the Italian population, based on the official data of the Italian public safety department (Dipartimento della Protezione Civile, 2020).

Beyond sociodemographic information (i.e., gender, age, nationality, occupation, education, number of people living with participants), the survey included the following measures.

Mental Health Issues

Based on Williams' theory 2009, mental health issues were evaluated by measuring the four long-term negative consequences of social isolation, namely depression, unworthiness, alienation, and helplessness. Following the procedure of previous research (Riva et al., 2017; Marinucci and Riva, 2020a), we selected a subset of five items from psychometrically valid scales measuring the four constructs to keep the measure as short as possible. Item selection was primarily based on items loading (i.e., the highest, the better) and avoiding overlaps with items measuring other constructs. Participants were asked to indicate how often the events reported by the 20 items occurred during the last week, from 1 (not at all) to 7 (always). Items measuring depression derived from the Depression Anxiety and Stress Scales ($\alpha = 0.89$; sample item: "I felt down-hearted and blue"; Henry and Crawford, 2005). Items measuring unworthiness derived from the Rosenberg Self-Esteem Scale ($\alpha = 0.78$; sample item: "At times, I thought I am no good at all"; Rosenberg, 1965). Items measuring alienation derived from the Social Connectedness Scale ($\alpha = 0.82$; sample item: "I felt disconnected from the world around me"; Lee and Robbins, 1995). Items measuring helplessness derived from the Beck Hopelessness Scale and the Beck Depression Inventory-II ($\alpha = 0.87$; sample item: "My future seemed dark to me"; Beck et al., 1974, 1996). The results of a confirmatory factor analysis estimating the four first-order factor and the second-order factor of mental health issues confirmed the scale's theoretical structure [$\chi^2(163) = 986.21$, $p < 0.001$; CFI = 0.915; TLI = 0.901; RMSEA = 0.071; SRMR = 0.049]. Thus, scores of mental health issues were computed as the mean of the 20 items and showed excellent internal consistency ($\alpha = 0.93$).

Offline and Online Social Contacts

Quantity and quality of social contacts were measured separately for offline (i.e., face-to-face) and online (i.e., mediated by phone and social media) contacts, using a listing procedure adopted in previous research (Page-Gould, 2012; Marinucci and Riva, 2020b). Specifically, participants were asked to list up to 10 persons they had interacted with during the previous week and rate how close they felt to each of them on a Likert scale ranging from 1 (not close at all) to 5 (extremely close). A final check question was included for both offline and online contacts.

Specifically, if participants did not fill in any list entry, they were asked if it was intended (meaning that they had 0 offline or online contacts) or if it was a mistake. In the latter case, participants were asked to go back and fill in the list. Scores were computed as the sum of closeness rates for each person reported, obtaining two separate indices for offline and online contacts, respectively. Based on the check questions, scores of 0 were given to participants who left the list blank on purpose. Offline and online social contacts were randomly presented to the participants to control for possible order effect.

Space Adequacy

Three items were developed *ad hoc* to measure the adequacy of the space where participants were currently living. Participants were asked to rate how adequate were the (1) size, (2) brightness, and (3) privacy of their living space on a Likert scale ranging from 1 (not at all) to 7 (extremely). The space adequacy score was computed as the mean of the three items and showed adequate internal consistency ($\alpha = 0.73$).

RESULTS

Preliminary Analysis

The regional percentage of COVID-19-positive cases over the total number of infected in the Italian population ranged between 0.23 and 58.28%, $M = 31.86$, SD $= 23.20$. According to the regional severity of contagion, the sample was split into a "low contagion" (LC) subsample ($n = 414$), range: 0.23–13.94%, $M = 4.73$, SD $= 4.75$, and a "high contagion" (HC) subsample ($n = 592$), range: 43.71–58.28%, $M = 50.83$, SD $= 4.85$. Descriptive statistics of and comparison between the two subsamples on sociodemographic characteristics and predictor variables are presented in **Table 1**. All the variables did not differ between the two subsamples, except the number of people living with participants and days of forced social isolation. Specifically, compared with LC, HC participants lived with more people and completed the survey almost 1 day before, on average. However, these differences were associated with small effect sizes; thus, they were considered negligible.

TABLE 1 | Descriptive statistics of and comparison between the low- and high-contagion subsamples.

	Low contagion ($n = 414$)	High contagion ($n = 592$)	Inferential statistic	Effect size
Gender			$\chi^2(1) = 3.19$, $p = 0.074$	$\phi = 0.056$
Males	93 (22.5%)	106 (17.9%)		
Females	321 (77.5%)	486 (82.1%)		
Age	29.55 (10.82)	29.58 (10.95)	$t(1004) = 0.05$, $p = 0.959$	$d = 0.003$
Nationality			$\chi^2(1) = 0.00$, $p = 0.981$	$\phi = 0.001$
Italian	405 (97.8%)	579 (97.8%)		
Other	9 (2.2%)	13 (2.2%)		
Occupation			$\chi^2(1) = 0.01$, $p = 0.931$	$\phi = 0.003$
Employed	240 (58.0%)	341 (57.6%)		
Not employed	174 (42.0%)	250 (42.2%)		
Education			$\chi^2(2) = 1.84$, $p = 0.400$	$\phi = 0.043$
<High school	17 (4.1%)	18 (3.0%)		
High school	197 (47.6%)	266 (44.9%)		
≥Bachelor	200 (48.3%)	308 (52.0%)		
People living with participants	2.10 (1.32)	2.31 (1.30)	$t(1002) = 2.47$, $p = 0.014$	$d = 0.158$
Social isolation	10.57 (4.90)	9.73 (4.64)	$t(1004) = 3.01$, $p = 0.003$	$d = 0.193$
Space adequacy	4.84 (1.43)	4.95 (1.38)	$t(1004) = 1.23$, $p = 0.218$	$d = 0.079$

Number of cases and percentages within the subsample (in brackets) were reported for categorical variables (i.e., gender, nationality, occupation, education), mean (and SD) for the other variables.

Main Analysis

A multi-group path analysis investigated the association of social isolation length and space adequacy with mental health issues and whether these relationships were mediated by offline and online contacts, estimating separate models for participants in low-contagion (LC; $n = 414$) and high-contagion (HC; $n = 592$) areas. Gender and age were entered as further predictors of the two mediators and the outcome to control for their effect. The analysis was run using Mplus, version 7 (Muthén and Muthén, 2012). The model is graphically depicted in **Figure 1**; the complete list of parameters is reported in **Table 2**. The variance of mental health issues explained by the model was 0.23 for LC and 0.14 for HC.

While space adequacy was negatively associated with mental health issues for both LC and HC participants, social isolation had a significant, direct effect on it only for the LC subsample: the longer the isolation, the higher the mental health issues. Moreover, the direct effect of space adequacy on mental health issues was significantly higher than that of isolation length for both LC, $\Delta b = 0.23$, $p < 0.001$, and HC, $\Delta b = 0.21$, $p < 0.001$. Both offline and online social contacts had significant negative associations with mental health issues, irrespectively from the level of contagion. For both LC and HC participants, (a) the longer the social isolation, the less the offline contacts, and (b) the worse the space adequacy, the fewer the offline contacts. Conversely, the only significant association of online contacts was with the length of isolation, which showed a positive effect only for the HC subsample.

Mediation paths were evaluated using the bootstrapping technique, computing the 95% CI based on 5,000 resamplings. Concerning the LC subsample, offline contacts significantly mediated the relationship between social isolation and the outcome, $\beta = 0.029$, 95% CI [0.006, 0.051], meaning that the negative association between forced isolation and mental health was partially due to reduced face-to-face contacts. The total effect (i.e., direct plus indirect effects) of the length of isolation on mental health issues was significant and positive, $\beta = 0.191$, 95%

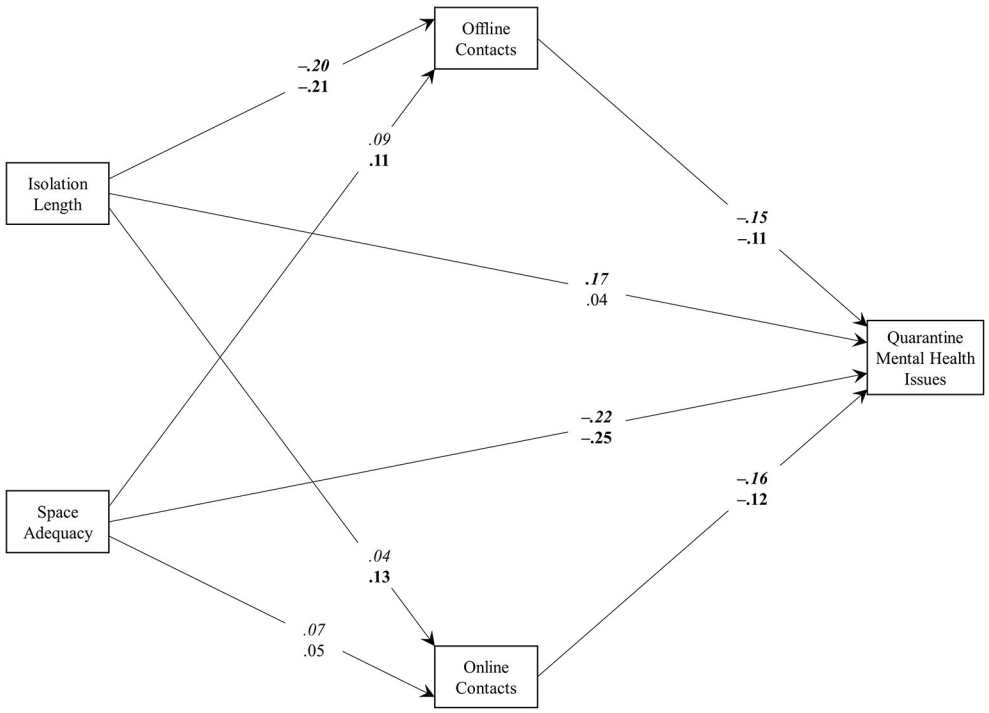

FIGURE 1 | The results of the multi-group path analysis model. Parameters for the low-contagion and high-contagion subsamples are reported in italics and plain text, respectively. Parameters in bold are significant at level $p < 0.05$.

CI [0.108, 0.275]. Conversely, offline contacts did not mediate the link between space adequacy and mental health issues, $\beta = -0.013$, 95% CI [−0.029, 0.002], and no indirect effects through online contacts were found (social isolation: $\beta = -0.007$, 95% CI [−0.022, 0.008]; space adequacy: $\beta = -0.011$, 95% CI [−0.027, 0.005]).

Concerning the HC subsample, both offline, $\beta = 0.023$, 95% CI [0.005, 0.041], and online, $\beta = -0.016$, 95% CI [−0.031, −0.001], contacts were significant mediators of the relationship between social isolation and the outcome. This means that, if fewer and less satisfying face-to-face contacts might decrease mental health due to forced isolation, the quantity and quality of online contacts might buffer the negative consequences of social isolation. The total effect (i.e., direct plus indirect effects) of the length of isolation on mental health issues was not significant, $\beta = 0.049$, 95% CI [−0.023, 0.122]. This was likely due to the two mediation effects that had an opposite sign. Offline contacts, $\beta = -0.012$, 95% CI [−0.024, 0.000], and online ones, $\beta = -0.007$, 95% CI [−0.018, 0.005], did not significantly mediate the link between space adequacy and mental health issues.

DISCUSSION

The COVID-19 pandemic led many nations to impose severe social restrictions on their citizens. Although this measure contained the virus spread, it could also have significant repercussions on people's mental health. However, different lockdowns have had different characteristics. In Italy, to date, no lockdown has had the level of severity of the one imposed in March and April 2020.

Based on 1,006 respondents in Italy, our data showed that forced isolation due to the first wave of COVID-19 could be associated with lower mental health constructs typically considered rather stable, especially in areas experiencing relatively low levels of contagion. Although the research design did not allow making causal inferences, the present findings indicated that, even in a relatively brief time span, social deprivation could lead to relevant repercussions for individuals' psychological well-being, showing that the longer the isolation, the worse the mental health.

Previous knowledge of social isolation's effects could be considered with what is revealed by our data according to two main standpoints. First, the COVID-19, as an exceptionally extreme event in recent history, may have elicited intense feelings of fear and threat for human survival, boosting the development of psychological issues. This result is consistent with studies that linked the pandemic with increased feelings of anxiety and depression (e.g., Hervalejo et al., 2020; Roma et al., 2020; Torales et al., 2020). Second, the virus local spread could have further moderated the impact of imposed social isolation on mental health. In this fashion, our findings add to the literature linking the virus local spread to its repercussions on mental health, helping to clarify the mixed results obtained so far (Ahmed et al., 2020; Gao et al., 2020). Accordingly, people in low-contagion areas might perceive the government's restrictions as exaggerated for their current situation and would suffer more from forced isolation. Conversely, people in high-contagion areas might

TABLE 2 | The results of the multi-group path analysis: standardized regression coefficients and 95% CIs are reported.

	Low contagion ($n = 414$)			High contagion ($n = 592$)		
	coeff	**95% CI**	***p***	**coeff**	**95% CI**	***p***
Regressions						
Isolation length → MHI	0.17	0.08, 0.26	<0.001	0.04	−0.04, 0.12	0.278
Space adequacy → MHI	−0.22	−0.31, −0.14	<0.001	−0.25	−0.32, −0.18	<0.001
Offline contacts → MHI	−0.15	−0.24, −0.06	0.001	−0.11	−0.19, −0.03	0.005
Online contacts → MHI	−0.16	−0.24, −0.07	<0.001	−0.12	−0.20, −0.05	0.001
Gender → MHI	0.01	−0.08, 0.09	0.860	−0.05	−0.13, 0.02	0.181
Age → MHI	−0.20	−0.29, −0.12	<0.001	−0.13	−0.21, −0.06	0.001
Isolation length → offline contacts	−0.20	−0.29, −0.10	<0.001	−0.21	−0.28, −0.13	<0.001
Space adequacy → offline contacts	0.09	−0.00, 0.18	0.059	0.11	0.03, 0.19	0.006
Gender → offline contacts	0.12	−0.03, 0.22	0.010	0.06	−0.02, 0.14	0.143
Age → offline contacts	0.03	−0.06, 0.13	0.493	−0.03	−0.11, 0.05	0.514
Isolation length → online contacts	0.04	−0.05, 0.14	0.360	0.13	0.05, 0.21	0.001
Space adequacy → online contacts	0.07	−0.03, 0.16	0.155	0.05	−0.03, 0.13	0.195
Gender → online contacts	−0.08	−0.17, 0.02	0.103	−0.04	−0.12, 0.04	0.377
Age → online contacts	0.19	0.10, 0.29	<0.001	0.07	−0.02, 0.15	0.109
Correlations						
Offline contacts–online contacts	0.16	0.06, 0.25	0.001	0.12	0.04, 0.20	0.002
Intercepts						
MHI	4.29	3.85, 4.73	<0.001	4.60	4.23, 4.97	<0.001
Offline contacts	1.60	1.13, 2.07	<0.001	1.67	1.29, 2.06	<0.001
Online contacts	1.30	0.81, 1.79	<0.001	1.48	1.08, 1.88	<0.001
Residual variances						
MHI	0.77	0.70, 0.84	<0.001	0.86	0.81, 0.91	<0.001
Offline contacts	0.93	0.88, 0.98	<0.001	0.95	0.91, 0.98	<0.001
Online contacts	0.95	0.91, 0.99	<0.001	0.97	0.95, 1.00	<0.001

All the parameters were standardized. The column "coeff." reports β for regressions and Pearson r for correlations. Gender was coded as 0 for females and as 1 for males. MHI, mental health issues.

better understand the need for physical distancing, accepting it, and perceiving the adherence to it as essential.

In high-contagion areas, we found a positive association between isolation length and online social contacts. Likely, the restrictions to face-to-face contacts could have led people to seek more online connections, which seemed to buffer against social restrictions' negative impact. This did not occur in low-contagion areas. This finding concurs with the aforementioned speculation in explaining the direct and stronger relationship between the length of isolation and mental health in low-contagion areas. Thus, it is possible that, compared with participants in low-contagion areas, the higher perception of threat could have prompted those in high-contagion areas to search (and, eventually, provide) social support through online contacts, protecting them from the adverse effect of isolation length. This interpretation is consistent with studies on the beneficial impact of online social contacts in disadvantaged individuals (e.g., physically restricted elderly; Delello and McWhorter, 2015) and people facing health challenges (e.g., breast cancer patients; Fogel et al., 2002), indicating that previous results might be broadened to the general population. Moreover, our results enrich the ongoing debate on social networking sites' role on well-being, which is at least controversial and primarily focused on their negative effects (Kuss and Griffiths, 2017). Several authors highlighted the risks of screen time—also encompassing social networking—for mental health, given that the time spent online reduced the commitment to offline activities and interactions (Twenge et al., 2018). Conversely, the present results seem to indicate that online social connections can replace the supportive effect of face-to-face interactions, especially when the latter are not available and in times of uncertainty and mass threat (in line with Waytz and Gray, 2018).

Crucially, we also found a key role in space adequacy in both low- and high-contagion areas. Indeed, the more adequate the space where participants were confined, the fewer mental health issues. This finding is consistent with both studies suggesting that inadequate living space can compromise psychological well-being (e.g., WHO/Europe, 2007; Jones-Rounds et al., 2014). Moreover, this association was even stronger than the one between the length of isolation and mental health. This result underlines the role of economic inequalities in relation to people's psychological well-being, suggesting that people who have the opportunity to live in relatively large and bright houses, guaranteeing privacy, suffer significantly less from the adverse effects of lockdown. Inevitably, special attention should be devoted when considering the impact of forced isolation for those living in inadequate dwellings.

Limitations and Future Research

There are some limitations regarding the current study. A first limitation is related to the constructs considered in this study: we cannot exclude that third variables (e.g., increased

fear of infection or the exposure to information on the pandemic considered, as in Gao et al., 2020) may account for the effects we have found. Importantly, the assessment of participants' mental illnesses would have been a useful control variable to exclude confounding effects deriving from pre-existing conditions. Similarly, our measure of space adequacy is not comprehensive of all the features that might be relevant in a condition of self-isolation at home, such as the availability of outdoor spaces (Soga et al., 2021).

A second limitation is related to our sample. Indeed, the prevalence of women and the slightly different composition of the two subsamples (i.e., LC and HC) in terms of number of people living with the participants and length of social isolation limited our results' generalizability, suggesting the need for future studies.

However, the main limitation concerns its cross-sectional design. Although we have followed the evolution of the pandemic's most critical phase over multiple days, the lack of baseline social contacts and mental health measures before the COVID-19 outbreak limited the interpretation of relationships among variables in a causal fashion. Nonetheless, the rationale of the model tested is supported by some theoretical considerations. First, the lockdown length and the virus regional spread, as objective indicators, could not depend on self-report measures and were reasonably treated as exogenous predictors. Second, the literature on social disconnection has demonstrated the detrimental effects of physical and emotional separation from others on well-being (Baumeister and Leary, 1995; Smart Richman and Leary, 2009; Williams, 2009; Holt-Lunstad et al., 2010; Riva and Eck, 2016), supporting the inclusion of offline and online contacts as predictors of mental health issues in our model. Third, although space adequacy was not an objective indicator, it was still included among the exogenous predictors, consistently with the literature that links the characteristics of the living space with the experience of isolation and well-being (WHO/Europe, 2007; Jones-Rounds et al., 2014). However, as a self-report measure, we must acknowledge a possible bi-directional influence between space adequacy and mental health. In other words, as people living in less satisfying physical spaces might suffer more from the lockdown, people suffering more from the lockdown might also have a worse perception of the living space where they are confined, which might be partially independent of the objective characteristics of the physical space itself. Again, this is a limitation that future studies might address through longitudinal design that links the length of isolation with mental health issues during a lockdown. Such studies should also consider the spread of contagion in the residence area and varying degrees of face-to-face and online connections.

Conclusions and Practical Implications

Beyond the advancement of the psychological impact of the COVID-19 lockdown, the exceptional nature of the COVID-19 pandemic made it possible to study an objective form of social isolation on a large scale, instead of limiting the research on certain marginalized social groups (e.g., Aureli et al., 2020). Moreover, assessing the level of contagion based on official, objective reports related to the participants' geographical area and the exact day of survey completion can be considered a strength of the present study.

Findings related to the local contagion rate's moderating role suggest governments and policymakers take special care to explain the reasons for forced isolation in areas where the infection rate is low. Moreover, the present results indirectly support the tier-based restrictive measures currently adopted by many governments. Indeed, adjusting the lockdown restrictions according to the local contagion rate might be crucial to prevent (or, at least, reduce) mental health issues, especially for people living in areas where the COVID-19 spread is limited. Nevertheless, our data do not allow a direct test of these speculations; thus, future studies should investigate further the plausibility of our interpretations.

Overall, this study suggests that restricting people's mobility, although essential to slow the spread of the infection, can put a significant strain on people's mental health on a scale unprecedented in recent history. Thus, in addition to trying to slow the spread of the pandemic, we must work to make multiple forms of psychological support available to manage the most critical situations, that is, those who have (a) few face-to-face contacts, (b) limited ability to use online contacts as buffers, and (c) inadequate physical spaces to live in.

DATA AVAILABILITY STATEMENT

The dataset presented in this study can be found in the OSF repository at the following link: https://osf.io/xb8yj/?view_only=966abafccc844b99924da85be3f76272.

ETHICS STATEMENT

The study involving human participants was reviewed and approved by Ethics Committee of the Department of Psychology at the University of Milan—Bicocca. The participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LP conducted the data analysis. PR supervised the research project. All the authors contributed equally to the conception and the design of the work, as well as to data collection, writing the first draft of the article and interpreting results, agreed to all aspects of the work, and approved the version to be published.

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The preprint, codebook, and dataset of this manuscript have been made available online (https://psyarxiv.com/uacfj/?view_only=966abafccc844b99924da85be3f76272) to inform other scientists conducting research on this topic.

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ORIGINAL RESEARCH
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Large Gatherings? No, Thank You. Devaluation of Crowded Social Scenes During the COVID-19 Pandemic

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In most European countries, the first wave of the COVID-19 pandemic (spring 2020) led to the imposition of physical distancing rules, resulting in a drastic and sudden reduction of real-life social interactions. Even people not directly affected by the virus itself were impacted in their physical and/or mental health, as well as in their financial security, by governmental lockdown measures. We investigated whether the combination of these events had changed people's appraisal of social scenes by testing 241 participants recruited mainly in Italy, Austria, and Germany in an online, preregistered study conducted about 50 days after the beginning of the COVID-19 outbreak in Europe. Images depicting individuals alone, in small groups (up to four people), and in large groups (more than seven people) were rated in terms of valence, arousal, and perceived physical distance. Pre-pandemic normative ratings were obtained from a validated database (OASIS). Several self-report measures were also taken, and condensed into four factors through factor analysis. All images were rated as more arousing compared to the pre-pandemic period, and the greater the decrease in real-life physical interactions reported by participants, the higher the ratings of arousal. As expected, only images depicting large gatherings of people were rated less positively during, compared to before, the pandemic. These ratings of valence were, however, moderated by a factor that included participants' number of days in isolation, relationship closeness, and perceived COVID-19 threat. Higher scores on this factor were associated with more positive ratings of images of individuals alone and in small groups, suggesting an increased appreciation of safer social situations, such as intimate and small-group contacts. The same factor was inversely related to the perceived physical distance between individuals in images of small and large groups, suggesting an impact of lockdown measures and contagion-related worries on the representation of interpersonal space. These findings point to rapid and compelling psychological and social consequences of the lockdown measures imposed during the COVID-19 pandemic on the perception of social groups. Further studies should assess the long-term impact of such events as typical everyday life is restored.

Keywords: COVID-19, social distancing, social gatherings, valence, arousal, perceived physical distance

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INTRODUCTION

The year 2020 has been marked, in most regions of the world, by the COVID-19 pandemic and its accompanying devastating effects on the economy and on individuals' physical and mental health. To protect the economy and prevent the collapse of health systems, most governments have adopted radical and unprecedented measures (see **Supplementary Material** for a list and a timeline of governmental measures introduced in Austria, Germany, and Italy). These included drastically reducing citizens' real-life social interactions, by limiting their freedom of movement and social exchange (social physical distancing). In the most extreme cases, people without family spent several months alone, without any meaningful physical social interactions.

This prevalence of prolonged isolation is worrisome, as humans possess "a pervasive drive to form and maintain at least a minimum quantity of lasting, positive, and impactful interpersonal relationships" (Baumeister and Leary, 1995, p. 497). A lack of social connections, and the resulting social isolation, has negative consequences on mental and physical health (Cacioppo et al., 2011, 2015), as the quality and quantity of social ties represent a major predictor for susceptibility to disease and mortality (Snyder-Mackler et al., 2020). According to the social buffering hypothesis, social support plays a crucial role in mitigating the negative consequences of adverse experiences (Cohen and Wills, 1985). Moreover, not only close others, but also weak ties, i.e., interactions with people on the periphery of the social network, seem to contribute to social and emotional well-being (Sandstrom and Dunn, 2014). Therefore, social networks may represent a crucial resource for resilience and survival in times of crisis, such as the current pandemic situation. Accordingly, greater social connectedness has been found to act as a buffer against perceived stress during the lockdown period (Nitschke et al., 2021) and to influence trust and adherence to governments' safety rules (Lamarche, 2020).

However, while gregariousness, i.e., the tendency to seek the company of others, has a beneficial impact on individuals' well-being, it also carries infection-specific risks (Schaller, 2011). During typical times, the social benefits outweigh the costs of pathogens transmission. Nonetheless, in times of high vulnerability, individuals may become less prone to sociality, to protect themselves from possible sources of infection (Schaller, 2011). Throughout the 2020–2021 pandemic, and especially during its initial phase, the importance of physically distancing from others has been emphasized by official government announcements and reminded relentlessly by major media outlets. In addition, many media reported daily (sometimes hourly) the continuously rising numbers of coronavirus-related infections and deaths, which made the topic of COVID-19 even more prevalent—shaping the social representation of the pandemic situation (Papapicco, 2020)—and likely contributed to a general feeling of fear and anxiety that influenced individuals' attitude toward health-related behaviors (Bendau et al., 2021). As a result, even brief social encounters previously perceived as trivial and insignificant—such as passing next to an unknown person in the aisle of a supermarket—took on a connotation of immediate, life-threatening danger.

Given the drastic changes in social interactions and proximity behaviors that occurred during the initial phase of the pandemic, we wondered whether people's appraisal of social scenes had changed as compared to the pre-pandemic period. Specifically, we hypothesized a change in the perceived connotation of scenes depicting large gatherings of people. These scenes, which before the pandemic outbreak were commonly associated with positive emotions, would now have become the cause of negative thoughts and a signal of a potentially dangerous situation. Moreover, we aimed to understand if such potential changes in the perception of large social gatherings could be moderated by the degree to which one had become personally affected by COVID-19, in terms of health, psychological, and financial impact, or increased loneliness.

To investigate these phenomena, we asked participants in several European countries to provide us with a range of information relating to their current and past living condition and their experience with the pandemic, and to rate the valence, arousal, and perceived physical distance of images depicting either a single person, small groups of people, or large social gatherings. The same images had been rated before the COVID-19 outbreak by another group of participants with comparable age and gender distribution (Kurdi et al., 2017), allowing a comparison of the appraisal of social gatherings before and after the pandemic outbreak.

MATERIALS AND METHODS

Subjects

We set the goal to test at least 110 participants in a 2-week period, corresponding to the number of participants who rated each image in the pre COVID-19 study by Kurdi et al. (2017). In total, 383 participants took part in the study, of which, however, only 241 completed it in all its parts. Three participants were excluded, as they failed to rate more than one-third of the items in one or more rating scales. Thus, the final sample included 238 participants (see **Table 1** for demographics). All participants were over 18 years old and provided consent to the use of the collected anonymous data. They were recruited via advertisements posted on social media (e.g., Facebook) or via direct contact (e.g., email). Participation was voluntary, and participants were not given any incentive for their participation. The study was approved by the Ethics Review Board of the University of Amsterdam (2020-EXT-12259).

Stimuli

A set of 60 images of social scenes (see **Supplementary Material** for a complete list) was selected from the database Open Affective Standardized Image Set (OASIS; Kurdi et al., 2017). The essential criterion for the selection was the presence of people, although images with sexual (e.g., explicit nudes, sexual activity), medical (e.g., surgery, injections), or grisly (e.g., wounds, violent scenes, cadavers) content were excluded. Depending on the number of people depicted, images were split into three categories: Alone (one person only), Small group (two to four people),

TABLE 1 | Demographics of the samples that rated valence and arousal of the stimulus images before (Kurdi et al., 2017; left column), and during the COVID-19 pandemic (current study; right column).

	Before COVID-19	During COVID-19
N	818	238
Nationality	Unknown	Italian (56%), German (14%), Austrian (9%), Dutch (1%), Other (20%)
Country of residence	USA (100%)	Italy (48%), Austria (22%), Germany (10%), UK (2%), Other (18%)
Gender	Male 49%, Female 51%	Male 37%, Female 62%, Other 1%
Age	M = 36.6; SD = 11.9; range 18–74	M = 35.4; SD = 13.6; range 20–82

TABLE 2 | Normative values of mean (SD) valence and arousal for the images included, as reported in the OASIS database.

	Alone	Small group	Large group
Valence	5.1 (0.48)	5.27 (0.47)	5.11 (0.45)
Arousal	3.88 (0.49)	3.74 (0.54)	3.67 (0.58)

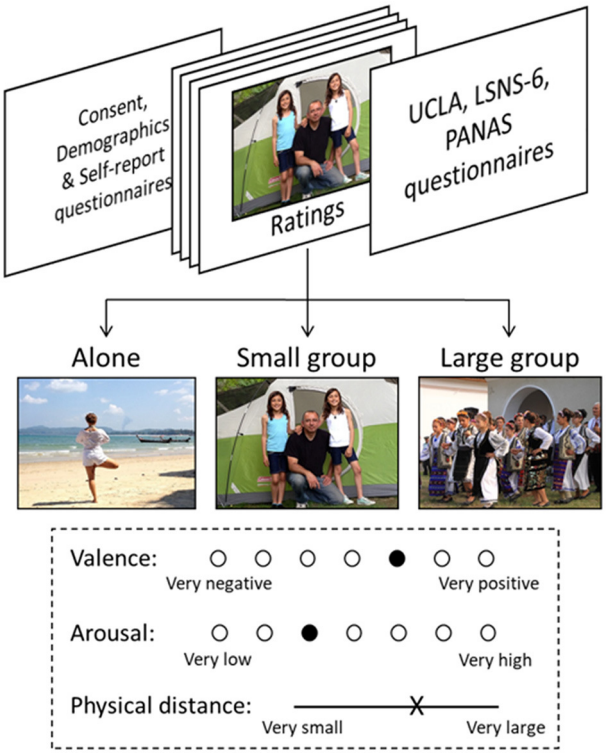

FIGURE 1 | Overview of the study and examples of the three categories of images: Alone, Small group, and Large group. Ratings of perceived physical distance between people were collected only for images depicting more than one individual. Images are from the OASIS database (Kurdi et al., 2017).

Large group (more than seven people). Images were matched across categories for valence (the degree of positive or negative affective response that the image evokes) and arousal (the intensity of the affective response that the image evokes) according to the normative values of the OASIS database (see **Table 2**).

Procedure

Data were acquired anonymously online (with the platform www.soscisurvey.de; Leiner, 2019), from April 30 to May 15. At the beginning of the experiment, participants could choose to view all materials (informed consent, instructions, task, and questionnaires) in either English, German, or Italian. After reading the instructions and providing consent, participants provided demographic data. Then they responded to a series of questions (see **Supplementary Material** for details) about (1) whether they were currently self-isolating, or had done so in the past, and for how long; (2) the number of people they (had) isolated with; (3) how their physical and virtual contacts with friends and relatives had changed compared to the pre-pandemic period; (4) whether they felt closer to friends and relatives compared to the pre-pandemic period; and (5) whether they or somebody among their family or friends had been diagnosed with COVID-19, and if so what the health consequences had been. Participants also filled out the "Perceived Coronavirus Threat" and the "Coronavirus Impacts" questionnaires (Conway et al., 2020).

In the main task (see **Figure 1**), participants saw the images one at a time, in random order, and rated their intrinsic valence and arousal using a seven-point Likert scale, as well as the perceived physical distance between the people shown on a visual analog scale (100 continuous points, this rating was not collected for images of the "alone" category). Every image was seen and rated once per participant.

After completing the picture rating task, participants filled out the UCLA Loneliness Scale (Russell, 1996), the abbreviated Lubben Social Network Scale (LSNS-6; Lubben et al., 2006), and the Positive Affect and Negative Affect Scales (PANAS; Watson et al., 1988). The total duration of the study was ∼25 min.

Statistical Analyses

The analysis plan was preregistered on the public data repository Open Science Framework (https://osf.io/mqau2/). Data collection had already begun at the time of preregistration to readily capture the ongoing phenomenon, yet data processing and analysis had not.

To investigate whether the COVID-19 pandemic induced changes in the evaluation of social images, we had originally planned to conduct a Linear Mixed Model (LMM) for each dependent variable (ratings of valence, arousal), with Group Numerosity (alone, small group, large group), and Time (pre COVID-19 outbreak: data from Kurdi et al., 2017, post COVID-19 outbreak: current study) as fixed effects. This analysis plan was subsequently revised, to account for minor differences between our experimental design and the one used by Kurdi et al. (2017); where each subject rated only a subset of the

images, see further explanation in the **Supplementary Materials**. Thus, we normalized (*z*-scores transformation) the ratings of valence and arousal collected in our study using the mean and standard deviation of the ratings of the same images collected in 2017. We then fitted to these z-scores of valence and arousal two separate LMMs, using the function *lmer* of the package *lme4*, with as fixed effect the within-subjects factor Group Numerosity (alone, small group, and large group), and as random effects by-subject intercepts and Group Numerosity slopes (the summary tables of all models are provided in the **Supplementary Materials**).

We conducted an exploratory factor analysis using principal component analysis with varimax rotation on the following measures: the UCLA Loneliness Scale (Russell, 1996), the abbreviated LSNS-6 (Lubben et al., 2006), changes in physical and virtual interactions, changes in feelings of closeness, the "Perceived Coronavirus Threat" and the "Coronavirus Impacts" questionnaires (Conway et al., 2020), and the number of days in isolation. Participants who indicated not to have been isolating (neither in the present nor in the past) were assigned a value of zero isolation days. We excluded participants ($N = 5$) who reported to have been isolating in the past, as we did not assess how long before they had been in isolation. We first used a parallel analysis and scree plot to determine the number of factors for the exploratory factor analysis, which both revealed the presence of three factors. However, since factor-4 presented an eigenvalue of one and the variable constituting it (COVID-19 impact) had a low loading (0.39) when using three factors only, we opted for a four factors structure, accounting for 69% of the total variance (as opposed to 57% of the three factors structure). The identified factors were subsequently added, as fixed main and interaction effects, to the previously described LMMs. The same analyses were carried out on the collected ratings of physical distance.

To control for individual differences, we also included in all LMMs the covariates age, nationality, country of residence, and participants' personal experience with COVID-19 (see **Table 3**). In all cases, continuous predictors were mean-centered and scaled. Where relevant, *post-hoc* analyses were adjusted for multiple comparisons using Tuckey correction.

The dataset and the analysis script in R are available at https://osf.io/mqau2/.

TABLE 3 | Participants' personal experience with COVID-19.

Personal experience with COVID-19			
Have you or anybody in your circle of acquaintances been tested positive for COVID-19?*		Consequences:	
1. No	61%	—	
2. Yes, somebody in my circle of acquaintances	38%	a. No serious consequences	49%
		b. Hospitalization	31%
		c. Intensive care	6%
		d. Death	12%
		e. Prefer not to answer	2%
3. Yes, myself	0%	—	—
4. Yes, myself and somebody in my circle of acquaintances	1%	a. No serious consequences	100%

Only one of the responses 1–4 could be chosen.

TABLE 4 | Participants' physical social distancing situation.

Physical social distancing situation		Average days in isolation	Average number of people in households*
Currently isolating	60%	M = 51.2, SD = 8.4	M = 1.7, SD = 1.5
Currently isolating but physical contacts with family/close friends	31%	M = 49.4, SD = 10.4	M = 2.3, SD = 2.1
Past isolation	1%	M = 35.4, SD = 37.3	M = 1.2, SD = 1.1
No current or past isolation	8%	—	—

Other than the participant.

RESULTS

Subjective Experience With the COVID-19 Pandemic and Physical Distancing

Participants reported to feel, on average, moderately threatened by COVID-19 (Perceived Coronavirus Threat: $M = 24.29$; $SD = 7.94$)[1] and not to have been heavily impacted by the pandemic in terms of financial security and mental health (Coronavirus Impacts scale: $M = 26.95$; $SD = 10$)[2]. Regarding their experience with COVID-19, only 1% of participants reported to have had first-hand experience with the virus, while 38% reported that somebody in their circle of acquaintances was diagnosed with COVID-19, often with direct health consequences (e.g., hospitalization, and in some cases death, see **Table 3**). Importantly, 91% of our sample affirmed to have been isolating for an average of 50 days at the time of the study (**Table 4**), and 60% reported to have had contact only with members of their household, which in one-third of the cases was just one person. Furthermore, 22% of the participants affirmed to have been isolating completely alone for more than 50 days at the time of the study.

We also observed that longer time in isolation, as well as higher threat and impact of COVID-19, were associated with higher negative mood (days of isolation: $r = 0.20$, $p = 0.024$; COVID-19 threat: $r = 0.43$, $p < 0.001$; COVID-19 impact: $r = 0.35$, $p < 0.001$)[3].

[1]The maximum score of the Perceived Coronavirus Threat questionnaire is 42.

[2]The maximum score of the Coronavirus Impacts questionnaire is 63.

[3]All *p*-values were adjusted for multiple comparisons using Bonferroni correction.

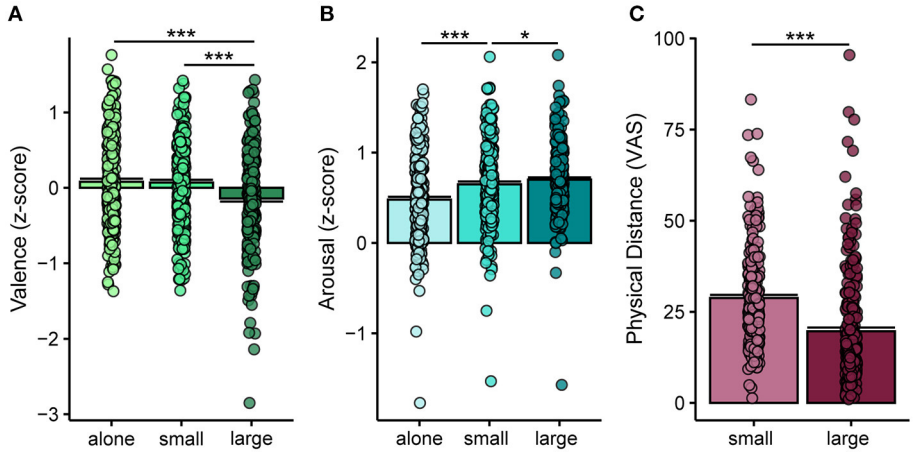

FIGURE 2 | Mean ratings of **(A)** valence, **(B)** arousal, and **(C)** perceived physical distance. Ratings of valence and arousal were normalized by the average ratings provided by another group of participants collected before the COVID-19 pandemic (Kurdi et al., 2017). Perceived physical distance was only recorded in this study, and only in response to images depicting more than one person. Bars represent standard error of the mean; points represent individual means; asterisks indicate significant differences between conditions (*$p < 0.05$; ***$p < 0.001$).

TABLE 5 | Mean (SD) of the normalized ratings (*z*-scores) of valence and arousal, and of the ratings of physical distance across the three categories of images (alone, small group and large group).

	Alone	Small group	Large group
Valence	0.08 (0.63)	0.07 (0.57)	−0.14 (0.65)
Arousal	0.48 (0.48)	0.65 (0.46)	0.7 (0.4)
Physical distance	—	28.80 (13.19)	19.67 (15.7)

Effect of Group Numerosity on the Appraisal of Social Scenes

To investigate whether the COVID-19 pandemic induced changes in the evaluation of social images, an LMM was fitted on the *z*-scores of valence (**Figure 2A**, **Table 5**). This revealed a significant main effect of Group Numerosity [$F_{(2,\ 235.98)} = 26.95$, $p < 0.001$]. As expected, participants rated the valence of images depicting individuals in large groups as significantly lower (more negative) compared to images of individuals alone and in small groups (both pairwise comparisons $p < 0.001$). Valence did not differ significantly between the alone and small group conditions ($p = 0.9$). To investigate whether the ratings of valence collected during the COVID-19 pandemic differed from the normative ones (OASIS dataset), we compared the *z*-scored ratings to zero using *t*-tests with Bonferroni correction. The analysis showed significantly reduced valence only for the images of large groups [$t_{(237)} = -3.39$, $p = 0.003$], while valence of images of individuals alone or in small groups did not differ significantly from zero (all $t < 1.81$, all $p > 0.22$).

Furthermore, the LMM fitted on the *z*-scores of arousal (**Figure 2B**, **Table 5**) revealed a significant main effect of Group Numerosity [$F_{(2,\ 236.75)} = 47.39$, $p < 0.001$]. Images of individuals in large groups were rated as more arousing than images of small groups ($p = 0.035$), which in turn were rated as more arousing than images of alone individuals ($p < 0.001$). Ratings of arousal for all the three conditions of Group Numerosity (alone, small group, and large group) were significantly higher during than before the pandemic, as indicated by *t*-tests of the *z*-scored ratings that were significantly greater than zero (all $t > 15.66$, all $p < 0.001$, Bonferroni corrected).

Lastly, the LMM fitted on the ratings of perceived physical distance (**Figure 2C**, **Table 5**) revealed a significant main effect of Group Numerosity [$F_{(1,\ 237.48)} = 158.47$, $p < 0.001$]. Individuals in large groups were perceived as physically closer compared to the individuals in small groups.

The pattern of the results for valence, arousal, and distance did not change after inclusion of the covariates age, nationality, country of residence, and participants' personal experience with COVID-19.

Effects of Subjective Experience With COVID-19, Physical Distancing, and Loneliness on the Appraisal of Social Scenes

We had hypothesized that appraisal of social scenes, in particular images depicting large groups of individuals, would be modulated by the experienced risk associated with COVID-19, as well as by the degree of felt/experienced isolation. We therefore measured with self-reports loneliness (UCLA; Russell, 1996), social networks size (LSNS-6; Lubben et al., 2006), subjectively felt threat and impact of COVID-19 (Conway et al., 2020), changes in the form of social interactions (virtual and physical) and perceived relationship closeness (see **Supplementary Material**), as well as number of days in isolation.

First, we explored whether these collected measures were correlated and could be gathered in underlying factors. Therefore, an exploratory factor analysis was carried out which

indicated the presence of four factors accounting for 69% of the total variance in the original measures. The rotated factor loadings showed that the number of days of isolation, changes in the perceived social closeness and perceived COVID-19 threat loaded on factor-1, which was named "Resilience" (loadings: 0.6, 0.67, 0.72). Positive values of this factor reflect more days of isolation and greater perceived COVID-19 threat, but also greater perceived closeness with significant others compared to the pre COVID-19 period, possibly indicating resilient response to the negative situation. Scores of loneliness and social network size loaded on factor-2 dubbed "Loneliness" (loadings: 0.85, −0.87). Positive values of this factor reflect smaller social network size and higher loneliness. Changes in physical and virtual social interactions loaded on factor-3, labeled "Changes in the form of social interaction" (loadings: −0.88, 0.76): positive values reflect an increase in virtual (but decrease in physical) interactions with others compared to the pre COVID-19 period, while negative values reflect an increase in physical (but decrease in virtual) interactions. Finally, perceived COVID-19 impact loaded on factor-4 (loading: 0.81). We termed this factor "COVID-19 impact": positive values reflect greater negative psychological and financial impact of COVID-19.

Each of these four factors were then separately added as a fixed effect to the previous LMMs on valence, arousal, and perceived physical distance to investigate whether an eventual shift in those measures were associated to the subjective experience of the pandemic.

Resilience (Factor-1)

The LMM fitted on the *z*-scores of valence including the predictor Group Numerosity and the factor-1 "Resilience" revealed a significant main effect of Group Numerosity [$F_{(2,\ 213.08)} = 24.23$, $p < 0.001$] and a significant Group Numerosity by factor-1 interaction [$F_{(2,\ 213.25)} = 3.45$, $p = 0.033$]. As shown in **Figure 3A**, we observed a positive relationship between ratings of valence and this factor for images of individuals alone and in small groups, but not for images of individuals in large groups. Thus, the longer participants had been isolating, the more they perceived COVID-19 as a threat, and the closer they felt to their significant others, the more they liked pictures showing single individuals and small groups. Their liking of images of crowds, on the other hand, was not affected by this factor. The same LMM on the *z*-scores of arousal revealed only a significant main effect of Group Numerosity [$F_{(2,\ 213.45)} = 46.72$, $p < 0.001$]. The LMM on the ratings of perceived physical distance revealed significant main effects of Group Numerosity [$F_{(1,\ 214.41)} = 169.91$, $p < 0.001$] and of factor-1 [$F_{(1,\ 213.87)} = 6.99$, $p = 0.009$], indicating that participants scoring higher on this factor perceived the individuals depicted in the pictures as physically closer to one another (**Figure 3B**).

Loneliness (Factor-2)

The LMMs fitted on the *z*-scores of valence and arousal, and on the ratings of perceived physical distance, including the predictor Numerosity and the factor-2 "Loneliness," revealed only a significant main effect of Group Numerosity [valence: $F_{(2,\ 212.97)} = 23.53$, $p < 0.001$; arousal: $F_{(2,\ 213.46)} = 46.69$, $p < 0.001$; physical distance: $F_{(1,\ 214.43)} = 169.35$, $p < 0.001$][4].

Changes in the Form of Social Interactions (Factor-3)

The LMM fitted on the *z*-scores of valence including the predictor Group Numerosity and the factor-3 revealed a significant main effect of Group Numerosity [$F_{(2,\ 213.03)} = 23.5$, $p < 0.001$]. The same LMM on the z-scores of arousal revealed a significant main effect of Group Numerosity [$F_{(2,\ 213.49)} = 46.70$, $p < 0.001$] and of factor-3 [$F_{(1,\ 214.14)} = 5.22$, $p = 0.023$][5], indicating that the pictures were generally perceived as more arousing by individuals who experienced a decrease in the number of physical social interactions during the pandemic as compared to the pre-pandemic period (**Figure 3C**). The LMM on the ratings of perceived physical distance showed only a main effect of Group Numerosity [$F_{(1,\ 214.41)} = 169.19$, $p < 0.001$].

COVID-19 Impact (Factor-4)

The LMM fitted on the *z*-scores of valence and arousal, and on the ratings of perceived physical distance, including the predictor Group Numerosity and the factor-4, revealed only a significant main effect of Group Numerosity [valence: $F_{(2,\ 213.99)} = 23.49$, $p < 0.001$; arousal: $F_{(2,\ 213.48)} = 47.2$, $p < 0.001$; physical distance: $F_{(1,\ 214.42)} = 169.23$, $p < 0.001$].

DISCUSSION

In the present study, we investigated the effects of the COVID-19 pandemic on the appraisal of social scenes. Between April and May 2020, images of individuals depicted alone, in small (up to four people), and large groups (more than seven people) were rated in terms of valence, arousal, and perceived physical distance. Valence and arousal were compared to pre-pandemic normative ratings (Kurdi et al., 2017). Further, we investigated if changes in these measures were associated with participants' personal experience of the COVID-19 pandemic.

Results indicate that during the pandemic images representing crowds and large gatherings were rated as less positive compared to the pre-pandemic period (**Figure 2A**). Moreover, participants experiencing overall greater physical isolation, stronger feelings of social closeness, and greater perceived threat of COVID-19 (factor-1) valued images depicting individuals alone and in small groups more positively (**Figure 3A**). Participants with higher scores on factor-1 also tended to judge the physical distance between individuals in small and large groups as smaller (**Figure 3B**). All three categories of images were rated as more arousing compared to the pre-pandemic normative data (**Figure 2B**). Further, higher arousal was associated with greater

[4] After including the covariates age, nationality, personal experience with COVID-19, and country of residence, we observed also a significant main effect of Loneliness on the *z*-scores of valence [$F_{(1,\ 201.13)} = 4.32$, $p = 0.039$] and on the ratings of physical distance [$F_{(1,\ 202.02)} = 4.7$, $p = 0.031$]. Ratings of valence decreased, while perceived physical distance increased, with higher scores of loneliness.

[5] After including the covariates age, nationality, personal experience with COVID-19 and country of residence this result was marginally significant ($p = 0.053$).

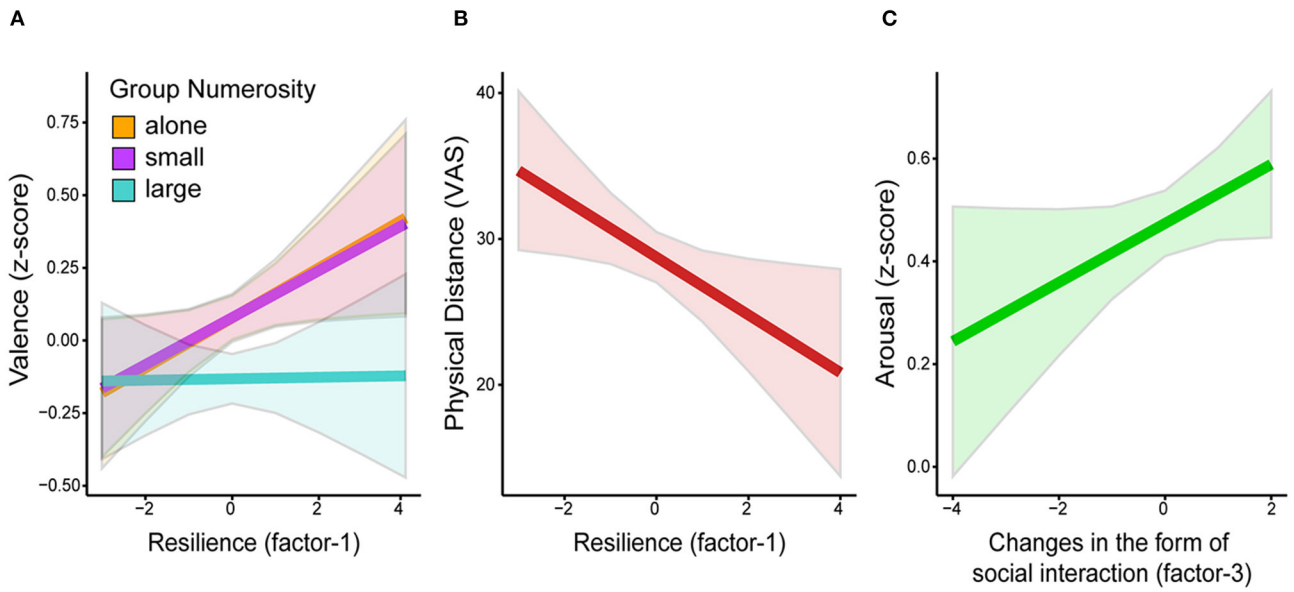

FIGURE 3 | Predicted values (marginal means and 95% CIs) of **(A)** z-scores of valence by Group Numerosity and factor-1 ("Resilience"); **(B)** ratings of physical distance by factor-1; and **(C)** *z*-scores of arousal by factor-3 ("Changes in the form of social interaction").

reduction of physical social interactions experienced during the pandemic (**Figure 3C**).

As humans, regular physical social contact with significant others, as well as with strangers, is part of everyday life, contributing to physical and psychological well-being (Field, 2010). The COVID-19 pandemic rapidly and drastically changed living habits and forced individuals to change their behavior, and the way they interact with others. Social activities involving gathering with other people, once considered harmless, such as going to a concert, suddenly had to be avoided to slow down the COVID-19 infection rate. We expected these changes to affect the thoughts and associations induced by the sight of unmasked crowds. Accordingly, we observed that during the pandemic the valence of images depicting large gatherings, which are associated with high risk for transmission of COVID-19, was significantly lower as compared to the pre-pandemic normative ratings of the very same pictures. Notably, the overall perceived valence of images of single individuals and small groups, which showed mainly intimate social interactions (e.g., partners, families), was not changed compared to pre-COVID-19 times. Further, all images were found to be more arousing than before the pandemic, with the highest increase for images of large groups. These findings point to a specific negative shift in participants' judgement of large gatherings during the COVID-19 pandemic, which may represent a possible mechanism to motivate avoidance of these potentially unsafe situations.

Further, we investigated whether these changes in the evaluation of social scenes were associated with the amount of physical distancing the participants had been exposed to, the perceived threat and financial/psychological impact of COVID-19, or changes in social behaviors and social connectedness. The results show that images depicting individuals alone and in small groups were rated more positively by participants who reported to be in isolation for a longer period of time, felt closer to their significant others compared to the pre-pandemic period, and felt more threatened by the COVID-19 pandemic (factor-1 "Resilience"). Valence ratings of images of crowds, on the other hand, were not modulated by this factor (**Figure 3A**). This finding suggests that participants who were more affected by the pandemic, both in terms of living (i.e., being forced to stay at home and avoid social contacts outside of the household for a large number of days) and psychological conditions (i.e., being more worried of a possible contagion for themselves and their relatives), had greater appreciation of images depicting situations considered safer in relation to the pandemic. Accordingly, across different cultures (Elmer et al., 2020; Killgore et al., 2020; Zhang and Ma, 2020) and pandemics (e.g., Lau et al., 2006), the caring for other family members and close friends increases, and the reciprocal support has been acknowledged to be an asset on which to rely for coping with the negative effects of a shared crisis. On the other hand, the reduced liking of crowded scenes during the pandemic (**Figure 2A**) was not affected by the participants' self-reported suffering from the pandemic (factor-1 "Resilience"; **Figure 3A**). The absence of modulation of this factor was not predicted. We speculate that this may be due to a floor effect, as the ratings of valence for images of individuals in large groups were already generally low, as shown in **Figure 2A**. As the COVID-19 pandemic represents a complex phenomenon impacting daily life on several aspects, it is also possible that other factors determined the lower valence expressed for this type of images, which we failed to capture with the collected self-report

measures. Future studies measuring other aspects possibly altered by the pandemic (e.g., measures of health concerns or general compliance with governmental countermeasures) will be needed to assess this possibility.

The present results are also consistent within an evolutionary framework and the notion of behavior driven by archaic mechanisms of the immune system. Previous research has shown that the human immune system includes a behavioral component, evolved to discourage individuals from interacting with possible sources of infection by enhancing psychological mechanisms, such as disgust and fear (Schaller, 2006; Curtis, 2014; Troisi, 2020). Moreover, signals of possible disease result in social contact avoidance, and higher pathogen disgust sensitivity is related to higher anxiety and avoidance in response to stimuli associated with disease (Fan and Olatunji, 2013), as well as to lower social trust (Aarøe et al., 2016). Importantly, these mechanisms of pathogen avoidance seem to be less likely to affect social motivation toward significant others, such as relatives and close friends (Aarøe et al., 2016).

In the context of an imposed lockdown, it is worth to note that physical isolation and social isolation are not equivalent: being in physical isolation does not necessarily mean to feel lonely or socially distant to others (Abel and McQueen, 2020; Das Gupta and Wong, 2020). Indeed, in the identified factor-1 "Resilience", the amount of days spent in physical isolation was positively correlated with the score in the scale "Changes in feelings of closeness", indicating that individuals who lived longer in isolation also felt closer to their significant others compared to the pre-pandemic period. Previous studies had reported that lonely individuals perceive social scenes as less rewarding and more threatening (Cacioppo et al., 2000, 2009). We, however, did not find direct evidence for an effect of loneliness or social network size on the perceived valence of the images. We nevertheless observed that increased feelings of social closeness with significant others were comparable with the pre-pandemic period (included in the factor-1) were associated with increased valence of social scenes depicting individuals alone and in small groups, suggesting, in accordance with previous studies, an influence of social connectedness on the appraisal of social scenes.

Regarding the ratings of perceived physical distance, previous research has shown that it can be affected by a number of factors, such as perceived social distance (Won et al., 2018), social exclusion (Knowles et al., 2014; Pitts et al., 2014), motivation and desire (Balcetis and Dunning, 2010), as well as perceived threat (Cole et al., 2013). The pandemic has drastically changed our relationship with physical proximity, by associating it to the threat of infection. It forced us to keep physical distance during social interactions, and to keep others away from our personal space. We observed that longer time spent in physical isolation and higher perceived threat of the virus were associated with a smaller perceived distance between the individuals depicted in the images, indicating a biased perception of the environment and physical proximity as a consequence of the pandemic.

Some limitations of the current study need to be considered. First, although the collected sample was similar in terms of age and gender to the one included in the study from Kurdi et al. (2017), other factors, such as the different nationalities and countries of residence or the study design, might have influenced the results. Second, the sample collected was not homogenous in terms of country of origin. In spite of a similarity of lockdown and containment measures issued by the different governments at the time of data collection, differences still exist. Finally, the studied sample was mainly constituted of young adults and a full generalization to different age groups is therefore limited.

To conclude, the current findings provide evidence for changes in the appraisal of social scenes during the COVID-19 pandemic. The data reveal how regular social activities implying large gatherings once perceived as positive and harmless can rapidly assume a negative valence when external, highly impacting events, such as the 2020–2021 pandemic, occur. These changes may be part of a phylogenetically developed behavioral immune response, aimed at avoiding source of pathogen infection to maintain health and preserve survival. Future research should investigate the time course and long-term effects of this negative shift as the COVID-19 virus continues to represent a major threat for health across the world and containment measures, such as city lockdowns, are prolonged. Further, other pandemic-related factors which are likely to contribute to the appraisal of social scenes should be assessed. For instance, the use of face masks, which has already been found to contribute to changes in other social cognitive processes, like face perception (Freud et al., 2020), the ability to recognize emotions (Carbon, 2020) and the attribution of trust (Marini et al., 2021).

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: Open Science Framework (OSF), https://osf.io/mqau2/.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Review Board of the University of Amsterdam (2020-EXT-12259). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CM, EC, RP, and SK contributed to conception and design of the study and data collection. CM performed the statistical analysis, under the guidance of EC, RP, and SK. CM and SK wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.689162/full#supplementary-material

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HYPOTHESIS AND THEORY
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Theory of Motivated Cue-Integration and COVID-19: Between Interoception, Somatization, and Radicalization

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The global dissemination of COVID-19 creates confusion and ambiguity in nearly every aspect of life, including fear of contagion, heightened awareness of the mortality of self and family members, lack of power, and distrust of experts and decision-makers. In this stressful situation, the question arises as to what mechanisms distinguish between adaptive and maladaptive self-regulation. The theory of Motivated Cue-Integration (MCI) is a novel theory of self-regulation that provides a new perspective on the effect of COVID-19 on self-regulation deficiency as an example of psychological distress. Inspired by predictive coding, social cognition, embodied cognition, and experiential approach, MCI suggests that self-regulation is based on interaction between (1) high-level values and goals, (2) low-level interoceptive and exteroceptive signals, and (3) trust in epistemic authority or a significant other. Motivated Cue-Integration posits that individuals create meaning by making moment-to-moment predictions that affect their interpretation of the experience of ambiguity influenced by their relationship with epistemic authority. According to MCI, deficiency in self-regulation during COVID-19 could result either from over-sensitivity or under-sensitivity to low-level interoceptive and exteroceptive cues; rigidity or ambiguity of high-level goals, poor integration between the two levels of processing as well as distrust in epistemic authority. According to MCI, variations of these deficiencies may occur in various clinical phenomena such as alexithymia and somatization, as well as in social phenomena such as goal radicalization. Based on this reasoning, MCI claims that the mentalization of the relationship between interoceptive cues, exteroceptive cues, goals, and psychological needs of the person, as well as the improvement of confidence in epistemic authority, can promote adaptive self-regulation. Psychological intervention can foster trust in epistemic authority, increase the mentalization of interoceptive and exteroceptive cues, and their association with adaptive goals. As such, the integration of these elements in a way that facilitates incentives pathways and insight fosters a more integrated subjective experience, higher clarity of emotion, and positive internal dialogue which promotes action tendency.

Keywords: COVID-19, motivated cue-integration, radicalization, somatization, interoception, embodied cognition, self-regulation, self-regulation failure

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INTRODUCTION

The global spread of COVID-19 due to severe acute respiratory syndrome (SARS-CoV-2) has generated uncertainty and ambiguity in almost every aspect of life. According to the World Health Organization as of mid-March 2021, more than 120 million cases have been confirmed, with more than 2.66 million deaths attributed to COVID-19, making it one of the deadliest pandemics in history. For many people, COVID-19 has created fear of contagion, increased awareness of the death of self and family members, economic crisis, loss of autonomy as well as distrust of experts and policy makers. The psychological effects of quarantine have been associated with post-traumatic stress, uncertainty, anger, fear of infection, dissatisfaction, boredom, inadequate supplies, and unreliable information (1). Despite these conditions, at the same time, some individuals have been engaged in cooperative and altruistic behavior and provided social and emotional support (2). In this stressful condition, the question arises as to what mechanisms distinguish between adaptive and maladaptive self-regulation. Theories of self-regulation have mostly related to control processes (3), and very little is known about the role of interoception and exteroception in the creation of subjective meaning and self-regulation, particularly in the context of pandemic. Based on the theory of Motivated Cue-Integration (MCI) (4–7), this paper will discuss the nature of adaptive vs. maladaptive self-regulation in the context of the COVID-19 pandemic.

In what follows, I will first present the novel theory of MCI as compared to traditional self-regulation and its association with predictive coding. Next, I will describe how pandemic-based insecurity affects the three pillars of MCI. Finally, I will address psychological guidelines that can improve the process of motivated integration of cues in a state of uncertainty.

WHAT IS SELF-REGULATION?

Self-regulation acts through a negative feedback loop which monitors the individual's current state against a reference value. Once a discrepancy is found, the person interacts with the current state and the desired state to minimize the discrepancy. In the context of health, self-regulation is seen as a personal resource that enables an individual to engage in objective behaviors that affect health, or as a set of behaviors, or as skills that can be learned and put into practice to promote health (8). At the core of self-regulation is the goal concept defined as cognitive representation of a desired end state that affects evaluations, emotions, and behavior (9). Goals include information on the desired states, which serves as a reference point to which behavior is directed (10–12). Individual life goals represent one's attempts to accomplish personal self-change, as well as enhance meaning and purpose in life (13). Accordingly, adaptive self-regulation requires selection and implementation of appropriate means to attain goals (4, 10, 11). Self-regulation can automatically be activated by contextual cues (e.g., word, image, metaphor, sound, smell), which activate goal representation and, subsequently, influence judgment and behavior without conscious awareness (14, 15). The automatic aspect of self-regulation is related to habits and does not require attention resources. Self-regulation involves cognitive and motivational properties. The cognitive properties are related to executive function such as focus of attention and working memory. The motivational properties include action selection, effort valuation, performance, reward learning, and reward expectations. Accordingly, self-regulation failure results in various deficits in these functions (5).

WHAT ARE THE TRADITIONAL THEORIES OF SELF-REGULATION LACKING?

Self-regulation theories describe numerous psychological phenomena related to action initiation, decision-making, self-control, and impulse control (16). However, some self-regulation processes have yet to be studied. First, while the psychology of action may be analogously linked to a car driven by both its energy and its goal directed action (17), research has been more concerned with self-regulation of goals than with regulation of energy. Second, based on dual process theories involving automatic vs. deliberated processes (18), self-regulation has been primarily concerned with goal-setting and goal-striving processes (19), and less is known about the effect of awareness of sensation on recognition of internal needs or personal goals, especially in the context of ambivalence and uncertainty. Third, research on self-regulation was primarily associated with a mechanistic cognitive approach or judgment of external reality, while the experiential aspect was underestimated. Fourth, self-regulation models suggest that goals are activated by exteroceptive contextual cues (20), and less is known about the effect of interoceptive cues on self-regulation (6, 7). Last, self-regulation theories have mainly focused on the "Self" and less is known on relational aspects of self-regulation. To address these gaps, the theory of MCI (4–6) proposes a new look at self-regulation, which integrates a predictive coding model, social cognition, embodied cognition research as well as a phenomenological approach. In what follows, I will first describe the predictive coding model. I will then present the fundamental assumptions of MCI in relation to deficiencies in self-regulation and relate MCI applications to COVID-19. Finally, I will include guidance for the course of therapeutic action resulting from MCI.

PREDICTIVE-CODING

According to predictive coding, the brain proactively adapts the body's physiological systems to meet needs before they arise. The brain has to find information about the potential explanations for sensory indications (i.e., perception) without direct exposure to these sources (21), for bodily navigations in the environment and reducing free-energy efficiency in internal states (22). This process is also influenced by the need to minimize the cost of prediction error, either by updating generative models or by taking action to link sensory states in line with predictions (23). Basically, the brain is asking what input is most similar to where similarity is calculated against population predictions and their associated costs and the potential benefits of the product. These predictions are

derived from Bayesian brain inferencing and all are about energy balance (24, 25). The process is promoted by the presence of two types of inputs: (1) exteroceptive inputs associated with body perception from the outside, based on multisensory integration, and (2) interoceptive inputs (26), classified as the sense of the inner physiological state that promotes homeostatic regulation of the body, culminating in physiological integrity and associated affective states, drives, and emotions (27, 28). The traditional predictive coding model suggests that the difference between internal state and environmental prediction is assessed by Bayesian statistics and described as a "surprise" that minimizes continuous system repairs. The system can also minimize the gap by intentionally changing the environment to the expected state. Prediction error is unanticipated information that comes from both internal and external sensory domains and modulates predictions. Error signals that track the difference between the sensations predicted and those coming from the sensory world are called precision signals. These signals calculate the prediction error from the incoming sensory input and optimize the sampling of the sensory periphery for allostasis. Unexpected sensory inputs that are expected to have allostatic implications because they are likely to have an impact on survival, reward or threat, or are of uncertain value, will be treated as "signal" and learned (i.e., encoded) to better predict energy needs in the future, with all other prediction errors treated as "noise" and safely ignored.

The theory of MCI (4–6) is a novel theory of self-regulation, indicating the existence of analogous mechanisms of brain and mental processes and integrating an experimental research perspective of social cognition and embodied cognition along with an experiential approach.

THEORY OF MOTIVATED CUE-INTEGRATION

The theory of MCI (4–6) suggests that the need for moment-to moment prediction is at the core of self-regulation. According to MCI, self-regulation is activated by both bottom-up and top-down processes through selective attention to goals and psychological needs, multisensory information, contextual cues, and affective signals, which, in turn, are integrated into meaning, resulting in action generation (4).

Following the perspective of "motivation as cognition" that attributed different functions to motivational and cognitive variables, suggesting that motivation will fluctuate between one moment to the next, thereby defining the degree to which any type of knowledge (strategic and peripheral; conscious and unconscious) is interpreted (29), MCI posits that not only do motivations fluctuate between one moment to the next but also interoceptive and exteroceptive cues are all integrated with high-level goals (4). Accordingly, the link between control processes and incentives through the term "goal" enables an understanding of the relationship between distinct dorsolateral and ventromedial brain-separated systems (6). Likewise, MCI fills an additional gap in the literature of embodied cognition. According to this school of thought, higher-level processing is based on the lower level sensory and motor experiences of the organism (30–33), indicating that activation automatically spreads from concepts based on experience in the physical world to their metaphorically associated social concepts [for reviews, see (32, 34)]. However, the study of perceptual symbols yielded various patterns of activation, which thus render assumptions about specific judgment and behavior problematic (4). Based on the shift in cognitive science that cognitive processes and their underlying neuronal activity patterns should be investigated primarily with respect to their role in generating action (35), Shalev (4) proposed that embodied cues are integrated according to their momentary functions within each individual's system of goals.

Following this view, MCI suggests that individuals consistently construe meaning based on relations between three pillars enabling self-regulation: (1) the low-level homeostatic moment-by-moment aspect of self-regulation which takes place through attention to emotion, interoceptive, and exteroceptive cues; (2) the high-level aspect of self-regulation, associated with individual goals, values, and aspirations; and (3) the continuous relationship of trust vs. distrust with epistemic authority (e.g., significant other, government, religious authority) which aims to reduce ambiguity, as elaborated in the next section.

THE THREE PILLARS OF MOTIVATED CUE-INTEGRATION

High Level Processes

High level processes relate to individual goals, personal needs, values, and aspirations. A systemic view of human behavior and its implications for the course of action indicates that goal systems are a mentally represented network in which goals with appropriate means and alternative goals can be cognitively associated (11). Whereas, the classic goal systems theory (11) is mostly related to general processes, MCI is focused on individual differences. The individual differences in perception of the social context are conveyed by previous patterns that created unique associations between goals and means of attainment (4), repeated coupling of sensory signals (36), and strength of the association between particular physical sensations and psychological concepts such as the combination of homeostatic cues (e.g., temperature and dryness). In addition, situational demands, history, and psychiatric and neuropsychological conditions (e.g., cognitive flexibility) influence MCI (4, 37). Ample research has been carried out on the relationship between the structure and function of the individual's goal system (38, 39), including the substitution of means, conflicting goals (12), rigidity, and radicalization of goals resulting in self-destruction (40, 41). The motivational relevance of the individual indicates the degree and duration of the goals of the individual in the present context thus influence its valence in cue-integration, resulting in adaptive vs. maladaptive self-regulation. Value relevance, for example, refers to the extent to which acts of mental representation produce the desired results or prevent unwanted outcomes; control relevance relates to the efficacy with

which active representation produces things; and truth relevance evaluates what is real (42).

Low Level Processes

Earlier emotion theories demonstrated the difference between high-level and low-level processes (43–45). For example, James and Dennis' (43) psychological theory related visceral-afferent input and emotional experience. Whereas, research on automatic self-regulation indicates that contextual cues (e.g., word, image, metaphor, sound, smell) automatically activate associated goal representations that subsequently influence judgment and behavior (14, 15), MCI emphasizes the importance of both interoceptive and exteroceptive signals (46, 47). Research on embodied cognition suggests that contextual and interoceptive visceral cues (e.g., temperature, dryness) carry contextual meaning, as well as cultural or idiosyncratic interpretation (47–50).

Likewise, whereas the traditional predictive coding model suggests that the difference between internal state and environmental prediction is assessed by Bayesian statistics, MCI relates to the motivated aspect of cue-integration, including subjective cognitive distortions as well as cultural influences. For example, Shalev (46) provided evidence that exposure to contextual cues associated with dryness and experience of physical thirst created by salty food results in procrastination of decision making and lower persistency in unsolvable anagram tasks. The same cues influenced the subjective experience of fatigue, indicating the association between interoceptive and exteroceptive cues and their influence on the cost of action. Bodily cues are mentalized, evolve into emotions, and reflect a contextual assessment that influences judgment and behavior, as in the case of disgust that has evolved in human cultures to respond to immoral acts or low-level people (51).

Trust in Epistemic Authority

The term epistemic authority refers to significant others, public leaders, policy makers, or God, suggesting individuals are willing to rely and accept information from epistemic authority as evidence of the truthfulness of the source's statements (29, 52). Motivated Cue-Integration claims that trust in epistemic authority reduces uncertainty. Ample research provides evidence of human dependence on external treatment in early life. This dependence enables advanced integration and organization of sensory and motor signals, resulting in the formation of a minimal self and brain mechanisms for incarnated mentalization (53). Evidence shows that attachment figures play a significant role in individual exploration and self-regulation (54–58). Following this view, Fonagy (59) suggests that epistemic trust in relationships is based on the person's experience of communicating with others, in particular the ability to receive and manage new information from others as relevant. Under ambiguity, the more individuals have confidence in the information provided by external sources, the more they can make autonomous predictions. On the other hand, the more distrust they have in the epistemic authority, the more dependence they have on external resources. Among adults, evidence shows that the more individuals trust the information provided by external sources (e.g., significant others, public leaders, policy makers), the more relatively autonomous predictions are made (60). According to expectancy-value models, this successful process increases both self-efficacy and hope (61).

DEFICITS IN SELF-REGULATION BASED ON THE MCI MODEL

Inspired by Frijda (62), MCI suggests that specific emotions imply specific eliciting sensations, specific action tendencies, and specific differential reinforcement. When functioning appropriately, this process allows for adjusting to evolving environmental demands in a flexible manner. In comparison, inefficient affective information retrieval or a failure to associate embodied cues with top-down goals contribute to affective dysregulation and inaction. When this inefficiency becomes serious, various pathologies are shown to occur (63). Following this view, several sources influence deficits in self-regulation. First, rigidity or ambiguity of goals. Second, low level interoceptive and exteroceptive signals as well as from poor integration of the two. Accordingly, recent research demonstrates that both symptom similarities within psychological conditions and symptom heterogeneity between disorders may be dependent on interoception (64–66). The association between interoception and alexithymia illustrates symptom intercorrelations, suggesting that interoceptive capacity may be underlying the p-factor, a first-order overarching factor that defines the severity of psychopathology and its associated neural dysfunction and is revealed by conducting confirmatory factor analysis on the co-occurrence of specific symptoms across psychiatric diagnoses (67). Following this view, Paulus et al. (68) differentiated between two patterns of interoceptive dysfunction that resulted in interoceptive psychopathology. Firstly, people have abnormally high expectations of situations that cause changes in the body (i.e., hyper-precise priors) and, secondly, when the environment changes (i.e., rigidity of context), they have great difficulty adjusting these perceptions. Therefore, lack of ability to adjust expectations as a function of context can contribute to a constant experience of somatic error, as an individual in a new environment does not alter old assumptions about different models.

Furthermore, deficits in self-regulation could result from distrust in epistemic authority, especially under uncertainty (59, 69). Uncertainty can also manifest itself in a disconnect between goals, sensations, and emotions that leads to difficulties in evaluating goals and delays in action. The lack of certainty in interpreting the sensations of the body and the lack of validation of emotional experience reduces the sense of agency and increases the need for external control. In what follows, I will look at COVID-19 as a case study for self-regulation deficits based on the MCI model.

COVID-19 AS A CASE STUDY FOR SELF-REGULATION DEFICITS BASED ON THE MCI MODEL

1. Uncertainty and Distrust in Self and Epistemic Authority

Because pandemic management is extremely amorphous, individuals need information from external sources to integrate their experience and predict the future. The experience of certainty is defined as the conviction that the information available is real and trustworthy. A state of mind of lack of doubt or a sense of security (70) is central to adaptive self-regulation. Uncertainty is reflected in the lack of internal constraints between the interactive parts of the system, such that knowing the status of one component provides minimal information about the others (71). There is evidence that the higher the level of public trust in government, the more public policy support among residents will be observed (72, 73). Specifically, there is more pro-social behavior and self-sacrifice behavior among residents (74, 75). By contrast, more conspiracy theories were linked with lower adherence to COVID-19 preventive actions (76).

2. The Effect of COVID-19 on Low-Level Processes

Interoceptive and Exteroceptive Cue Misperception, Misinterpretation, and Miscommunication as Markers of Health and Disease

A fundamental experience of certainty comes into play through reality testing involving the orientation of time and place, the assumption that what is perceived exists, the experience of contrast between inner and outer realms, and a clear assessment of how individuals respond to their environment (77). According to MCI, the lack certainty in the interpretation of the body's sensations and the lack of validation of emotional experience impairs the sense of agency and increases the need for external control. Therefore, confusion and ambiguity about perception and interpretation of interoceptive and exteroceptive signals have been generated by COVID-19. For instance, while extensive research has emphasized the association between feelings of affection and trust in physical proximity, COVID-19 leads to the creation of an association between social proximity and insecurity that contradicts innate processes.

A fundamental experience of certainty comes into play through reality testing involving the orientation of time and place, the assumption that what is perceived exists, the experience of contrast between inner and outer realms, and a clear assessment of how individuals respond to their environment (77). The pandemic has created a lack of confidence in the sensation of the body as a health and disease marker, since without sensing or experiencing physical symptoms, one can be infected and infect others. Likewise, symptoms of impaired taste and smell damage the fundamental trust in body data as a source of prediction. Motivated Cue-Integration suggests that the lack of confidence in body signals as health or disease markers increases the reliance on external signals as data sources, as in the case of alexithymia (6, 7). While interoceptive and exteroceptive signals play a key role in human behavior, people's introspection of the causes of their own behavior and attitude has led to undervaluation of the impact of these low-level signals because they tend to interpret their own behavior as a result of conscious and rational decision-making (78).

Low Emotional Clarity, Alexithymia

Motivated Cue-Integration views emotional episodes as special types of goal directed action episodes (79), indicating that emotion is extended to external perception (i.e., contextualized: "I feel like that") and transformed into a goal that comes into play through voluntary action (80). Following this view, Hommel et al. (79) argued that both emotional and non-emotional action trends are determined by high-level goal-directed processes, which differ only in the degree of control priority they have. Therefore, MCI suggests that greater clarity and awareness of emotion will result in action tendency. Emotional clarity deficits are linked to signs of depression, social anxiety, borderline personality disorder, binge feeding, and alcohol consumption, implying that emotional clarity deficits can be regarded as a transdiagnostic syndrome of divergent processes causing difficulties regulating emotions (81). These deficits are especially evident in alexithymia (82), which is described as a spectrum disorder characterized by difficulty identifying feelings and distinguishing them from bodily sensations of emotional arousal, difficulty describing one's own feelings, and an externally oriented cognitive style, i.e., a focusing of one's attention externally with little introspection or insight (83). Following this view, in total, 2,501 home-quarantined students from six southwest Chinese universities, it was discovered that participants with probable depression or PTSD experienced more severe alexithymia symptoms (84).

Somatization

During the COVID-19 outbreak, it was found that psychosomatic symptoms increased, and changes in perceived threat and biological rhythm, especially intolerance of uncertainty, were influential throughout this increase among 533 participants (85). Likewise, recent research on somatic symptoms associated with COVID-19 among 399 college students and primary school students in February and March 2020 indicates that the prevalence of somatic symptoms in college students was 34.85% (mild, 26.26%; moderate, 8.59%) and in primary school students, the prevalence of somatic symptoms was 2.39% (all mild) (86). The various distortions of the body–mind relationship were recently classified into clusters that corresponded to different interventions, suggesting that in some cases, stress associated with uncertainty heightened several biological disorders with a distinct pathophysiology, while in other cases an increased sensitivity to physical stimuli, along with hyper-reactivity of the autonomic system, forms a "vicious cycle" of learning processes involving biological and psychological dysfunctional mechanisms (e.g., central sensitization, catastrophizing, and selective attention). Another pattern of distortion is demonstrated by the conversion disorder, which indicates the translation of psychological distress into somatic complaints (87).

3. The Effect of COVID-19 on High Level Processes

According to MCI, the lack of clarity and ambiguity of individual goals or, on the other hand, radicalization and rigidity manifest a deficiency in high-level processes under uncertainty.

Goal Ambiguity

Goal ambiguity occurs with an increased likelihood that no result will be more likely than others. As a result, the individual can no longer confidently ascertain the meaning of any criterion, action or experience. Similarly, the goals or means of coping with the pandemic, vaguely defined by policymakers, cannot narrow the range of potential opportunities. Likewise, uncertainty arises when the resources or costs of coping with the pandemic are not available, or when the number of barriers to achieving reduced rates of contagion is high, so that the system is unable to maintain effective perception and behavioral constraints. This helps to explain the ambiguity caused by COVID-19, which takes place in the form of doubts as to the confidence of decision-makers in obtaining information perceived as true.

Goal Conflict

Another source of uncertainty is the conflict between goals, which is the simultaneous activation of competing interpretive mechanisms without particular superiority for a given instance (88) and which may lead to inaction. A significant scope of research on motivation orientation suggests that stagnation and failure require recurrent involvement in chronic assessment of what is the right thing to do rather than engagement in goal directed action (89, 90). Gray and McNaughton (91) argued that goal conflict is one of the precipitators of activation of the behavioral avoidance (or inhibition) system (BIS), reflecting indecision about how best to construct and respond to stimulus (e.g., approach or avoid). If there is clearly no interpretive framework or behavioral response that is most appropriate, there will be parallel activation of many different perceptual and motor response options. Accordingly, response conflicts were also identified as reliably triggering the operation of the anterior cingulate cortex (ACC) and subsequent involvement of the dorsolateral prefrontal cortex (DLPFC) (92–94).

Teleological Thinking and Conspiracy Theories

The confusion caused by COVID-19 is expressed in doubts as to the confidence of decision-makers in obtaining information perceived as true and relying on dubious sources of information, such as conspiracy theories, based on the assumption that powerful forces conceal everything. Conspiracy theories are informed by teleological thought, in which everything has a specific secret purpose (95). The use of conspiratorial theories can also be explained on the cognitive level through automated, rapid, and shallow processing of information influenced by limited cognitive resources (96, 97).

Complexity and Flexibility versus Rigidity of Goals

Motivated Cue-Integration suggests that trust vs. distrust influences the complexity or rigidity of an individual's narrative. This form of automation takes place in decision-making based on heuristics due to mental shortcuts that reduce the cognitive burden of decision-making, particularly under stress. In fact, excessive rigidity and lack of willingness to explore and confront uncertainty have been linked to a variety of pathological situations, such as obsessive-compulsive disorder (98). These fears are closely linked to the anxiety of existential philosophy that argues that freedom can lead to uncertainty and confusion (99). Such dogmatism can easily spread among individuals and the level of group interpretation and action (100–102). To control the experience of chronic goal-conflict, individuals may engage in goal-shielding, a mechanism that "automatically regulates one's focus by inhibiting potentially distracting alternative objectives" (103). Similarly, radical groups have oversimplified, rigid, and extremist narratives which reduce uncertainty (40).

Intervention

The intervention's aim is to address self-regulation deficits that manifest via high-level goals (e.g., radicalization, tension, confusion), low-level signals (e.g., low clarity of emotion, somatization), and dissociation or distorted integration of the two. Motivated Cue-Integration suggests that psychological or somatic symptoms associated with emotion dissociation and detachment from genuine psychological needs. Therefore, awareness of the relationship between goals and multisensory data allows for the interpretation of perceptual cues and their potential interaction with psychological needs. The process of motivated cue-integration entails processing the distressing experience by tracking sensations and emotions, identifying the relationships between bodily signals and concepts associated with needs, and developing the ability to examine the scenario from several viewpoints simultaneously. The psychological intervention can be appropriate for both clinical and subclinical conditions where the clinician recognizes low clarity of emotions, dissociation of psychological needs, or cognitive rigidity. The intervention may be combined with other therapeutic intervention or be used as an additional tool like many awareness of sensation techniques (e.g., mindfulness). The intervention begins by identifying a particular area of concern to the patient. The procedure entails paying close attention to emotions as well as interoceptive and exteroceptive cues related to the subject. The perceived sensations are then expressed by associated concepts, which enable movement between perceived sensations and associated words or images. The mentalization of physiological experiences, as well as the association of physical and psychological experiences, can result in a more accurate understanding of the essence of the dilemma or action that can be taken. Paying attention to perceptual cues results in the identification of a specific word or image that carries meaning or reveals an individual's latent personal intent. Tracking bodily sensations linked to concepts or images can result in a broader experience. For example the Focusing technique (104) facilitates the monitoring of sensory perception as well as the association of body signs and verbal ideas that go beyond the linear interpretation that has already been made. By echoing the patient's associations, the therapist facilitates the emergence of unique and fresh information. Exploring the relationship will be handled by personifying the troubling emotion and asking

detailed questions about what good meaning is underneath this emotion (e.g., reframing anxiety as need for caution). In the case of people suffering from emotional rigidity or somatization, therapists may be able to help in recognizing the underlying unexpressed desire. The therapist should be aware of any potential biases in perception or ignorance of perceptual cues, allowing for more contemplation and exploration of neglected facets. To increase the clarity of the interaction, this mentalization process should be repeated several times during a single session. Once the patient has experienced relaxation, she documents aspects of the process that she wishes to recall or apply in order to form an integrative image of the experience. The therapist will advise her to write a constructive self-talk statement that summarizes her psychological experience and encourages her to take action.

Because the process of cue-integration is influenced by external information resources, trust has an impact on future prediction and meaning generation. Handling experience and working with a therapist fosters a feeling of secure attachment. Clearly, in acute cases of ambiguity, it is important to reinforce the paths that have contributed to a sense of relative control. This is because adaptive self-regulation fosters trust and comfort zones in an individual's life. Promoting increased awareness of psychological needs, constructive emotion signals, incentive mechanisms, and insight allows for a greater tendency to act.

Taken together, the present paper presented the principles of the theory of MCI (4–6), a novel theory of self-regulation and its applications for the understanding of self-regulation deficiencies under COVID19. According to MCI, individuals create meaning by linking low-level interoceptive and exteroceptive cues and high-level goals, values, and aspirations. Motivated Cue-Integration claims that individuals differ in their associative relationships with their goal system, as well as their interaction with interoceptive and exteroceptive signals and emotions, and how these associations are expressed by words, bodily sensations, mental images, or physical symptoms. The process of MCI is influenced by trust-based relationships with epistemic authority as a trustworthy source of support and information. Psychopathology including deficits in interpreting the social environment are linked to the peculiar form of human interpretation, which creates integration between high level goals and external and low-level internal signals. Psychotherapy is a restructuring of particular and contextual emotional perception for the purpose of self-regulation. Future studies should examine the efficacy of MCI in optimizing MCI as a predictor of adaptive and maladaptive functioning. Such research would advance the state of the art of evidence-based analysis in the areas the creation of meaning, self-regulation, predictive coding, and the potential convergence between these fields.

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The author confirms being the sole contributor of this work and has approved it for publication.

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Multiple Mediating Effects of Conflicts With Parents and Self-Esteem on the Relationship Between Economic Status and Depression Among Middle School Students Since COVID-19

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This study explores associations between perceived economic status and depression among middle school students during COVID-19 in the context of conflict with parents and self-esteem. Data were collected in South Korea in the fall of 2020. A total of 328 middle school students were included, and a multiple mediator model was employed to examine the multiple mediating effects. Middle schoolers' household economic status was negatively associated with their conflict with parents. Conflict with parents was negatively related to middle school students' self-esteem. Indirect effects of perceived economic status *via* conflict with parents were significantly associated with depression. The indirect effect of perceived economic status *via* both conflict with parents and self-esteem was related to depression. Government subsidies should temporarily be expanded to improve households' economic status to potentially improve middle school students' depression and to enhance relationships between children and their parents during the COVID-19 pandemic. Further, extra financial support from the government should be focused on poor households with children in order to address family conflict, self-esteem, and depression among middle school students.

Keywords: depression, multiple mediating effects, conflicts with parents, self-esteem, economic status, middle school students

INTRODUCTION

Since December 2019, people around the world have experienced negative impacts from the COVID-19 pandemic, including loss of life, illness, and financial and mental health impacts. It is not just adults who have been negatively affected; middle school students, usually adolescents between the ages of 11 and 14, have reported worse depression since the COVID-19 pandemic began (e.g., Magson et al., 2021; Ravens-Sieberer et al., 2021). Prior to the COVID-19 pandemic, researchers have found that middle schoolers' depression is associated with low economic status, high conflict with their parents, and low self-esteem (e.g., Cho et al., 2001;

Orth et al., 2008; Yun et al., 2019). Additionally, since the pandemic, households across the world have been negatively affected economically (Falk, 2020; Wilson et al., 2020), so it is of interest to examine the relationship between household economic status and adolescent depression in the period of COVID-19, particularly as both have potentially been worsened by the circumstances of the pandemic. Further, it is of interest to examine the multiple mediators of conflict between adolescents and their parents, which may have increased due to more time spent together at home due to COVID-19-related lockdown measures, as well as adolescents' self-esteem.

LITERATURE REVIEW

Depression Among Adolescents Since COVID-19

A number of studies comparing depression prevalence among adolescents before and during the COVID-19 pandemic showed increased rates of depression among adolescents in many different countries (Hafstad et al., 2021; Jones et al., 2021; Luijten et al., 2021; Magson et al., 2021; Ravens-Sieberer et al., 2021; Thorisdottir et al., 2021). In a sample of Australian adolescents, there was a significant increase in depression symptoms from 12 months before the COVID-19 pandemic to 2 months into the pandemic (Magson et al., 2021). Icelandic adolescents were also administered a survey in 2016, 2018, and during the COVID-19 pandemic in 2020, and there was an increase in depressive symptoms across all age groups, with the increase worse for girls than boys (Thorisdottir et al., 2021). Moreover, Dutch children and adolescents showed worse depression symptoms in April 2020 than in 2018, controlling for factors, such as age and parental education (Luijten et al., 2021). Clinical levels of depression also increased slightly among Norwegian adolescents from February 2019 to June 2020, and German children and adolescents experienced more mental health problems, including depression, after the pandemic began (Hafstad et al., 2021; Ravens-Sieberer et al., 2021). Additionally, in a systematic review of studies conducted from 2019 to 2021, adolescents around the world exhibited higher rates of depression during the pandemic (Jones et al., 2021). Further, in a sample of adolescents and young adults in the United States, adolescents were more likely to report clinically significant depression symptoms during the COVID-19 pandemic than adults (Murata et al., 2020). Therefore, it is of interest to examine the potential impact of such high and increasing rates of depression among adolescents during the COVID-19 pandemic.

Household Economic Status Since COVID-19 and Adolescent Depression

The COVID-19 pandemic has negatively affected the global economy (Acs and Karpman, 2020; Jeong et al., 2020; Trading Economics, 2021). Although overall less negatively affected than some other countries, South Korea's economy has been negatively affected by decreased factory output, a reduction in exports, and rising unemployment rates that hit 20-year highs in December 2020 (Jeong et al., 2020; Jackson et al., 2021; Trading Economics, 2021). Further, three studies have examined how adolescents with lower socioeconomic status particularly have been affected by depression since the COVID-19 pandemic (Luijten et al., 2021; McGuine et al., 2021; Szwarcwald et al., 2021). Data collected in May 2020 from adolescent athletes in the United States showed that as their level of household poverty increased, so did their symptoms of depression (McGuine et al., 2021). Further, less affluent Brazilian adolescents were more affected by sadness, irritability, and sleep problems from June to September 2020 than their more affluent peers (Szwarcwald et al., 2021). Moreover, when examining the influence of parental job loss on depressive symptoms, Dutch children and adolescents whose parents had a negative change in work situation by April 2020 were more likely to report depression symptoms than children whose parents' work situation remained stable (Luijten et al., 2021). Thus, examining adolescents' household economic status and particularly whether it has changed negatively since COVID-19 are important factors when examining adolescent depression.

Parent-Adolescent Conflict Since COVID-19 and Adolescent Depression

Since the COVID-19 pandemic, there is some evidence to suggest that conflict between adolescents and their parents has increased (Russell et al., 2020) and that parent-adolescent conflict and support from and satisfaction with family relationships are associated with adolescent depression (Chen et al., 2020; Magson et al., 2021). Compared to a national sample of parents in the United States from 2011, parents reported more conflict between themselves and their children during the pandemic (Russell et al., 2020). Further, in a sample of adolescents living in Wuhan, China, during a COVID-19-related lockdown, higher perceived parental rejection and overprotection, including parent-adolescent conflict, were associated with increased depression (Chen et al., 2020). Additionally, among Australian adolescents, increased conflict with fathers – but not mothers – during the COVID-19 pandemic moderated change in adolescents' depressive symptoms from before the pandemic to 2 months into the pandemic (Magson et al., 2021).

Moreover, there is some evidence from prior to the COVID-19 pandemic to suggest that parent-adolescent conflict is indirectly associated with adolescent depression through adolescent self-esteem (Portes and Zady, 2002; Barber et al., 2003; Lin et al., 2008; Siyez, 2008; Ozdemir, 2014). In a longitudinal study of Spanish-speaking adolescents in the United States, parent-child conflict and adolescent depression were inversely associated with adolescent self-esteem (Portes and Zady, 2002). In another sample of Taiwanese adolescents, both lower self-esteem and higher family conflict predicted adolescent depression in a logistic regression analysis (Lin et al., 2008). Further, in a sample of Turkish adolescents aged 14–18, conflict with their parents explained 8% of the variance in self-esteem score, while conflict with their parents

and self-esteem together explained about 26% of the variance in their depression score (Ozdemir, 2014). Moreover, in a study of Turkish high school students, if adolescents perceived high conflict within their families, they were more likely to report low self-esteem and high depression (Siyez, 2008). Last, in a sample of African-American adolescents, adolescent self-esteem partially mediated the relationship between quality of the parent-adolescent relationship and adolescent psychological functioning (Barber et al., 2003). Thus, more research is needed to examine parent-child conflict since the pandemic and its relationship with adolescent self-esteem and depression.

Adolescent Self-Esteem and Depression Since COVID-19

One consequence of the COVID-19 pandemic and associated lockdowns and social distancing measures has been a decrease in adolescent self-esteem and an associated increase in depression (Rossi et al., 2020; Pizarro-Ruiz and Ordonez-Camblor, 2021). In Spain, children and adolescents were not allowed to leave their homes except for emergencies from mid-March to late April 2020, and during this time, a survey was conducted to examine the impact of such confinement on young people's wellbeing (Pizarro-Ruiz and Ordonez-Camblor, 2021). One such outcome was a decrease in self-esteem, with girls showing lower self-esteem than boys (Pizarro-Ruiz and Ordonez-Camblor, 2021). Moreover, although no studies were found examining adolescents specifically since COVID-19, in line with the hypothesis that self-esteem serves as a buffer against negative mental health outcomes, results showed that self-esteem mediated the relationship between fear of COVID-19 and depression (Rossi et al., 2020).

The Current Study

There have been a large body of research examining the effects of COVID-19 on society (e.g., Falk, 2020; Wilson et al., 2020). However, few studies have addressed pathways related to middle school students' depression since COVID-19. As middle school students are still maturing and greatly influenced by their family relationships (Greenberger and Chen, 1996; Sheeber et al., 1997; Tucker et al., 2003; Sajjadi et al., 2013; Yun et al., 2019), it is important to account for family factors when considering their depression. In particular, many households have encountered economic challenges due to COVID-19-related economic recession (Acs and Karpman, 2020; Jackson et al., 2021; Trading Economics, 2021). Thus, households' economic status and family relationships, which are affected by economic status, are important predictors influencing middle school students' depression since COVID-19. Further, self-esteem is also a critical factor that affects middle school students' developmental processes and is related to depression (e.g., Rossi et al., 2020). Therefore, it is necessary to investigate how self-esteem influences middle school students' depression. However, despite the importance of the influence of family factors and self-esteem on middle school students' depression, little is known about these relationships during COVID-19. During the period of the pandemic crisis, middle school students' depression might be more influenced by social and psychological mechanisms, including family relationships and self-esteem. Even though those factors are critical to deeply understand depression among middle school students, little is known about these relationships since the COVID-19 pandemic. Thus, this study explores the associations between perceived economic status and depression among middle school students during COVID-19 in the context of a multiple mediation model. We examine the following research questions: (1) Is economic status related to depression among middle school students? (2) Does economic status influence middle schoolers' conflict with parents and their self-esteem? and (3) Is there a multiple mediating effect of conflict with parents and self-esteem on the association between economic status and depression among middle school students?

MATERIALS AND METHODS

Participants and Study Setting

As the current study addresses depression among middle school students in South Korea, middle school students who were registered in a public school at the time of our study were the target population. Middle school students living in Gyeonggi Province, which is the most populous province in South Korea, were asked to participate in a survey. Data collection took place from September to October of 2020. To avoid face-to-face interviews due to coronavirus, we conducted an online survey by using an official communication tool provided by the middle schools. Parents, students, and teachers can mutually communicate through this tool, which all public middle schools use. The online survey in this study was delivered to middle school students through this tool. We used Google Forms to create the online survey and a link. Before posting a consent form and statement of this research to the communication tool, the online survey questionnaires were refined by experts, including a middle school teacher, in order to protect human rights and reduce misunderstandings of each item. The final questionnaires took about 20 minutes to complete, and respondents received $2 gift card as a reward for their participation. A total of 354 middle school students engaged in the online survey, but 26 students were excluded for the analysis because they declined to participate in the online survey. As we distributed two consent forms to both students and parents, parents were also asked whether they allowed their children to participate in the study. Some of the excluded sample included students whose parents refused their participation. Thus, 328 respondents were included in the final sample. The average age of middle school students in this study was 14.4 years old (average international age = 13.4 years old). Slightly more than half of all participants were girls (55%). As the current study does not include any identifiable information, the Institutional Review Board approved this study (#200810-1A).

Measures

Depression

Depression among middle school students was measured by the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). In this study, we used a short-form version of the CES-D with seven items (Santor and Coyne, 1997; Levine, 2013). Each item was rated on a four-point Likert-type scale. Respondents selected one of four response options: 0 = rarely or none of the time, 1 = some or little of the time, 2 = moderately or much of the time, and 3 = most or almost all the time. The specific questions are as follows: "I did not feel like eating; my appetite was poor"; "I had trouble keeping my mind on what I was doing"; "I felt depressed"; "I felt that everything I did was an effort"; "My sleep was restless"; "I felt sad"; and "I could not get going." For analysis, we used an average score of the seven items and higher scores indicated higher levels of depression. Cronbach's α of the depression variable was 0.86 in this study.

Conflict With Parents

Conflict with parents refers to levels of conflict between parents and middle school students during blended learning due to the crisis of COVID-19. This variable consists of four items with a five-point Likert scale. The response options include as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The items include the following, all related to blended learning since COVID-19: "I have been scolded more frequently by my parents because they do not like my behaviors"; "I have had increased disputes with my parents because of different viewpoints"; "I feel annoyed about communicating with parents"; and "I do not want to be in the same place as my parent." The average score of the four items was used for analysis, and a higher score indicates that middle schoolers have experienced more conflict with parents during blended learning since COVID-19. Cronbach's α of this scale was 0.86.

Self-Esteem

Middle schoolers' self-esteem was measured by the Rosenberg Self-Esteem Scale (Rosenberg, 1965). This measure consists of 10 items with a four-point Likert-type scale. Respondents chose one of the following response options: 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Self-esteem items included "I feel I am a person with worth, at least on an equal basis with others"; "I feel I have a number of good qualities"; "All in all, I am inclined to feel I am a failure"; "I am able to do things as well as most people"; "I feel I do not have much to be proud of"; "I have a positive attitude toward myself"; "On the whole, I am satisfied with myself"; "I wish I could have more respect for myself"; "I certainly feel useless at times"; and "I sometimes think I am no good at all." Before analysis, five items were reverse coded. We used an average score of all items, and higher scores indicated higher self-esteem. Cronbach's α of the four-point Likert-type scale was 0.89.

Perceived Economic Status

The Leyden Poverty Line suggested by Kapteyn et al. (1988) was used to measure perceived economic status. Using this scale, middle school students' perception of their household's economic status was measured. This measure had one question, "In your circumstances, do you consider your household's economic status to be good or bad?" Respondents were given six response options: 1 = very bad, 2 = bad, 3 = insufficient, 4 = sufficient, 5 = good, and 6 = very good. A higher score on this variable indicated that the middle school student perceived themselves to have a higher economic status.

Control Variables

Gender, age, academic performance, and absence of a caregiver after school were included as control variables in this study. Respondents reported their academic outcomes with the following response options: A, B, C, D, and F. Further, middle school students were asked whether they have a caregiver after school, rather than being on their own.

ANALYSIS STRATEGY

A multiple mediator model suggested by Preacher and Hayes (2004, 2008) was employed to examine the multiple mediating effects of conflict with parents and self-esteem on the relationship between perceived economic status and depression among middle school students during the COVID-19 crisis. As the multiple mediator model is conducted based upon bootstrapping, it allows researchers to include more than one mediator. Thus, this study accounts for conflict with parents as a first mediator and self-esteem as a sequence mediator. The effects of perceived economic status on depression during COVID-19 were calculated through the multiple mediators. The PROCESS macro 3.4 was used to identify the multiple mediating effects.

RESULTS

Table 1 shows descriptive statistics of the current study. Average self-reported academic performance among middle school students was a C grade, and 57% of middle school students

TABLE 1 | Sociodemographic and psychosocial characteristics of participants.

Variables	% or Mean (*SD*)	Range
Depression	0.91 (0.73)	0–3
Perceived economic status	4.00 (0.90)	1–6
Conflict with parents	2.17 (1.03)	1–5
Self-esteem	1.80 (0.74)	0–3
Age	14.42 (0.71)	12–16
Gender (girl)	55%	–
Academic performance	3.11 (1.03)	1–5
Absence of a caregiver after school	57%	–

Girls (n = 182); absence of a caregivers after school (n = 176).

TABLE 2 | Direct effects of perceived economic status on conflict with parents and self-esteem.

Variables	Conflict with parents	Self-esteem
(Constant)	4.68 (1.17)	2.64 (0.82)
Perceived economic status	−0.25 (0.06)***	0.01 (0.04)
Conflict with parents		−0.22 (0.04)***
Age	−0.11 (0.08)	−0.05 (0.05)
Gender (girl)	−0.26 (0.11)*	−0.17 (0.08)*
Academic performance	0.03 (0.06)	0.15 (0.04)***
Absence of caregiver after school	0.19 (0.11)	−0.10 (0.08)

*$p < 0.05$; ***$p < 0.001$.

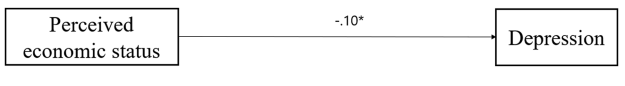

FIGURE 1 | Total effect of perceived economic status on depression.

did not receive care from a parent or other caregiver after school. Middle schoolers' average depression score was 0.91. On average, they considered their household's economic status to be sufficient. The average scores of the conflict with parents and self-esteem measures were 2.17 and 1.80, respectively.

Middle schoolers' household economic status was negatively associated with their conflict with parents ($\beta = -0.25$, $p < 0.001$; **Table 2**). That is, middle school students in wealthier households were less likely to report conflict with their parents. As shown in **Table 2**, conflict with parents was also negatively related to middle school students' self-esteem ($\beta = -0.22$, $p < 0.001$). Further, girls tended to have lower conflict with their parents and lower levels of self-esteem as compared to boys ($\beta = -0.26$, $p < 0.05$; $\beta = -0.17$, $p < 0.05$). Academic performance was positively related to self-esteem ($\beta = 0.15$, $p < 0.001$).

Figures 1, 2 show a multiple mediation model to identify an underlying association between perceived economic status and depression among middle school students since COVID-19 by including two mediators: conflict with parents and self-esteem. Further, model 1 in **Table 3** indicates the total effect of economic status on depression, and model 2 shows the direct and indirect effects of economic status on depression after including two mediators – conflict with parents and self-esteem. The total effect of economic status on depression is presented in **Figure 1**, which was statistically significant in model 1 of **Table 3** ($\beta = -0.10$, $p < 0.05$), and **Figure 2** indicates direct and indirect effects after considering the two mediators. The direct effect of perceived economic status on depression was not significant after entering the two mediators (model 2 of **Table 3**). Conflict with parents and self-esteem were significantly related to depression, respectively ($\beta = 0.26$, $p < 0.001$; $\beta = -0.19$, $p < 0.001$). Indirect effects of perceived economic status *via* conflict with parents were significantly associated with depression ($p < 0.01$), while the indirect effect of perceived economic status *via* self-esteem was not significant. Moreover, the indirect effect of economic status *via* both conflict with parents and self-esteem was related to depression ($p < 0.05$). In other words, the multiple mediating effects of conflict with parents and self-esteem on the relationship between economic status and depression among middle school students were significant.

DISCUSSION

Beyond adults' depression, depression among middle school students has been given attention in the literature as many have suffered from depression due to school life or relationships with their parents (Greenberger and Chen, 1996; Sheeber et al., 1997; Tucker et al., 2003; Sajjadi et al., 2013; Yun et al., 2019). Since COVID-19, middle schoolers have reported more frequent depression and higher levels of depression (Barendse et al., 2021; Magson et al., 2021; Ravens-Sieberer et al., 2021). As COVID-19 has changed various aspects of our lives, there may be complicated relationships influencing middle school students' depression. Despite the importance of middle school students' depression since COVID-19, few studies have addressed their depression in the context of conflict with their parents and their self-esteem. Thus, the current study revealed how perceived household economic status influences depression among middle school students by considering the multiple mediators of conflict with parents and self-esteem. This study found that perceived economic status was related to middle school students' depression and conflict with their parents. In addition, an indirect effect of conflict with parents was significantly associated with the relationship between perceived economic status and depression. This study also indicated that an indirect effect of perceived economic status *via* multiple mediators, including conflict with parents and self-esteem, was significant. This demonstrated that perceived low economic status influenced more conflicts with parents, which then leads to low self-esteem among middle school students. Those who had low levels of self-esteem were also more likely to be at greater risk of depression during the period of the COVID-19 crisis.

This study revealed that those who perceived themselves to have low economic status were more likely to experience higher levels of depression and conflict with their parents, which is consistent with previous studies (e.g., Smetana and Gaines, 1999; Cho et al., 2001; McLaughlin et al., 2011; Sajjadi et al., 2013). A large body of research has addressed these relationships; however, this study reported that the associations were also significant among middle school students since COVID-19. During the COVID-19 crisis, many households have suffered from economic challenges because of economic recession and job insecurity (Falk, 2020; Wilson et al., 2020). Even if their parents' income has been negatively affected, middle schoolers have been expected to access additional online educational resources, *via* a laptop, tablet, iPad, or smartphone, which are expensive. Middle school-aged adolescents may be particularly susceptible to peer influence of what electronics to which they should have access, and so middle schoolers

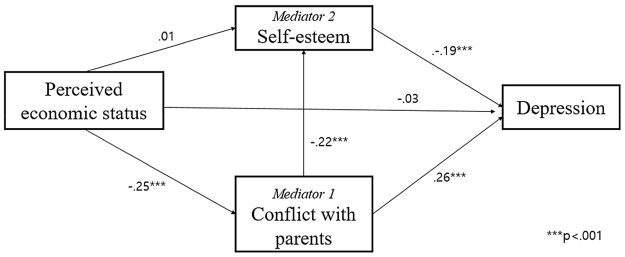

FIGURE 2 | Multiple mediating effect of conflict with parents and self-esteem.

TABLE 3 | Direct and indirect effects of perceived economic status on depression using SPSS process.

Variables	Depression	
	Model 1	**Model 2**
(Constant)	−0.38 (0.82)	−1.29 (0.76)
Perceived economic status	−0.10 (0.05)*	−0.03 (0.04)
Age	0.13 (0.06)*	0.15 (0.05)**
Gender (girl)	0.04 (0.08)	0.09 (0.07)
Absence of a caregiver after school	0.20 (0.08)*	0.12 (0.07)
Academic performance	−0.08 (0.04)	−0.06 (0.04)
Mediators		
Conflict with parents		0.26 (0.04)***
Self-esteem		−0.19 (0.05)***
Indirect effects		
Perceived economic status -> Conflict with parents		−0.06 (0.02)**
Perceived economic status -> Self-esteem		−0.00 (0.01)
Perceived economic status -> Conflict with parents -> Self-esteem		−0.01 (0.01)*

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

who come from families that cannot purchase expensive electronic tools for education and communication in the COVID-19 environment may become depressed because they feel as if they cannot communicate with their friends. Further, parents may have been forced to reduce their spending, including on their children, due to COVID-related economic issues, which may influence their children's risk of depression.

Likewise, middle school students whose parents have suffered from economic difficulties since the pandemic may be reluctant to communicate with their parents because they feel that their parents' support is not sufficient, leading to more conflicts with their parents. Further, parents might show more aggressive attitudes toward their children as they encounter more stresses from financial problems since COVID-19. As such, perceived low economic status may critically influence depression among middle school students and conflicts with their parents. Thus, government subsidies should temporarily be expanded to improve households' economic status to potentially improve middle school students' depression and to enhance relationships between children and their parents during the COVID-19 pandemic.

Moreover, this study revealed an indirect effect of conflict with parents on the association between perceived economic status and depression. However, the direct effect of perceived economic status on depression was not significant. This implies that it is critical to examine the underlying association between perceived economic status and depression during the COVID-19 pandemic crisis in the context of relationships between children and their parents. Thus, our findings indicated that poor self-perceived household economic status does not directly influence middle school students' depression, while it does lead to more conflicts with parents, and these greater conflicts result in higher depression among middle school students since COVID-19. This aligns with previous research, which demonstrates the relationship between economic status and conflicts between children and parents (Smetana and Gaines, 1999), as well as the relationship between parent-child conflict and children's depression in adolescence (Greenberger and Chen, 1996; Sheeber et al., 1997; Tucker et al., 2003; Sajjadi et al., 2013; Yun et al., 2019).

Beyond these associations, this study further contributes to understanding middle school students' depression since COVID-19. Our findings show that middle school students' depression was not directly influenced by their perception of their parents' poor economic status since the coronavirus pandemic. This may be because middle schoolers are young and may not recognize their household's economic status. Along with this, during the period of coronavirus, middle school students have spent more time in the house due to online education, which requires food for breakfast and lunch that may have previously been provided at school and greater economic resources, such as advanced tools for e-learning. If middle schoolers' needs are unmet because of limited financial supports from their parents, they may be more likely to fight with their parents, especially when forced to spend longer times in the house. Therefore, extra financial support from the government should be focused on poor households with children in order to provide additional vouchers for food and tools for e-learning.

The current study identified the multiple mediating effects of conflicts with parents and self-esteem on the relationship between perceived economic status and depression among middle school students during the period since COVID-19. Economic challenges since COVID-19 – such as unstable jobs, higher unemployment rates, and reduced income (Falk, 2020; Wilson et al., 2020) – have increased parents' stressors, while extra expenditures needed for e-learning have had a negative impact on the relationship between children and parents. If parents are less able to financially support their children due to economic hardships and children's needs are not being met, it may lead to more conflicts between children and parents, in part because middle school students are not as mature as to understand the current difficulties their parents are facing. Given that middle school students are in adolescence, a life stage which may increase troubles with parents, low economic status can further instigate conflicts in an already volatile relationship between middle school students and their parents.

Such conflicts with parents may interrupt communication between parents and their children, which is particularly relevant since COVID-19, because middle school students have been often forced to stay at home rather than going to school and socializing with their friends. In other words, parents are one of the closest persons who middle schoolers can talk to in-person about their daily life since COVID-19. As a good relationship between parents and children is associated with higher self-esteem in adolescence (Bulanda and Majumdar, 2009; Keizer et al., 2019), middle school students who reported more conflicts with their parents are more likely to have low self-esteem than their counterparts who have fewer conflicts with their parents. Thus, frequent conflicts with parents may lead to parents exhibiting aggressive behaviors and scolding their children, and these behaviors may be a buffer against adolescents' developing positive self-esteem. This is particularly important because low self-esteem is inversely associated with depression (Brage and Meredith, 1994; Marcotte et al., 2002; Orth et al., 2008, 2014; Masselink et al., 2018), and this is also true since COVID-19 as shown in this study. As such, multiple mediating effects of conflicts with parents and self-esteem implied that complicated pathways should be examined to deeply understand depression of middle school students since COVID-19. Over one and half years into the COVID-19 era, our daily lives have been dramatically changed and new life patterns have emerged. Thus, this study considered multiple mediators to explain levels of depression among middle school students since COVID-19. Even though perceived household economic status did not directly influence depression, perceived poor economic status during the pandemic influenced conflicts with parents and self-esteem. Therefore, financial subsidies from the government for households with children as well as financial community supports should be expanded to address mental health problems among middle school students.

Although this study sheds light on the relationship between perceived economic status and depression among middle school students in the context of multiple mediators, especially during the coronavirus pandemic, there are several limitations that impact the interpretation of this study's findings. First, even if middle school students might have similar characteristics based on their developmental processes, traditional values or cultural differences should be considered, as this study includes a sample from South Korea. Second, findings in the current study are limited to the context of the period during the COVID-19 pandemic. Thus, there might be other factors influencing the relationship between economic status and depression among middle school students before COVID-19 or after COVID-19. Third, other factors which were not included in this study, such as peer influence, might be other important factors influencing depression. Due to the already long length of the survey, we could not include other factors. Along with this issue, some factors, such as cultural factors, sense of control, and resilience, were not included in this study. Thus, interpretation may be limited to demonstrate alternative explanations of the association between socioeconomic status and depression in adolescents. Thus, we recommend that future studies should consider more control variables, which might influence depression among middle school students and support alternative explanations. Fourth, this study employed standardized measurements, except for the variable of conflict with parents. It was difficult to find an appropriate scale that considers cultural differences and fits well with students in South Korea. However, we suggest that other sources of parent-adolescent conflicts could be used in future studies to better measure levels of the conflict. Further, the scale of perceived economic status used in this study is highly subjective. This study could not collect information about real economic status because we did not collect data from parents or guardians. However, we acknowledge that an economic status variable based on income, net worth, and poverty is needed to interpret findings based on objective economic status. Fifth, the sample size was calculated by using a sample size calculator with a 5.24 confidence interval and 95% confidence level. The calculated number was 349 participants; however, we suggest that more participants should be recruited to improve the generalizability of findings by utilizing more advanced power analysis or sample size estimation.

IMPLICATIONS

Poor perceived economic status and other economic challenges since COVID-19 may lead to numerous deleterious impacts for a family. Direct impacts of such economic challenges include decreased income and job insecurity, which negatively influence quality of life. For a family with children, in particular, middle school students who perceive themselves to have low economic status during the pandemic are more likely to face conflict with their parents, to experience low self-esteem due to less interaction with parents, and to suffer from depression associated with low self-esteem. Although perceived economic status was not directly related to mental health among middle schoolers since COVID-19, this study showed the multiple mediating effects of conflicts with parents and self-esteem on the association between perceived economic status and depression. Therefore, it is important to investigate the underlying pathways in the context of individual and family factors. In particular, middle school students who perceive themselves to have a poor economic status tend to be at greater risk for depression, and they might not have sufficient support for their mental health due to COVID-19-related social distancing measures. Thus, temporarily increasing the number of staffs and professionals who can help with the mental health problems of middle school students, particularly those with lower economic status, might be effective to reduce levels of depression among middle school students. In addition, given that multiple factors influence middle school students' depression during the pandemic, economic supports from government or community sources should also be focused on programs and interventions to improve family relationships by decreasing conflicts between children and parents and to enhance levels of middle school students' self-esteem, rather than by only providing financial support to families to improve their economic status.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of Inha University approved this study (#200810-1A). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

The authors contributed equally to this study. All authors have read and agreed to the published version of the manuscript.

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Trusting Others During a Pandemic: Investigating Potential Changes in Generalized Trust and Its Relationship With Pandemic-Related Experiences and Worry

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Generalized trust, the belief that most other people can be trusted, has positive consequences for health and wellbeing. An increased sense of community is often seen in times of crisis or disaster, but it is unclear whether this is the case in the COVID-19 pandemic. The objectives of the current study were to assess whether generalized trust increased in an early pandemic phase compared to pre-pandemic levels, and whether trust was lower in individuals who felt particularly threatened or burdened in the pandemic. We compared levels of generalized trust in a population-representative Norwegian sample (n = 1,041) with pre-pandemic levels from the European Social Survey (ESS). Age- and gender-adjusted expected scores were compared to observed scores, using weighted data. Secondly, we tested whether indicators of pandemic-related strain, perceived health risks, or pandemic-related worry were associated with a lower level of generalized trust. This cross-sectional study was conducted in an early opening-up phase (May, 2020). The observed levels of generalized trust in an early pandemic phase did not differ significantly from expected levels based on pre-pandemic measures. Higher trust was found among individuals who reported personal experience with the COVID-19 disease (tested positive, admitted to hospital, or lost someone to the disease). Pandemic-related worry and a high perceived health threat were both associated with a lower level of generalized trust. These results indicate that personal experiences with the COVID-19 pandemic could influence trust in others, although this link may be context-dependent. Generalized trust is considered to be an important asset in society, and promote health and well-being. As the pandemic evolves, there is a risk that we may lose, or a chance that we could gain, trust, with potential consequences for our health.

Keywords: generalized trust, pandemic (COVID-19), worry, strain, European Social Survey, perceived health risk

INTRODUCTION

Generalized trust, the belief that most other people can be trusted, is thought to positively influence individuals and society in a multitude of ways (Dinesen, 2012). High trust is associated with better physical and mental health, increased cooperation, well-being, and satisfaction with life (Kawachi et al., 2008; Miething et al., 2020; Zhang, 2020). Although generalized trust is conceptualized as a rather stable factor, major events may have the power to initiate changes in our general evaluation of other people. In this paper, we propose that the current COVID-19 pandemic has impacted trust in the general population and investigate whether trust is particularly affected by pandemic-related strain, worries, and risk perception.

Generalized trust is a phenomenon that has been investigated within multiple scientific disciplines, and there is no uniform agreement about the conceptualization and operationalization of the construct. In survey studies, trust is often defined as the expectation that others will behave with goodwill, keep promises, and avoid doing harm, in other words, a default expectation of people's trustworthiness (Glanville et al., 2013). Generalized trust refers to expectancies toward other people (strangers or people in general), and is differentiated from institutional, or political, trust (e.g., trust in the police, the justice system, politicians), and from trust in particular individuals (such as family, friends, and acquaintances) (Bjørnskov, 2007; Glanville and Paxton, 2007). Generalized trust is believed to influence behavioral tendencies on an individual and a community level and to promote prosocial behavior and cooperation (Van Lange, 2015). Thus, a high level of trust is desirable both for the individual and for society. Nevertheless, optimal trust may not be the same as maximal trust. A very high level of trust can render an individual or a community vulnerable to deception or exploitation, unless combined with realism or skepticism. This has been called the dark side of trust (Neal et al., 2016).

Whether generalized trust is malleable or resistant to change is a matter of controversy (Dinesen, 2012). Basic trust is first acquired in interactions with reliable caregivers (Rotter, 1980). Thus, early life experiences lay the foundation for a belief that other people can be trusted. This developmental perspective aligns with personality theories, in that both conceptualize generalized trust as a trait that will predict behavior across contexts and experiences, and will determine how new experiences are evaluated. In contrast to institutional trust and trust in specific people, generalized trust is thought to be less fragile as it does not depend as much upon reciprocity (Uslaner, 2015). Generalized trust is therefore considered to be a fairly stable feature of society (Nannestad, 2008). On the other hand, social learning theory postulates that evaluations of other people's trustworthiness derive from personal and local experiences throughout life (Hardin, 2002). Thus, new experiences, particularly extraordinary or highly emotional events, will shape future expectations about others (Glanville and Paxton, 2007).

The stability of generalized trust has been supported by several empirical investigations (Bjørnskov, 2007; Uslaner, 2008; Bauer, 2015), and challenged by others. A study that tested the two theoretical predictions found support for the social learning theory model, demonstrating that adult experiences did influence trust (Glanville and Paxton, 2007). Additionally, research on immigrants from a low-trust to a high-trust society shows that experiences in a new context affect trust (Dinesen, 2012). Thus, the empirical evidence seems to support both stability and change in generalized trust, indicating that trust may be shaped both by early socialization and later experiences. Generalized trust has been found to be low in individuals with low education and a poor financial situation (Alesina and La Ferrara, 2002).

The COVID-19 pandemic is a slow-motion disaster with worldwide long-term consequences for health, well-being, and economic conditions. When confronted with threatening situations, humans primarily protect themselves and their next of kin, but research has pointed out that acts of mutual aid frequently occur (Mawson, 2005). Humans are vulnerable as individuals, and external threats may stimulate togetherness and connectedness for protection. Experiencing a common faith may strengthen a sense of community (Sibley et al., 2020), and an expectation that one might need help from others in the future also seems to increase trust in others (Cassar et al., 2017). Thus, we can hypothesize that threatening situations, such as the COVID-19 pandemic, may increase generalized trust.

Changes in relationships to other people have been observed in the aftermath of several previous disasters. Following the 2011 earthquake and tsunami in Japan, researchers documented an increase in a feeling of solidarity and trust in others (Hommerich, 2012), and earthquakes have been linked to increased social cohesion in Chile (Calo-Blanco et al., 2017). In the wake of the 9/11 attacks, researchers found that Americans drew closer, not only to friends and loved ones, but also to their fellow citizens (Morgan et al., 2011), although not necessarily to all ethnic and religious groups (Disha et al., 2011). Similarly, Cassar et al. (2017) identified increases in prosocial behavior in areas struck by the 2004 tsunami in Southeast Asia. They argue that the positive effect that living in a tsunami village had on trust occurred due to the experience of receiving help from others. However, not all studies have found an increase in trust following disasters (Fleming et al., 2014). In the COVID-19 pandemic, the countermeasures have likely reduced interactions with other people in the community. According to Putnam, such a reduction in everyday activities, in other words less "bowling together," will lead to a loss of social capital, including trust in others (Putnam, 2002). On the other hand, a sense of a common destiny, the need to help each other, and the actual experience of helping and receiving help from other people, may increase trust during the COVID-19 pandemic.

Disasters may not promote increased trust for every group in a society (Kang and Skidmore, 2018). Dissatisfaction or discontent with other people's behavior in the pandemic could erode trust (Kye and Hwang, 2020), perhaps especially for people who are at risk of getting seriously ill, or perceive the health threat as particularly relevant to themselves. Exposure to traumatic events has been associated with low trust (Alesina and La Ferrara, 2002). Additionally, pandemic-related unemployment, economic hardships, and potential social polarization could

lead to increased inequality in society, which may result in decreased trust (Bjørnskov, 2007; Brück et al., 2020) among individuals who carry the heaviest burden of the outbreak and the countermeasures.

The pandemic has spurred a massive global research initiative to understand the consequences of the disease threat and the countermeasures for individuals and for society. Risk factors for individual distress related to the pandemic include young age, female gender, financial strain, and unemployment, increased risk for getting seriously ill if catching the virus, psychiatric illness, and extensive worry about the pandemic (Achdut and Refaeli, 2020; Xiong et al., 2020; Blix et al., 2021). Scholars have argued that social capital and social bonds in communities may shape the course of the pandemic (Borgonovi and Andrieu, 2020). Research has demonstrated an increase in institutional trust early in the pandemic (Baekgaard et al., 2020), and a relationship between high governmental trust and adherence to social distancing (Gratz et al., 2021). However, the potential impact of the pandemic on trust has not been thoroughly investigated, even though potential changes in trust may have important consequences for cooperation, health, and well-being. To the best of our knowledge, only one study has been conducted on the relationship between the pandemic and generalized trust, and that study identified a modest increase in trust in South Korea (Kye and Hwang, 2020). One other study found that pandemic-related stress and worry impacted trust in institutions, family, and neighbors (Brück et al., 2020).

The current study attends to this knowledge gap by investigating the potential impact of the pandemic on generalized trust. We propose that generalized trust will increase in the general population during the pandemic, but that the opposite dynamic will occur in people who feel particularly threatened, either because they are in a risk group for the disease or unemployment, perceive their risk to be particularly high, or have a high level of health worry.

In the current study, we pursue the following research questions: (1) Did generalized trust increase in the community in the COVID-19 pandemic compared to pre-pandemic levels? (2) Was generalized trust lower in individuals who carry a heavy burden in the pandemic, in the sense of experiencing pandemic-related strain, perceiving their health risk to be high, or having a high level of pandemic-related worry?

We investigated these research questions in a presumed representative sample of the general Norwegian population by comparing levels of generalized trust during the pandemic with pre-pandemic levels among individuals of the same age and gender in a previous survey. Secondly, we examined whether indicators of pandemic-related strains, perceived health risk, or pandemic-related worry were associated with a reduced level of generalized trust.

MATERIALS AND METHODS

Design

This study was designed as a cross-sectional web survey which was fitted to compare levels of trust in the pandemic with previous levels of trust measured in the European Social Survey. The web survey was performed by the data collection agency Kantar/Gallup, Norway in their panel consisting of approximately 46,000 participants. The panel was constructed to represent the Norwegian general population. Recruitment to the panel is done by probability sampling, not self-recruitment. Sampling is performed based on official statistics from Statistics Norway. The panel is considered to be representative of the Norwegian "internet population" (everyone who has access to the internet), which constitutes about 97% of the total Norwegian population. Data collection was performed during week 21, 2020 (May 18–24). At that time, the COVID-19 situation was described as under control in the Norwegian society, and the government had recently begun easing the countermeasures after a period of approximately two months of lockdown.

Procedure

The data collection agency approached 2,612 individuals within the panel, stratified on gender, age, education, and area of residence. Potential participants were invited to a survey on well-being and health in the pandemic. The Regional Committee for Medical and Health Research Ethics approved the study (Registration number 133226/2020), and participants consented to participation. Panel members received points for their participation according to the number of minutes estimated to complete the questions. In the current study, estimated to 20 min completion time, participants were rewarded 20 points (equals 20 Norwegian Kroner, 1.9 Euro, or 2.2 USD).

Participants

In total, 39.9% (N = 1,041) completed the survey, 55.8% (N = 1,457) did not respond, 2.7% (N = 71) started the survey but did not complete it, 1.6% (N = 41) clicked on the link to participate but did not confirm their agreement to the terms of the study, and 0.1% (N = 2) withdrew from the study. Our study participants did not significantly differ from non-responders in gender or education, but the sample was highly skewed toward older age, with a mean age of 54.1 in responders and 43.3 in non-responders (Blix et al., 2021).

Tools

Generalized trust was measured with three items identical to those used in the European Social Survey[1] (1) Would you say that most people can be trusted, or that you can't be too careful in dealing with people? (2) Do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair? and (3) Would you say that most of the time people try to be helpful or that they are mostly looking out for themselves? For each item, participants scored their degree of trust on a scale ranging from 0 (low trust) to 10 (high trust). The mean of the three items was used as an expression of "generalized trust." Each individual received a mean generalized trust score if they had answered at least two of the three items (99.7%, N = 1,038). Cronbach's alpha was 0.79.

[1] www.europeansocialsurvey.org/

Expected levels of generalized trust were calculated based on data from the European Social Survey (ESS), round 9, collected in 2018[2]. This data material comprises 1,406 participants with ages ranging from 15 to 90. For the purpose of calculating expected trust scores, we used data on the 1,315 ESS participants within the age range 18–89 years, corresponding with the ages represented in our study. Within this age range, 44.3% (n = 583) were female, and the mean age was 48.2 (SD = 17.3). Cronbach's alpha for the three generalized trust items in the ESS sample was 0.73. The ESS data are presumably representative of the Norwegian general population, nevertheless, the ESS recommend using weighted data. In the current study, we applied design weights and post-stratification weights to correct for sampling design, sampling error, and non-response bias.

Sociodemographic factors age, gender, and education were pre-recorded by the data collection agency. Education was dichotomized into "high" (college or university degree) and "low" (not college or university degree). In addition, participants were asked to evaluate their relative financial situation, as "above average," "average," or "below average." We dichotomized this variable into "below average" and "average or above."

Pandemic-related strains included measures of: (1) pandemic-related job or financial problems, (2) at-risk health condition, and (3) personal experience with COVID-19. Participants reported (yes/no) whether or not they had: (1) lost their job, (2) been temporarily laid off, or (3) experienced financial difficulties because of the pandemic or the countermeasures. Any confirmative answer to these three questions was coded as "Pandemic-related work or financial strain," vs. no such strain. At-risk health condition (yes/no) was measured with a single question: "Do you have a chronic disease or a health problem with an increased risk of serious disease from COVID-19 (e.g., cancer, heart condition, diabetes)?" Personal experience with COVID-19 was measured by three questions (yes/no), whether or not the participant had: (1) Tested positive for COVID-19, (2) been admitted to hospital because of COVID-19, or (3) knew someone who had died from COVID-19. Any confirmative answer to these three questions was coded as "Personal experience with COVID-19," vs. no such personal experience.

Perceived health threat in the pandemic was measured by two questions from the COSMO study (Betsch et al., 2020): (1) "How likely is it that you will catch the coronavirus?" (mean = 3.45, SD = 1.19), and (2) "How serious would it be if you were to catch the coronavirus?" (mean = 4.32, SD = 1.65). Participants responded to both questions on a scale from 1 (low) to 7 (high).

Pandemic-related worries the participants were asked to indicate their level of worry on a scale from 1 (not worried) to 7 (very worried) for 12 questions about COVID-related worries adapted from the COSMO study (Betsch et al., 2020). In a previous paper (Blix et al., 2021), we conducted a confirmatory factor analysis, resulting in support for six worry items that are believed to represent an underlying worry factor. We asked participants how much they worried about "losing someone I love," "becoming seriously ill from the virus," "infecting others," "the health system being overloaded," "not being able to visit people who depend on me," and "a new outbreak of COVID-19." Responses to the six questions were averaged to create a composite worry score with Cronbach's alpha = 0.85 (range 1–7, mean = 3.8, SD = 1.2).

[2]www.europeansocialsurvey.org/data/country.html?c=norway

Statistical Analyses

For all individuals in the sample, an expected score was computed as the mean score in the ESS survey for the same age and gender for each single trust item and for the mean trust score. Expected scores were computed both with and without weights. When using weights, weighted means used the weight variables within each combination of age and gender. Confidence intervals for mean differences between actual and expected scores were computed by bootstrapping stratified by sample (the actual and the ESS samples) with 10,000 bootstrap replications. Percentile 95% confidence intervals for the mean differences were computed. The bootstrap procedure included both computation of expected scores and subsequent computation of mean differences. Differences were considered significant if the neutral difference 0 was outside the 95% confidence interval.

Linear regressions were performed to test the associations between generalized trust and pandemic-related strains, threats, and worries. All analyses were adjusted for demographics, i.e., gender, age, education, and pre-pandemic financial situation.

There were no missing values on gender, age, and level of education as these variables were pre-recorded by the data collection agency. Missing on the other independent variables ranged between 0.2 and 3.8% (n = 2–40). Only three individuals (0.3%) were not ascribed a mean generalized trust score. Single item missing on the three generalized trust questions ranged from 0.6 to 1.1% (n = 6–11).

Descriptive analyses and linear regression analyses were performed in IBM SPSS Statistics 26, while analyses involving expected scores were performed in R (The R Foundation for Statistical Computing, Vienna, Austria, version 4.0.3) with the R package boot for bootstrap analyses.

RESULTS

The sample comprised 1,040 participants, of which 49.0% (n = 510) were female and 35.9% (n = 374) had completed a college/university education (a minimum of 16 years of education). Ages ranged from 18 to 89 years, with a mean age of 54.1 (SD = 15.9). A perceived lower-than-average financial situation was reported by 12.6% (n = 129).

A total of 12.8% (n = 129) reported that they had either lost their job (1.9%, n = 19), been temporarily laid off (9.9%, n = 101), or had experienced financial trouble because of the COVID-19 situation (5.3%, n = 54). Although this is the same number of individuals who reported having a lower than average financial situation prior to the pandemic, the overlap was modest and non-significant (15.9% in the lower than average financial situation group vs. 12.2% in the average/above average group, chi square p-value = 0.246). A substantial minority (24.9%, n = 255)

reported that they had a chronic disease or a health problem with an increased risk of serious disease from COVID-19. Only 4.9% (n = 50) had personal experience with the pandemic in that they had tested positive for COVID-19 (0.8%, n = 8), had been admitted to hospital because of COVID-19 (0.8%, n = 8), or knew someone who had died from COVID-19 (4.7%, n = 48).

Level of Generalized Trust

The observed levels of generalized trust (range 0–10) in our sample were 6.4 (SD = 2.4) for "Most people can be trusted," 7.1 (SD = 2.2) for "People try to be fair," 6.3 (SD = 2.3) for "People try to be helpful," and 6.6 (SD = 1.9) for the generalized trust mean score.

The differences between observed (O) and expected (E) generalized trust are displayed in **Table 1**. If O was higher than E, this would indicate an increase in trust from before the pandemic, while O lower than E would indicate decreased trust. Overall, we found no convincing support for the hypothesis that generalized trust in the pandemic had increased compared to pre-existing levels. In unweighted analyses, there were some indications that some aspects of generalized trust were marginally lower in the pandemic. However, when weighting was applied, these differences were very small and non-significant.

Factors Associated With Generalized Trust

As shown in **Table 2**, only one of the pandemic-related strains was significantly associated with trust in the adjusted model; increased trust was observed for individuals who reported personal experience with COVID-19 (tested positive, admitted to hospital, or knew someone who died). Perceived probability of catching the virus and perceived health threat if catching the virus were both associated with lower levels of generalized trust when adjusted for sociodemographic variables. However, only perceived health threat if catching the virus was significantly associated with trust in the fully adjusted model. Worrying a lot about the pandemic was also uniquely associated with lower levels of generalized trust.

Women reported higher trust compared to men, trust increased with age, and was low in individuals with a poor financial situation. Trust was not significantly associated with education level.

Aspects of Trust

Table 3 displays adjusted associations between the three single trust items and pandemic-related strains, threats, and worries. Personal experience with COVID-19 was significantly associated with more trust in the categories of "people can be trusted" and "people try to be helpful," but not "fairness." Perceiving one's health risk as high (if the virus were to be contracted) was significantly associated with lower levels on all three aspects of generalized trust. Pandemic-related worry, however, was only significantly associated with a lower score on the item "Most people can be trusted."

DISCUSSION

In this study, our first aim was to investigate whether generalized trust had increased in the pandemic. Our results did not indicate any overall increase in generalized trust in the Norwegian society in May 2020, compared with pre-pandemic levels. Some previous studies have observed an increased sense of community and trust in the early aftermath of disasters (Morgan et al., 2011; Hommerich, 2012). This phenomenon in disaster recovery has been termed "the honeymoon phase" (DeWolfe, 2000), and is presumably a result of a need to stick together in times of threat, increased prosocial behavior, and a sense of a common destiny (Cassar et al., 2017; Sibley et al., 2020).

The only previous study on generalized trust in the pandemic that we have identified, found a modest increase in generalized trust in South Korea (Kye and Hwang, 2020). Their results differ from our findings of stability in generalized trust. However, it should be mentioned that the measurement of generalized trust differed between the two studies. In the current study we used the three items from the European Social Survey (trustworthiness, helpfulness, and fairness), while the South Korean study used a single item (trust in the South Korean people). Thus, it is not completely certain that the two studies tap into exactly the same phenomenon. Nevertheless, these diverging results may indicate that generalized trust might be impacted differentially depending on local conditions, such as the pre-pandemic trust level, the public adherence to countermeasures, and the local threat level. Further research is needed to clarify whether trust in other people may change with local conditions and over time, as the pandemic unfolds.

As mentioned above, we did not find indications of a change in generalized trust in the community from before to during the pandemic. At first glance, this seems to support the hypothesis that trust is highly stable and robust against new experiences (Uslaner, 2015). However, mean scores may mask subgroup differences, and within our sample, our results indicated that pandemic-related experiences were associated with levels of generalized trust, both positively and negatively. Thus, our results are in line with some previous research which shows that it is possible for trust to be both strengthened and weakened in the disaster recovery process (Kang and Skidmore, 2018). While personal experience with the disease was associated with more trust, higher levels of worry and perceived threat were related to less trust. We found no evidence of a relationship between trust and economic or work-related strains.

Originally, we presumed that generalized trust would be lower in individuals who have carried a heavy burden in the pandemic. Our results show, however, that people who had personal experience with the COVID-19 disease (tested positive, admitted to hospital, or lost someone close) reported a higher level of trust. A potential *post hoc* interpretation may be that these individuals have had positive personal experiences with medical personnel or have received kindness and help from others, which may have resulted in increased trust in other

TABLE 1 | Differences between observed (O) and expected (E) generalized trust with 95% confidence intervals (CI).

	Un-weighted		Weighted	
Generalized trust items and mean score	**O-E**	**95% CI**	**O-E**	**95% CI**
Trust 1: Most people can be trusted (range 0–10)	−0.29	−0.42, −0.17	−0.13	−0.27, 0.05
Trust 2: Most people try to be fair (range 0–10)	−0.11	−0.22, 0.01	0.03	−0.10, 0.22
Trust 3: People try to be helpful (range 0–10)	−0.12	−0.23, −0.00	−0.04	−0.16, 0.15
Generalized trust (Mean of trust 1–3)	−0.18	−0.27, −0.08	−0.04	−0.16, 0.13

O (observed) = reported levels of trust in the current data material. E (Expected) = age- and gender-adjusted expected scores based on pre-pandemic trust measures in the European Social Survey (ESS). A positive value of O-E reflects an increase in trust; a negative value of O-E reflects a decrease in trust. Weighted = Design and post-stratification weights of ESS data.

TABLE 2 | Associations between demographics, pandemic-related strains, perceived threat and worry, and generalized trust.

	Single regressions adjusted for demographics[a]			Fully adjusted		
Independent variables	**Regression coefficient**	**95% CI**	***p*-value**	**Regression coefficient**	**95% CI**	***p*-value**
Pandemic-related strains						
Lost job/financial problems due to the pandemic/the countermeasures	−0.02	−0.37, 0.33	0.931	−0.08	−0.43, 0.27	0.648
At-risk health condition	−0.09	−0.37, 0.18	0.504	0.22	−0.09, 0.52	0.164
Personal experience with covid-19	0.60	0.06, 1.13	0.028	0.70	0.17, 1.24	0.010
Perceived threat and worries						
Perceived probability of catching the corona virus	−0.12	−0.22, −0.02	0.017	−0.05	−0.16, 0.05	0.338
Perceived health threat if catching the corona virus	−0.19	−0.27, −0.11	<0.001	−0.17	−0.26, −0.08	<0.001
Pandemic-related worry	−0.21	−0.31, −0.12	<0.001	−0.13	−0.24, −0.02	0.024
Demographics						
Gender: Female	–	–	–	0.41	0.18, 0.64	0.001
Age	–	–	–	0.03	0.02, 0.04	<0.001
Education: High[b]	–	–	–	0.19	−0.06, 0.44	0.441
Below average financial situation	–	–	–	−0.89	−1.25, −0.54	<0.001

Linear regressions with unstandardized regression coefficients, 95% Confidence Intervals (CI), and p-value.
[a]Separate regression analyses for each independent variable (pandemic-related strains, personal experiences with covid-19, and perceived threat and worries) adjusted for demographics (gender, age, education, and financial situation). Coefficients for demographics are not reported in these analyses, since these coefficients are different in each of these six regression analyses. Adjusted R^2 in the fully adjusted model = 0.12.
[b]High education = college or university degree.

people (Andrabi and Das, 2017). A previous study has also revealed that people who are in need of help in a disaster seem to trust others more (Cassar et al., 2017). We would like to remind the reader that in Norway, the hospitals had not been not stretched beyond capacity, and personal experiences with the disease may have other outcomes in areas with a greater pressure on the health system.

In accordance with our hypothesis, we observed less trust in individuals who perceived their health risk as high or who worried a lot about the pandemic. A similar relationship between worry and trust in family/neighbors and trust in institutions has been identified in a previous study (Brück et al., 2020). Those who feel a particular threat to their health, or who spend a lot of time worrying about a negative future development, may perceive others as a threat and have an attentional bias toward people who do not comply with countermeasures. Perceiving others as threatening and unpredictable may result in a downward adjustment of trust in other people. Keeping an emotional and physical distance from others is not necessarily irrational, as detecting and avoiding threats may be beneficial for survival. Whether threat is associated with protective behavior is, however, debated. Some studies indicate that perceived threat and fear may not be the best predictors of compliance with countermeasures. Rather, perceived self-efficacy, i.e., feeling capable of following advice, seems to motivate protective behavior in the pandemic (Jørgensen et al., 2020).

Although worry and perceived health risk were both uniquely associated with lower trust, these two factors differed in their relationship with the three separate trust items. A high perceived health risk was significantly associated with lower perceived

TABLE 3 | Adjusted associations between Demographics, pandemic-related strains, perceived threat and worry, and the three aspects of generalized trust.

Pandemic-related strains, threat, and worries	Trust 1 most people can be trusted			Trust 2 most people try to be fair			Trust 3 people try to be helpful		
	Coef	95% CI	*p*-value	Coef	95% CI	*p*-value	Coef	95% CI	*p*-value
Pandemic-related strains									
Lost job/financial problems due to the pandemic/the countermeasures	−0.11	−0.55, 0.33	0.629	−0.24	−0.63, 0.16	0.240	0.11	−0.32, 0.53	0.624
At-risk health condition	0.05	−0.34, 0.43	0.814	0.27	−0.07, 0.61	0.121	0.35	−0.02, 0.72	0.064
Personal experience with covid-19	0.78	0.10, 1.46	0.024	0.45	−0.16, 1.05	0.150	0.86	0.21, 1.51	0.010
Perceived threat and worries									
Perceived probability of catching the corona virus	−0.02	−0.12, 0.15	0.826	−0.11	−0.23, 0.01	0.075	−0.06	−0.19, 0.07	0.341
Perceived health threat if catching the corona virus	−0.16	−0.27, −0.04	0.008	−0.15	−0.25, −0.05	0.005	−0.22	−0.33, −0.11	< 0.001
Pandemic-related worry	−0.21	−0.35, −0.07	0.003	−0.05	−0.17, 0.08	0.473	−0.13	−0.26, 0.01	0.060
Demographics									
Gender: Female	0.15	−0.15, 0.44	0.334	0.57	0.30, 0.83	< 0.001	0.51	0.23, 0.80	< 0.001
Age	0.02	0.01, 0.04	< 0.001	0.03	0.02, 0.04	< 0.001	0.04	0.03, 0.05	< 0.001
Education: High[a]	0.48	0.16, 0.80	0.003	0.14	−0.14, 0.42	0.327	−0.02	−0.32, 0.29	0.914
Below average financial situation	−0.79	−1.24, −0.34	0.001	−1.15	−1.55, −0.75	< 0.001	−0.74	−1.16, −0.31	0.001

Linear regressions with unstandardized regression coefficients (Coef), 95% Confidence Intervals (CI), and p-value.
[a]*High education = college or university degree.*

trustworthiness, fairness, and helpfulness of other people. Worry about the pandemic, however, was only significantly related to trustworthiness. Our measure of worry included worries about getting infected oneself, but the majority of items tapped into more social aspects, such as losing someone close, not being able to help significant others, and more general aspects, such as worry about a new outbreak and an overloaded health system. Thus our results may indicate that personal threat relates to a general downward adjustment of trust, and that worry perhaps specifically relates to how much people can be trusted to adhere to important countermeasures in the pandemic. Future research is necessary, however, to replicate and expand on these findings, and to assess if a potential loss of trust will be restored when the pandemic has passed.

Finally, loss of employment and/or financial difficulties due to the pandemic did not seem to affect generalized trust. We would like to remind the reader that the data in this study was collected in May, 2020, in an early opening-up phase, during which countermeasures were eased. Thus, employment loss or financial difficulties may have been perceived as temporary at the time. A previous study investigating the link between institutional trust and unemployment demonstrated large differences between countries. In some countries, this link was strong, in others it was weak, suggesting that the context of these experiences are key to their effect (Brück et al., 2020). The potential impact of these factors may rest upon the general welfare practices in each society; the current study was conducted in a high-income society with social welfare practices that may have somewhat compensated for the marginalization effect of (perceived temporary) unemployment. If, over time, the pandemic brings about a financial recession, increased inequality, and polarization, a long-term outcome might be loss of generalized trust in society (Bjørnskov, 2007).

Limitations

The present study compared levels of generalized trust in the pandemic with pre-pandemic levels, but the regression analyses were conducted in the cross-sectional data. We used a stratified probability sample from a panel representing "Norway in miniature" according to a set of sociodemographic variables. Our response rate of 39.9% is within the expected range for this type of study. Responders did not differ substantially from non-responders in gender or education, although young people were significantly under-represented, reflecting a trend in survey research that is not specific to this study. Nevertheless, non-responders may have differed from responders in undiscovered ways. It is possible, for example, that engagement in social issues or in the pandemic may have led to increased interest in participation. Furthermore, we used only self-report measures. This is probably not a limitation for measuring generalized trust, for which there are no alternative methods of measurement in survey studies, but other items may have been subject to interpretation by the participant (e.g., "financial difficulties"). We measured trust beliefs (expectancies toward other people), and were not able to investigate trust as a behavior. Participants first responded to questions about pandemic-related stress and strains, secondly to a series of questions into the quality of social relationships. The preceding questions may have affected their responses to the trust items. Moreover, we were only able to compare levels of trust at one time point in the pandemic with pre-pandemic levels, and the development over time could not be investigated. Most importantly, our study was conducted

in a specific society at a specific time, and it is likely that the relationships between pandemic-related experiences and trust will differ between localities and over time.

CONCLUSION AND IMPLICATIONS

In conclusion, we did not observe any overall increase in generalized trust in the early phase of the pandemic in the Norwegian society. The level of generalized trust was, however, higher in individuals with direct experience with the disease and lower in individuals who perceived themselves to be at particularly high risk or who worried a lot about the pandemic. These results indicate that personal experiences with the COVID-19 pandemic may have an important influence on trust in others. Thus, this study lends support both to the notion that generalized trust is established early in life and is fairly stable in society (Nannestad, 2008; Uslaner, 2015), and is, additionally, shaped by personal experiences throughout life, particularly new, extraordinary, and highly emotional events (Hardin, 2002; Glanville and Paxton, 2007).

Research so far in the pandemic has focused mainly on the immediate physical and mental health consequences. But the pandemic represents much more than a health crisis, and may prove to have far-reaching implications for societies at large. In light of the increased risk of future pandemics (Madhav et al., 2018), research on the COVID-19 pandemic is of great value to understand how the health risk and the countermeasures can affect trust. Of particular importance is research that can assess under which conditions trust is affected, for whom, and for how long. A previous study has shown that loss of institutional trust in disaster victims may last for decades (Thoresen et al., 2018), but future research is needed to identify factors that help restore trust when countermeasures are eased. Multi-national studies, such as the European Social Survey, are well suited to answer questions regarding the development of trust over time in different countries, but need to be accompanied by data on individual pandemic-related experiences.

Such research can assist governments in disaster planning and communication strategies, to potentially counteract a loss of trust in society. National and regional governments may encourage helpfulness and pro-social behavior, particularly toward at-risk groups, such as individuals who worry a lot or perceive their health risk as high. Similar strategies may also be implemented in hospitals, health and care services, and educational institutions. Theoretically, personal experience with helping others and receiving help will increase social trust, but there is a need to test the effectiveness of such interventions in the context of pandemics. Generalized trust is considered an important asset for health and well-being. As the pandemic evolves, there is a risk of losing, and an opportunity for gaining, trust, with potential consequences for health. The link between pandemic-related experiences and trust probably depends heavily upon the context. Future trust in society may be stimulated by interventions in the health sector, care and kindness toward those who worry and feel threatened, and welfare benefits for those who become unemployed.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because According to the Ethics committee, we may not share the data anonymously until the personal identity in the original data file is deleted. Requests to access the datasets should be directed to corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Regional Committee for Medical and Health Research Ethics, Southern and Eastern Norway. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ST was the principal investigator in this study. ST, IB, and MB contributed equally to the design of the study, the data collection, in organizing the data file, and in formulating the research questions. ST had the lead in writing up the manuscript, with significant contributions from IB, MB, and TW-L. TW-L and ST carried out the statistical analyses. All authors have read the manuscript in the submitted form.

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BRIEF RESEARCH REPORT
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Hitting Close to Home: The Effect of COVID-19 Illness in the Social Environment on Psychological Burden in Older Adults

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This study examines the impact of COVID-19 experience of infection in the individual's social environment on psychological burden controlling for a broad range of factors using data on an older population (50+ years). Based on the empirical evidence of preexisting studies, it is hypothesized that psychological burden will increase concurrent to the severity of COVID-19 experience (tested positive, hospitalized, and death) independent of the other stressors resulting from the pandemic, such as a subjective sense of uncertainty or financial burden. Data of the Survey of Health, Aging and Retirement in EUROPE, and a European cross-national panel study were used to examine this hypothesis. Besides Chi^2 test and Spearman's rho, a logistic regression model was constructed to test the hypothesized model. The study confirms that there is significantly higher risk for psychological burden by heightened COVID-19 severity in the social environment independent of multiple also significantly influential variables depicting stressors to everyday life of older people during the pandemic. The results point to the importance of multiple factors (social, financial, health, and sociodemographic) which have significantly affected the psychological condition of the individual during the past year. Conclusively, the results illustrate the dilemma that infection and illness in the social circle, as well as countermeasures (social distancing), have negative consequences for our mental health.

Keywords: social environment, psychological burden, COVID-19, depression and anxiety, secondary traumatic stress, effects of the pandemic on mental health, older adults

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INTRODUCTION

The global pandemic and the ensuing safety measures have had a major (mostly unfavorable) impact on the everyday lives of large parts of the population. From a gerontologists perspective, this is especially true for older people, whose life has been subjected to multiple burdens over the past year. This group has been, and continuous to be, considered at risk for severe illness and mortality from COVID-19 infection (Shahid et al., 2020; Gerwen et al., 2021) and therefore has had to incorporate changes into their day to day life. Health policies have targeted older people in asking them to isolate and physically distance to avoid infection which, although successful in protecting from the virus, have had negative consequences of their own: Increased

subjective social isolation (Peng and Roth, 2021), lower healthcare utilization (Ksinan Jiskrova et al., 2021), reduction of physical activities (Creese et al., 2020; Brown et al., 2021), and social interaction (Richter and Heidinger, 2020; Heid et al., 2021) as well as the ever increasing problem of loneliness (Carson et al., 2020; Entringer et al., 2020; Heidinger and Richter, 2020; Luchetti et al., 2020; Stolz et al., 2020; Krendl and Perry, 2021) have been reported as byproducts of COVID-19 safety measures. As these lifestyle changes have been previously linked to adverse mental health outcomes, it is not surprising that an increase in depression, anxiety and stress symptoms, and a general decline of mental health during the pandemic (Shahid et al., 2020; Gerwen et al., 2021) have been noted in multiple studies (Banks and Xu, 2020; Bailey et al., 2021; De Pue et al., 2021; Grolli et al., 2021; Tsoukalis-Chaikalis et al., 2021). These issues seem to be greater in younger population cohorts (Banks and Xu, 2020; Carson et al., 2020) but have been found to be universal among (western) populations.

Unfavorable Consequences of the Pandemic on the Mental Health of Older People

Practices, such as withdrawal (Skoog, 2020) and cocooning (Bailey et al., 2021) with the accompanying decrease in social contact and increase in feelings of loneliness (Okruszek et al., 2020; Clair et al., 2021), have been identified as influential for increased psychological burden among older people. In addition, experience of COVID-19-related ageism (Skoog, 2020), perception of increased risk of COVID-19 illness (Sigurvinsdottir et al., 2020), fear due to the virus (Warren et al., 2021), experience of COVID-19 infection (Sigurvinsdottir et al., 2020; Silver, 2020), and decrease in physical activity (Creese et al., 2020) have been found to adversely impact mental health. This impact is moderated by the psychological makeup of individual encompassing personality traits (Wei, 2020), emotion regulation ability (Prout et al., 2020), coping behaviors (Minahan et al., 2021), anxiety sensitivity (Warren et al., 2021), and social resources (Litwin and Levinsky, 2021).

Lessons From SARS and Research Goal

Even though the literature on the psychological effect of the pandemic is growing, it is still worth sharing Gallagher's et al. (2020) sentiment that little empirical work has addressed how differential COVID-19 experiences of infection, illness, and death in the social environment affect the mental health of individuals. Experience of disease is an important factor for mental health, which had been previously shown in studies pertaining to the SARS outbreak in the early 2000s. Hawryluck et al. (2004) noted that having persons in one's social circle hospitalized with SARS increased the probability of exhibiting symptoms of posttraumatic stress and depression (Hawryluck et al., 2004). This finding was mirrored in a later study focusing on healthcare workers, where having an infected friend or family member increased symptoms of posttraumatic stress disorder (PTSD) by a factor of three (Wu et al., 2009). Utilizing these findings as starting point, it is interesting to ask whether similar findings have been reported during the present, far longer-lasting, pandemic. An overview of relevant studies published up until this point in time is presented below.

Current State of Research on Mental Health Burden During COVID-19

In a study surveying the Spanish population at an early stage of the pandemic (March of 2020), researchers showed that having a close relative infected with the disease was positively related to anxiety, depression, and PTSD (González-Sanguino et al., 2020). A comparable finding was reported by Mazza et al. (2020) who surveyed the general population in Italy in the first moths of the pandemic: Psychological burden was increased among people who had experienced COVID-19 illness in their personal network. They reported increased anxiety to be a consequence of a family member being infected with the virus, while increased depression followed the infection of acquaintances (Mazza et al., 2020). In a similar vein, an Australian team reported depression, anxiety, and stress as well as PTSD symptoms to be significantly higher in persons who had themselves come into contact with the disease or had someone in their social circle infected with, hospitalized with, or pass away from the virus (Bridgland et al., 2021). Anticipated negative outcomes of the pandemic, of which the most commonly mentioned and most feared was that a family member or close friend falls ill and dying from the virus, were also shown to affect PTSD, depression, anxiety, and stress measures which indicates that worry about the welfare of the social circle may itself have a powerful impact on mental health. Similarly, an American study demonstrated that COVID-19 illness in the social environment strongly influences participants subjective stress levels, finding that worry for others had a measurable impact on the individuals' mental health: Authors reported that the "risk of loved ones becoming infected" had the second highest stress rating after the "loss of job security and income" and was mentioned by 61% of the respondents (Park et al., 2020). This finding is in accordance with Gallagher et al. (2020) who reported significant relationships between anxiety and depression and COVID-19 experience, such as "having a COVID-19 related death in one's proximity" or "knowing someone who was infected with the virus." They were able to show that the latter tripled the chance of receiving a depression or anxiety diagnosis (comparable with Cao et al., 2020), while the former increased probability of depression diagnosis by a factor of 5 and anxiety diagnosis by a factor of 6.

These findings have provided indications that lived experience of COVID-19 illness of "other" (as opposed to own) affects mental health differentially, but generally aversely. This can be interpreted in the context of secondary traumatic stress defined as "the natural, consequent behaviors and emotions resulting from knowledge about a traumatizing event experienced by a significant other. It is this stress resulting from helping or wanting to help a traumatized or suffering person" (Figley, 1999, S. 10). The symptoms of secondary trauma are close to PTSD symptoms with the "by standing" person developing adverse psychological reactions to the experience of another,

most commonly close, individual. These reactions can include stress and anxiety to depression and somatization among more severe PTSD symptoms, providing a comprehensive picture of life during the pandemic and its impact on mental health.

Résumé and Research Question

Thus far, a more in-depth analysis of psychological burden by COVID-19 experience on the foreground of a larger, holistic view of the individuals lived experience during the pandemic is lacking. While Gallagher et al. (2020) distinguished between other-illness severity levels, they did not include any other potentially influential variables concerning the lives of the respondents. Mazza et al. (2020) and González-Sanguino et al. (2020) conducted multivariate analyses without differentiating the severity of COVID-19 experience thereby leaving a gap in the research. Finally, these studies have been conducted among the general population, while, to the best of our knowledge, none to date have analyzed the specific effect on the older population.

This study will provide an examination of the impact of COVID-19 experience of infection in the individual's social environment staggered by severity on psychological burden controlling for a broad range of factors using data on an older population (50+ years). Burden, as used in this study, encompasses multiple adverse psychological states (self-reported feelings of anxiety, depression, and troubled sleep) which conjointly result in an unfavorable mental condition. Based on the empirical evidence of the preexisting studies, it is hypothesized that psychological burden will increase concurrent to the severity of COVID-19 experience independent of the other included factors.

MATERIALS AND METHODS

Sample Design

Data of the Survey of Health, Aging and Retirement in EUROPE (SHARE), and a European cross-national panel study were used to examine this hypothesis.[1] To this end, wave 8 and wave 7 data were combined to construct a more comprehensive model of the respondent's life situation. The wave 8 – COVID-19 Survey 1 – release version: 0.01 (Börsch-Supan, 2020b) was conducted from June to July 2020 in 27 countries and focused specifically on life experience during the global pandemic. Data from wave 7 release version: 7.1.1 (Börsch-Supan, 2020a) collected in 2017 were used to impute information on personality traits and supplementary demographic information of the respondents.

Nine Percent (i.e., 4,715 persons) of the 52,310 participants of the wave 8 survey indicated that they knew someone who had been (1) tested positive, (2) hospitalized, or (3) had passed away due to a COVID-19 infection. As data collection was conducted in the summer months of 2020 during the first wave of the pandemic, which, compared to later waves in autumn and winter of 2020, was relatively small in large parts of Europe with heterogeneous prevalence rates between European countries, this study only included data from countries, where at minimum 5% of respondents had indicated COVID-19 experience as described above. Sorted by the prevalence rate among respondents provided here in brackets these countries are: Luxembourg (24.5%), Belgium (24.1%), Sweden (21.4%), Netherlands (19.6%), Switzerland (18.3%), Spain (18.2%), Denmark (15.1%), Portugal (14.3%), France (13.9%), Italy (13.3%), Israel (10.3%), Germany (8.8%), and Malta (7.5%). Additionally, respondents ($n = 273$ or 0.5% of the whole sample) who indicated having had a COVID-19 infection themselves were filtered out in order to exclude any spillover effect of own infection experience. Furthermore, data gathered by proxy interviews were filtered as well. The resulting sample included 22,776 participants and was made up of 57% female participants. Mean age was 70.73 years ($SD = 8.83$ years, range 50–104 years) with 25% of the sample living alone during the pandemic. Education was distributed as follows: 37% no education – ISCED 2, 35% ISCED 3–4, and 28% ISCED 5–6.

Measures

An overview of all measures is provided in **Table 1**. To construct the dependent variable of psychological burden, data of six individual items were combined. First, persons were asked whether they had felt (1) nervous, anxious or on edge, (2) sad or depressed or whether they had (3) trouble sleeping which they could affirm or deny. In case of an affirmative answer, a follow-up question of change in frequency as compared to life before the pandemic was asked ("Has that been more so, less so, or about the same as before the outbreak of Corona?"). Descriptive information on these items is provided in the first part of the results section. As burden is a comprehensive concept informing on adverse mental health states, authors did expect moderate intercorrelations among the individual psychological measures (correlations among measures of depression, anxiety, and disturbed sleep ranged from Phi = 0.31 to 0.49). Aside from prior knowledge on the relationship between these psychological states (Staner, 2003; Nutt et al., 2008; Tiller, 2012), these moderate to strong intervariable relationships provide a statistical basis for the construction of this variable. For multivariate analysis, items were combined and dichotomized as: (0) no reported psychological burden or similar or lesser burden as compared to before the pandemic and (1) reported higher psychological burden in one or more adverse psychological states.

COVID-19 experience was defined as subjective encounter with the virus in the individuals social circle,[2] whereby experiences were categorized by their severity: (0) no COVID-19 case, (1) positive COVID-19 test, (2) hospitalization, and (3) mortality due to the virus. The resulting variable was termed severity of COVID-19 experience (SoCE) and focused solely on the witnessed experiences of other, close persons in the individuals

[1]SHARE data collection is continuously ethically reviewed (see: http://www.share-project.org/fileadmin/pdf_documentation/SHARE_ethics_approvals.pdf). All studies using SHARE data uphold strict rules of participant protection.

[2]Persons were asked whether "anyone close to them" had lived through a COVID-19 infection or illness.

TABLE 1 | Operationalization.

Variable	Manifestation	
Psychological burden	0 'no reported psychological burden or similar or lesser burden as compared to before the pandemic"	
	1 "reported higher psychological burden in one or more adverse psychological states (nervous, anxious or on edge, and/ or sad or depressed, and/or trouble sleeping)"	
Severity of COVID-19 experience	0 "No COVID in social environment"	
	1 "Anyone tested positive for COVID-19"	
	2 "Anyone hospitalized due to COVID-19"	
	3 "Anyone died due to COVID-19"	
Health vulnerability	subjective health status prior to the pandemic	1 "Excellent/very good"
		2 "Good"
		3 "Fair/poor"
	Health status during the pandemic	0 "Same or improved"
		1 "Deteriorated"
	Neuroticism	1 (low) – 5 (high) scale
Variables describing subjective loss of control	Postpone medical appointment	0 "no"
		1 "yes"
	Denied medical appointment	
	Receive help to obtain necessities since outbreak	
	Able to make ends meet	1 "with great difficulty"
		2 "with some difficulty"
		3 "fairly easily"
		4 "easily"
Sociodemographic variables	Highest formal education	1 low "(= ISCED 97; 0,1 and 2)"
		2 middle "(= ISCED 97; 3 and 4)"
		3 high "(= ISCED 97; 5 and 6)"
	Household size	Metric
	Age	
	Gender	1 "male"
		2 "female"

social circle. When multiple experiences were reported by the respondent, the most severe experience was used on this variable.

Multiple control variables were introduced to test the hypothesized association between psychological burden and SoCE in the context of the unusual circumstances due to the pandemic. These had been previously linked to increased psychological burden or, respectively, had presented as stressors during the pandemic and can be summed up into three dimensions: health vulnerability, variables describing subjective loss of control, and sociodemographic factors.

Health vulnerability was depicted using three variables: (A) subjective health status prior to the pandemic which was coded on a scale of (1) excellent/very good, (2) good, and (3) fair/poor; (B) perceived change in health status since the outbreak of the pandemic coded as (0) same or improved and (1) deteriorated, and (C) psychological susceptibility to adverse effects of the pandemic proxied by neuroticism. Persons who score high on this personality trait are generally more prone to uncertainty, nervousness, anxiety, and depression (Lahey, 2009). Caci et al. (2020) suggested that neuroticism is influential for coping with the COVID-19 pandemic, as highly neurotic people show greater emotional reactivity and exhibit fewer resources for stress management. They also reported a positive correlation between neuroticism and COVID-19 health anxiety (also Lee et al., 2020; Nikčević et al., 2021). Therefore, the neuroticism score extracted from the Big Five Inventory (BFI-10, Rammstedt et al., 2013) was added into the computed model. The score ranges from 1 to 5 with higher scores depicting higher neuroticism.

It has been previously shown that an internal locus of control is beneficial to mental health (Cheng et al., 2013), with a study conducted during the pandemic finding an association between external locus of control and adverse mental health states, such as anxiety, depression, and stress (Sigurvinsdottir et al., 2020). This led us to include variables describing a subjective loss of control which may separately contribute to psychological burden. The first variables concern the suspension of medical care using the following questions: "Did you have a medical appointment scheduled, which the doctor or medical facility decided to postpone due to Corona?" and "Did you ask for an appointment for a medical treatment since the outbreak of Corona and did not get one?" (each: 1 = yes and 0 = no). Additionally, a measure of social dependence was added into the model: "Since the outbreak of Corona, were you helped by others from outside of home to obtain necessities, e.g., food, medications or emergency household repairs?" (1 = yes and 0 = or no). Finally, participants were asked to provide information on their financial situation during the pandemic: "Would you say that your household is able to make ends meet with great difficulty, with some difficulty, fairly easily, or easily?", which was scored on a scale (1) great difficulty to (4) easily.

Sociodemographic variables were also added into the model. Level of formal education rated using the ISCED 1997 system was included as education had been previously associated with psychosocial resources (Niemeyer et al., 2019). Education was summarized into three categories (1) low [ISCED 0–2], (2) middle [ISCED (3–4)], and (3) high [ISCED (5–6)]. Additionally, household size, measured as a metric variable, was included, as larger households had previously been shown to protect against the negative impacts of the pandemic (Groarke et al., 2020). Finally, the model also introduces age as a metric variable and gender as nominal variable (1) male and (2) female.

Statistical Analysis

Data analysis was conducted using IBM SPSS 26. Unweighted data were used for analyses. For bivariate analyses of the association between SoCE and the variables of burden Chi^2 test with *Bonferroni* adjusted *post-hoc* tests and Spearman's rho were computed. In order to test the hypothesized influence of SoCE on psychological burden over and above all other

TABLE 2 | Univariate and bivariate analysis of psychological burden and COVID-19 cases.

Adverse psychological state	No	Yes			N
		Less so	About the same	More so	
nervous/anxious/ or on edge	69.3%	0.5%	6.3%	23.9%	22,605
sad/depressed	73.6%	0.5%	6.9%	19.0%	22,587
trouble sleeping	75.2%	0.5%	15.3%	9.0%	22,609

State Change (more so)	COVID-19 cases in the social environment				Spearman's rho
	No	Tested positive	Hospitalized	Died	
Nervous/anxious/ or on edge (more)	$23.1\%_{a}$	$25.7\%_{a}$	$26.8\%_{a,b}$	$31.6\%_{b}$	0.043; $p < 0.01$
Sad/depressed (more)	$18.4\%_{a}$	$18.9\%_{a}$	$20.6\%_{a}$	$26.7\%_{b}$	0.035; $p < 0.01$
Trouble sleeping (more)	$8.7\%_{a}$	$8.9\%_{a}$	$9.9\%_{a}$	$13.4\%_{b}$	0.027; $p < 0.01$

Subscript letters represent the Bonferroni adjusted post-hoc tests: Values with a significantly differ from values with b.

variables, a logistic regression model was constructed using psychological burden as the dependent variable and introducing SoCE as well as all mentioned control variables as explanatory variables.

RESULTS

Table 2 provides an overview of the sample distribution on the captured adverse psychological states (feeling nervous/anxious/on edge, feeling sad/depressed, and having trouble sleeping) as well as bivariate analysis. 23.9% of participants felt they had become more anxious or nervous during the pandemic, 19% reported feeling more depressed, and 9% had more trouble sleeping than before the pandemic.[3] Analyzing the impact of SoCE among individuals who indicated an increase in psychological stressors revealed a relationship between these variables: The more severe the degree of infection in the social environment, the more likely respondents reported an increase in adverse psychological states, particularly when someone in the social environment had passed away due to the virus (significant differences between no/tested positive/hospitalization vs. death due to infection among all three adverse states). However, Spearman's rho, are small, illustrating weak correlations.

The analyzed sample in the logistic model includes 18,586 observations due to missing values. With Nagelkerke's R^2 at 0.158, the Hosmer-Lemeshow test at 0.078 and ROC AUC at 0.703, the model is deemed acceptable. Odds ratios are presented in **Table 3**. Within the model, SoCE is shown to be a predictor of increased psychological burden over and above all other variables. The association follows the hypothesized direction as the likelihood for increased psychological burden surges with increasing SoCE: tested positive ($OR = 1.257$; CI 1.107–1.427); hospitalization ($OR = 1.330$; CI 1.119–1.582); and death due to the virus ($OR = 1.579$; CI 1.371–1.819). It can be concluded that the more serious the COVID-19 experiences in the persons social environment, the higher the risk of increased burden – however, as the CIs of the point estimators overlap, this increase of the ORs should be interpreted with caution.

As seen in **Table 3**, most of the included variables significantly impact psychological burden with negative health change having the largest effect ($OR = 3.694$; CI 3.296–4.139). Participants subjective health and neuroticism levels both influence the likelihood of psychological burden, as do the variables describing a subjective loss of control. It is also notable that postponed and denied medical appointments as well as new dependencies to obtain necessities since outbreak increase the risk of psychological burden. Having a member of the social circle die of the virus is roughly comparable to experiencing serious financial strain during the pandemic in the likelihood of reporting increased psychological burden (great difficulty to make ends meet during the pandemic, $OR = 1.676$; CI 1.423–1.974).

Included sociodemographic variables are partly associated with psychological burden: A moderate level of education and rising age (OR = 0.984; CI 0.980–0.988) leads to lower risk of an increased psychological burden during the first months of the pandemic. Women are twice as likely to report psychological burden than men ($OR = 0.548$; CI 0,514–0,590) while household size does not significantly predict psychological burden.

DISCUSSION

This study presents evidence of increased psychological burden among persons 50+ during the pandemic with close to every 10th respondent reporting heightened trouble sleeping, every fifth respondent being more sad or depressed, and close to every fourth person feeling more anxious, on edge, or nervous. These results are striking, considering that data were collected during the first wave of the pandemic which was relatively small compared to the second and third wave experienced over the autumn and winter months. However, as COVID-19 was a novel, largely unknown infectious disease at this time, it may have led to higher anxiety and feelings of distress,

[3]7.293 respondents or 32% of the tested sample reported increased psychological burden since outbreak, of these 53% reported one, 33% two, and 14% three queried adverse states.

TABLE 3 | Logistic regression model predicting psychological burden.

		Odds Ratio	95% CI		Wald	*P*
Severity of COVID-Experience (SoCE)	COVID in the social environment (ref. no COVID-19 cases)					
	Anyone tested positive	**1.257**	1.107	1.427	12.461	< 0.01
	Anyone hospitalized due to COVID-19	**1.330**	1.119	1.582	10.448	< 0.01
	Anyone died due to COVID-19	**1.579**	1.371	1.819	39.970	< 0.01
Health vulnerability	Subjective health (ref. excellent/ very good)					
	Good	**1.314**	1.209	1.428	41.179	< 0.01
	fair/poor	**1.951**	1.770	2.150	181.575	< 0.01
	Health change (ref. improve or same)	**3.694**	3.296	4.139	506.219	< 0.01
	Neuroticism (Big Five)	**1.258**	1.218	1.300	188.630	< 0.01
Control-relevant burdens	Postpone medical appointment (ref. no)	**1.216**	1.133	1.305	29.197	< 0.01
	Denied medical appointment (ref. no)	**1.338**	1.163	1.539	16.673	< 0.01
	Receive help in obtaining necessities since outbreak (ref. no)	**1.267**	1.170	1.372	34.092	< 0.01
	Able to make ends meet (ref. easily)					
	Fairly easily	**1.084**	1.003	1.171	4.119	< 0.05
	With some difficulty	**1.395**	1.264	1.539	43.955	< 0.01
	With great difficulty	**1.676**	1.423	1.974	38.188	< 0.01
Control Variables	Highest formal education (ref. low)					
	Middle	**0.831**	0.767	0.901	20.387	< 0.01
	High	0.938	0.858	1.026	1.939	0.164
	Household Size	1.011	0.970	1.053	0.261	0.610
	Age	**0.984**	0.980	0.988	51.565	< 0.01
	Gender (ref. women)	**0.548**	0.511	0.587	289.339	< 0.01
	X^2/df/p			2231.268/18/0.000		
	Nagelkerke's R^2			0.158		
	n			18,586		
	Hosmer-Lemeshow/ ROC AUC			0.078/0.703		

Values in bold are significant ($p < 0.05$).

which may have leveled off over the following months (Bendau et al., 2021).

Ultimately, the ventured hypothesis of increased psychological burden by COVID-19 severity in the social environment can be confirmed by this study. The effect of SoCE remains significant, if slightly smaller than previously reported (Gallagher et al., 2020; Mazza et al., 2020), after the inclusion of multiple variables depicting stressors to everyday life during the pandemic. This result shows the importance of multiple factors (social, financial, health, and sociodemographic) which have significantly affected the psychological condition of the individual during the past year. Results of this study demonstrate this for older age cohorts. Although older age presents as somewhat of a protective factor against increased psychological burden, which may be explained by psychological resilience (Gooding et al., 2012), COVID-19 experience in the social circle remains a significant contributor to increased psychological burden in persons of 50+ years.

The stressor "risk of loved ones becoming infected" described in Park et al. (2020) is shown to truly affect psychological burden with increased severity of infection experience coinciding with a heightened risk of occurrence of adverse psychological states. These findings can be interpreted as secondary traumatic stress or as consequence from knowledge about a traumatizing event experienced by significant others. Also, COVID-19 experience in the social circle may well have helped substantiate an, at that point rather abstract, illness contributing to the feeling of threat to the environment but also to own health. As Berger and Luckmann, 1990 ascertained, reality is shaped by the experiences of the body in the present time; therefore, the actuality of the threat of COVID-19 illness in a person's social circle may well have changed the assessment of and behavior toward this virus. Furthermore, this study shows that the increase of psychological burden seems to arise from a culmination of factors resulting from the pandemic, such as a subjective sense of uncertainty regarding medical care or financial stability, as well as some confounding factors, such as health status and neuroticism. The current situation is probably best described as a dilemma. Both the results of the pandemic, in terms of infection and illness, as well as countermeasures (social distancing), have negative consequences for our mental health. The results show that intensive work must be done on finding solutions – possibly through immunization *via* vaccination – as stressful moments caused by the pandemic contribute holistically to the psychological burden of the older population.

One limitation of this study is its cross-sectional design which restricts assumptions of causality. It cannot be assumed that the constructed model includes all influential factors modulating the relationship of COVID-19 experience in the social environment and psychological burden, which is depicted in the model fit. Furthermore, the construction of the variable psychological burden can be criticized, as it is based on several standalone items measuring adverse psychologic states

rather than trialed psychological measures. This, however, is due to the largescale survey SHARE used as database of this study which assesses a multitude of variables to holistically depict the lives of persons pre- and postretirement in Europe. It is also important to stress that this study does not use before and after tests on psychological states. Therefore, burden changes only reflect the subjective perception of the respondents. Finally, the exclusion of persons who reported own experiences of COVID-19 may have led to an exclusion of relevant participants, as an infection in the environment is likely to coincide with own infection. However, as stated early on in this paper, these participants were excluded in order to avoid the contamination of the effect of experience of other with own experience.

Overall, this paper provides further evidence that illness experience in the environment, particularly the experience of the COVID-19 virus, adversely influences the psychological constitution and health. This study therefore reinforces prior findings provided by other international teams while adding information on the influences of other, previously overlooked factors pertaining to the reality of persons living in the time of COVID-19.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: This paper uses data from SHARE waves 7 and 8 (DOIs: 10.6103/SHARE.w7.711, 10.6103/SHARE.w8ca.100), see Börsch-Supan et al. (2013) for methodological details and for data access http://www.share-project.org/.

ETHICS STATEMENT

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

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Mask Use Depends on the Individual, Situation, and Location—Even Without COVID-19 Transmission: An Observational Study in Shanghai

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COVID-19 has drastically altered people's mask-wearing behaviors around the world. What is unknown is how long these mask behaviors will last post-COVID-19? To investigate how individual, situational, and locational factors influence mask use in the absence of community spread of COVID-19, we conducted an observational study in public areas in the megacity of Shanghai, China. Researchers coded people's mask use in various suburban and urban districts and outdoor and indoor locations with and without mask requirements. Firstly, even without any local transmissions in more than 40 days, 62% of the sample ($N = 1,282$) still wore masks in public places. The data showed that people in more urban areas wore masks more often and that people wore masks in places where it was mandated. Women also wore masks more than men, and older people complied more with mask enforcement policies. We found that more densely populated districts and areas with more inflow of non-locals also predicted more mask use. We argue that the pandemic has long-lasting effects on human behavior like mask usage and reflects individuals' continual conformity to new social norms.

Keywords: conformity, COVID-19, mask use, observational study, social norms

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INTRODUCTION

The COVID-19 pandemic has immensely reshaped our understanding of urban space and health. To contain community infections, city-wide lockdowns were implemented in Wuhan, New York, London, and many other cosmopolitan cities throughout 2020. To prevent the spread of the virus, citizens were instructed to remain within their homes and neighborhoods. However, even as mandatory bans were lifted and people felt comfortable leaving their homes, people's approach to public space and contact had been redefined by safe behaviors, and their interaction with the outside world remained the same as it had been mid-lockdown. Notably, social distancing and mask wearing have emerged as new behavioral norms (Bavel et al., 2020).

Most of the COVID-19 research has focused on the containment of the pandemic and the psychological experiences of people during lockdown; however, these studies are needed, few research studies have examined ground-level behaviors in response to health risks in public settings (Kitayama, 2020; Seitz et al., 2020). Specifically, little research has investigated non-intervention approaches (i.e., observation field studies) to truly discern the naturalistic

behavior of people in their social environment in response to the pandemic (Karaivanov et al., 2021).

Our current report captures the up-to-date observations in the COVID-19 urban space by presenting data from China, the ground-zero of the global pandemic and a place where local COVID-19 community transmission was contained within 13 days from the first report on January 20th, 2021. We were interested in exploring how long-lasting COVID-19 mask norms might be changing people's social behaviors in public in response to this community outbreak. The study wanted to understand if people's mask use might differ across individual variables (age and gender), situational factors (time of day and indoors where masks were enforced), and location (urban versus suburban settings). In the following report, we will highlight our site selection and our theoretical framework for why we explored urban mask use in post-COVID-19 Shanghai.

STUDY OVERVIEW

Why Shanghai?

Shanghai is approximately 840 KM from Wuhan and has a population of 20 million people. There are roughly 3,830 people per KM^2 and like other global metropolises; the majority of Shanghai's population consists of a massive inflow of internal (domestic) and international migration (Wen et al., 2010). Shanghai first reported its first COVID-19 case on January 20th, 2020, but since then, apart from the occasional local outbreak of a handful of cases in May, June, August, and November, 2020, Shanghai has been mostly COVID-19 free. As of the time of this study, Shanghai totaled only 1,828 confirmed infections with a large proportion being imported and contained from international travel. While being mostly COVID-19 free, citizens in Shanghai still might foster fairly tight mask norms. Our study provides concrete evidence of how social norms regarding masks explain and reflect different situations in which people endorse masks or certain situations in which people do not. Exploring mask norm variations within Shanghai is valuable because an intra-city look reduces confounding variables that might be present in nationwide comparisons. Looking at district-level factors and situational factors within one city also reduces potential "messier" observational data that might occur if comparing cross-cultural mask norms.

This study focuses on how individuals comply with mask use in various locations and how we might find district-level differences around the city 1 year after the COVID-19 outbreak that devastated China. We especially focused on identifying the factors that may determine when, where, and why citizens wear masks or not. Observing people in the same city guaranteed a degree of homogeneity and reduced potential variation due to regional differences, city policies, and unpredictable outbreaks or changes.

Population Density

Social contact in populated areas fosters greater chances of contracting infectious diseases (Yang et al., 2017). Recent research on mask-wearing behavior during COVID-19 has found population density as a positive correlate of virus transmission (Rader et al., 2020) and that faces masks help control transmissions (Clapham and Cook, 2021) with experts calling for mask wearing in population-dense areas (Zhai, 2020). Therefore, we assumed that areas with greater population densities may be more at risk, and people within those regions are more likely to wear masks (Haischer et al., 2020). Thus, we expected that in districts with greater population density, people would wear masks more than other areas in the suburbs.

Mask Enforcement

After the coronavirus began to spread outside of Wuhan, China, authorities quickly adopted lockdown procedures and mask mandates to control the spread of COVID-19. Enforcement across the country was strict. In some cases, people were denied access to public facilities, detained, or punished for not following health guidelines (Beijing Daily, 2020; China News, 2020). By February 8th, 2020, Shanghai officials required citizens to wear masks outside their homes (Xinhua News Agency, 2020a). One week later, all taxi and bus drivers were required to wear masks, and people were refused service on any public transportation if they were not wearing masks (Xinhua News Agency, 2020b). Even as Shanghai became a low-risk zone and life returned to normal by the summer of 2020, masks and green health codes were still widely used and enforced in shopping malls and on public transportation (Institute for Transportation and Development, 2020). People had become accustomed to when it was time to "mask up" and when it was not necessary. Since the inception of the policy, many people complied with the requirement, while others did not. We would expect enforcement to vary across the country, but testing it within a megacity like Shanghai allowed us to eliminate the potential confusion and obscurity of inter-city mask policy differences.

Conformity and Mask Norms

Even though mask mandates were implemented very strictly when infection risks were high, when domestic transmissions lessened and summer temperatures rose, municipal authorities loosened mask wearing (e.g., recommended indoors but not required) under certain low-risk locations Shanghai Urban (Bureau and L. E., 2020). The changing nature of mask enforcement indicates that people's actions might not be entirely guided by policy references, and when mandates are perceptually ambiguous, people may use social cues as a reference (Burgess and Horii, 2012). Subtle social influences from the environment may serve as a guide for people to comply out of the need for self-categorization (Cialdini and Goldstein, 2004). In the classic Asch conformity experiment, researchers demonstrated the power of *groupthink*—i.e., that individuals would rather sacrifice free agency and go along with the majority to achieve group harmony. One advantage of observing people in homogeneous locations is that it allows us to explore how people in one area might respond in-sync under similar conditions, like during the unexpected spread of an infectious

disease. For example, during the SARS pandemic, British researchers who attended a medical conference in Thailand observed the power of conformity and cultural assimilation of masks as they adapted to mask norms in the face of the disease threat (Syed et al., 2003). With our knowledge of COVID-19 and the power of mask wearing, we expected that most people would wear masks (i.e., a descriptive norm), and authorities would encourage or even require mask use (i.e., injunctive norm). Therefore, we contend that people would comply and wear masks more frequently where it was required and still wear masks even if not required.

Individual and Cultural Factors

Prior to COVID-19, researchers had also studied mask use during infectious disease outbreaks, and they found disparities between gender and age groups. During SARS, more elderly people wore masks (65%) than young people (53%), and more females wore masks (66%) than men (52%; Sim et al., 2014). In a nationwide telephone study of more than 10,000 people in China, 75% (range of 64–84% across provinces) self-reported they would wear a mask if they had influenza-like symptoms (Ren et al., 2020). Shanghai reported one of the highest levels of mask adherence, at 80%. Also, a high percentage of wealthy (more than 77%) and college-educated (80%) people said they would wear masks if they were ill. While this recent study provides a valuable perspective on individuals' mask intentions, it *only* reported people's "intentions" to wear masks and follow other health prevention measures, not their actual behaviors in public situations.

An alternative to self-report data is to conduct a naturalistic observational study, but this approach has rarely been applied in pandemic situations. To date, one mask study during H1N1 conducted face mask observations, but it was limited to two subway stations in Mexico (Condon and Sinha, 2010). Although a similar mask study was carried out in Wisconsin, United States (Haischer et al., 2020), it was conducted in a situation where infection risks were extremely high (US total at the time of study: 7 million confirmed cases and over 200,000 deaths nationwide). It was also carried out where mask policies were not clear, and in some instances, people refused to adhere to health guidelines for political or personal reasons (Cui et al., 2021). Another cross-national study found collectivistic cultures were more likely to wear masks than individualistic cultures (Lu et al., 2021). Therefore, cross-cultural comparisons may add potential confounds due to gaps in cultural cohesion, COVID-19 knowledge, and political ideology, such as in the United States. Thus, we chose Shanghai, where social norms are relatively tight (Chua et al., 2019; Talhelm and English, 2020) as a single location of observation. To date, no such research has been carried out in China to examine the persistence of long-term mask wearing as a collective behavioral change measure despite the low risk of infection.

Therefore, the present study expands on these past studies to explore intra-city variation, situational factors (time of day and mask enforcement) which beyond basic demographic information, such as gender or age. It also allows us to gauge the long-term impact of the pandemic on social behaviors.

Hypotheses

Demographic and Individual Factors (Hypotheses 1)

Even though Shanghai is a low-risk area, we hypothesized that mask usage would remain high at around 60% (H1a). This mask percentage is comparable to YouGov data from Shanghai where mask use remained over 80% from the early days of COVID-19 in 2021 (see **Supplementary materials**). This estimation also reflected our certainty as we observed change over time in our previous observational study at the start of the outbreak where mask use was near universal (93%) at the start of the pandemic (English et al., under review).

We expected demographic and individual variations in gender (H1b; females to wear masks more than males) and age (H1c; older people to wear masks more), both of which have been essential factors of COVID-19 risks (Haischer et al., 2020).

Situational Factors (Hypotheses 2)

We hypothesized that areas with mask enforcement would lead to more people wearing masks (H2a). Our point was not to prove that when mask mandates are in place, people do not have much of a choice but that the probability of deviant behavior (norm tightness) would be much lower in situations that require mask wearing than those that do not. Deviance and adherence are key to understanding conformity and norm tightness across different situations and conditions (Gelfand, 2012). In a cross-sectional study across five cities in three countries, researchers found mask use was lower with age (MacIntyre et al., 2021); however, we argue that this result depends on situations (indoor mask compliance), thus, we hypothesized that older people will comply more in mask enforced areas (H2b).

We were also interested in the idea that mask use might vary by time of day. A recent qualitative study from Tokyo, Japan speculated that nighttime mask use might decrease due to individuals acceptance of risk and more willingness to engage in deviant behaviors (Giammaria, 2020). Thus, we hypothesized that across the entire sample, nighttime mask use will be significantly lower than in daytime (H2c).

Locational Factor (Hypotheses 3)

We also examined the effect of city location. We expected mask usage to be generally high downtown because people commute and tour the city daily (H3). Population density is much greater in downtown areas compared to suburbs. While this hypothesis seems intuitive, a recent observation study in Hawaii found participants in downtown business districts wore masks (88% compared to 66%) significantly more than a recreational and tourism-based region (Tamamoto et al., 2020).

Finally, we explored several further predictions using district-level data that might explain mask usage. One idea is that frequent inflow and outflow of outgroup population (i.e., non-Shanghai residents) in downtown might induce

locals to reduce contact by conforming to mask-wearing norms to avoid pathogen transmission (van Leeuwen and Petersen, 2018). Finally, district COVID-19 cases, population over 60, and district wealth will be incorporated into our regression models as robustness tests to verify our hypotheses that individual, situational, and locational factors can predict mask use.

MATERIALS AND METHODS

Methodological Approach

In this study, we explore how mask differences might exist in various situations in daily life in Shanghai, China. We conducted a natural observation because it addresses the fundamental problems of self-report measures in social psychology. First, researchers have documented issues with using self-report scales due to the effect of social desirability or response style bias (Hamamura et al., 2008). This problem is persistent in the US and is just as common in collectivistic countries like China and Korea (Oyserman et al., 2002). Second, there is often a lack of correlation between personality traits (such as extraversion) and objective behaviors that tap into that same trait (Heine et al., 2008). Fortunately, observational studies can help us understand people's real world behaviors and their psychology (Levine et al., 2001; Talhelm et al., 2018, 2019). Finally, the pandemic provides researchers a time to explore social coordination and compliance as situations to naturally they take place in the real world. While observational studies are not so procedurally as robust compared double-blind controlled experiments in the laboratory, we argue that they are a good supplement as we can observe and address real-life behaviors across social situations.

COVID-19 Situation in Shanghai

Shanghai is the largest metropolitan city in China and is considered a model city in taming COVID-19 outbreaks even during the early, uncertain times of the pandemic (Caixin, 2020; Xu et al., 2020). It has been exceptionally effective in containing eruptions without full-scale city lockdowns or mass testing (Dezan Shira and Associates Staff in China, 2021). As of late February 2021, only 1,828 COVID-19 infection cases have been documented, with 371 being local transmissions and 1,457 "imported" from people returning from overseas (Baidu COVID-19 Data, 2021).

Over a three-day window (February 26th –February 29th, 2020), we collected 1,282 observations of mask use behavior in various parts of Shanghai. This time window and homogeneous area allowed us to study location effects, time-of-day effects, and policy effects in detail. The time of the study was more than 1 month (~ 40 days) since the last community outbreak in Shanghai, when a small cluster of 16 cases appeared in two districts (Huangpu and Baoshan) between January 20th and 26th (Dezan Shira and Associates Staff in China, 2021).

Observation Rules

The researchers coded whether people wore masks, along with people's gender and approximated age by decade ("10 and under" to "70 and above"). The researchers recorded their codes in their phone that allowed us keep digital records (see OSF file). We took precautions to ensure safety, such as wearing masks and maintaining social distance. Given the low risk of infection in Shanghai, we were also confident that the researchers were not exposed to any danger. All procedures and study design information were approved by the recommendations of the Institutional Review Board of Shanghai International Studies University IRB protocol # 2020-UNI-0211 Entitled "Psychological Experiences during the COVID-19 Outbreak."

Observational Settings

The researchers coded people in public places, such as banks, cafés, shopping malls, outdoor community centers, and outside subway station entrances. In the analysis, we explored whether mask use differed by settings of enforced vs. non-enforced mask areas (explained in **Supplementary Material**). Researchers avoided tourist areas so that the data did not reflect visitors. We sampled a diverse group of people in nine districts in Shanghai (out of 16 total districts), encompassing the urban districts of Huangpu, Hongkou, Yangpu, Jing'an, Putuo, Changning, Xuhui suburban districts Minhang and Baoshan (See **Figure 1** for a district map of Shanghai). These districts vary greatly in district population, density, and local COVID-19 cases. A total of 548 people (45.6%) in our sample were in the suburbs, while 54.4% ($n = 698$) were located downtown (**Supplementary Figure S1**).

Next, we coded areas where masks were required. In total, we observed people in nine places where masks were enforced (395 observations). Because of this community outbreak, masks must be worn inside supermarkets, so the space in front of the supermarket is an area where masks are enforced. These places included supermarkets, banks, convenience stores, large indoor shopping malls, and cafés, such as Starbucks. The other areas where masks were not required were on street corners and outdoor apartment complexes. We coded mask enforcement (1 = yes; 0 = no), which included a body-temperature check, mask wearing upon entrance, or in some cases requiring a green QR health code to enter (described in detail in **Supplementary Material**).

As mentioned above, we collected our data over a three-day window to reduce the chances of a time effect or a possible eruption of new COVID-19 cases that would impact mask usage. There were no remarkable differences across the 3 days. In sum, it is safe to say that our data are reliable against the possible influence of changes due to the severity of COVID-19; thus, it is a genuine representation of stability and people's willingness or unwillingness to adhere to mask mandates even without the presence of any COVID-19 risks.

RESULTS

Personal and Situational Factors

Overall, 62.71% of the people ($N = 1,282$) observed wore masks. In our previous study at the start of the outbreak in January

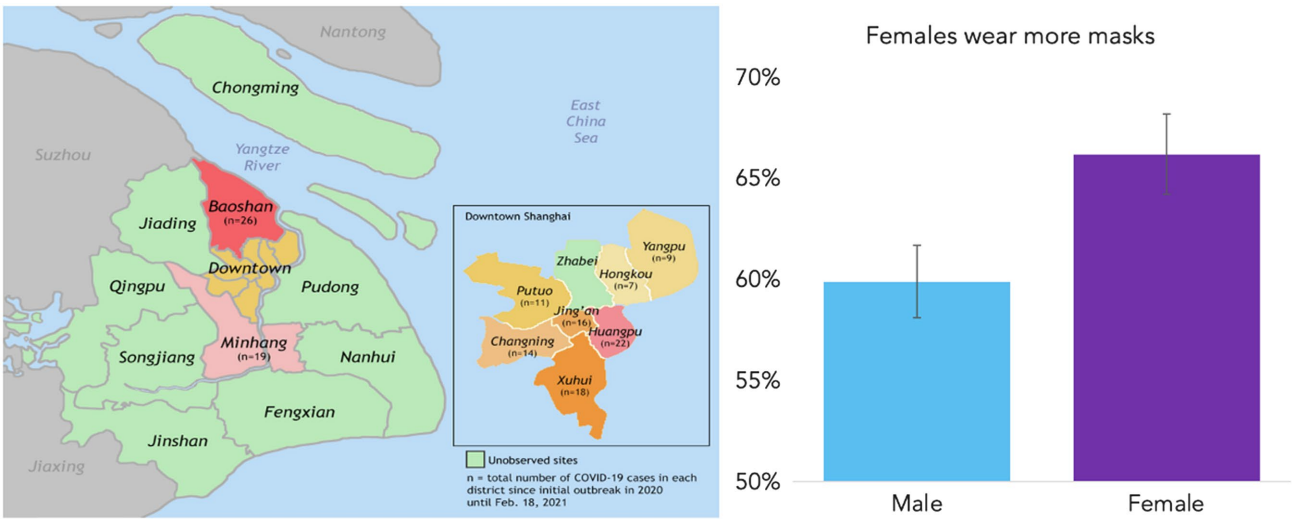

FIGURE 1 | Map of Shanghai's 16 districts with lables of total COVID-19 (*n*) cases in each district we conducted the mask observation **(left)**. Overall, 59.8% males wore masks while 66.2% female wore masks **(right)**. Error bars represent ISD.

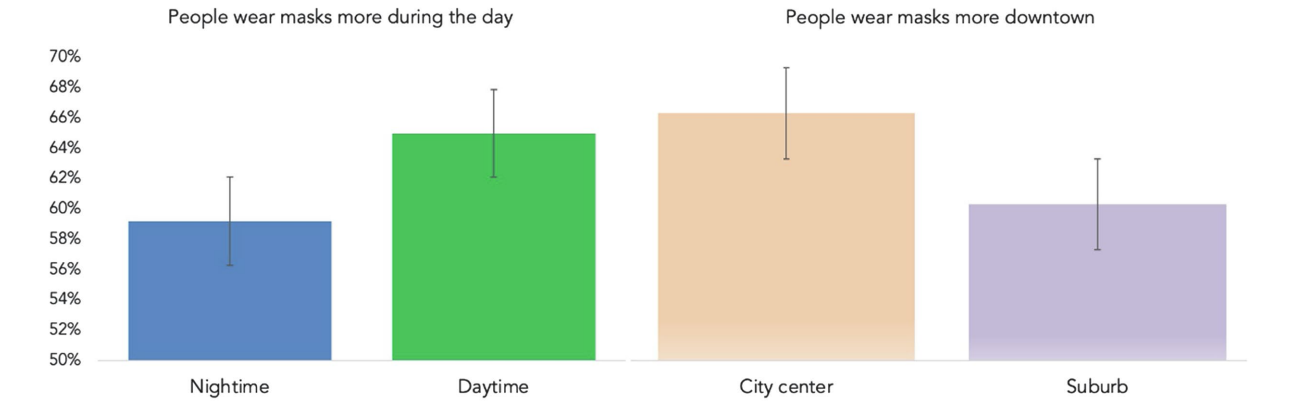

FIGURE 2 | People wore masks 69.2% when in areas where mask were required as opposed to 59.6% in areas where masks were not required **(left)**. Older people conformed *more* when mask was enforced, younger people wore the same amount of masks regardless of mask regulations **(right)**.

2020, we found that older people (over 50) were less likely to wear masks (English et al., under review). This time, however, we found no difference in age groups ($p = 0.355$). However, mask use was still more common among women ($B = 0.25$, $z = 2.06$, $d = 0.12$, $p = 0.039$; **Figure 1**). In sum, H1a and H1c were supported, and H1b was rejected as we found no difference between age groups.

As expected, across all the observation sites, mask enforcement positively predicted more mask usage ($B = 0.34$, $z = 2.43$, $d = 0.14$, $p = 0.015$; $r_{\text{district-level}} = 0.43$; **Figure 2**). Next, since we did not find a main effect of age, it is possible that certain age groups might comply with mask mandates more. We found that age interacted with mask enforcement and that older people complied more when masks were required ($B = 0.26$, $z = 3.08$, $d = 0.14$, $p = 0.002$; $r_{\text{district-level}} = 0.43$; γ represents district-level regression coefficients). This result supports previous evidence that older people comply more than middle-aged or young people (Haischer et al., 2020), but only on the condition of mask mandates (**Figure 2**). Finally, because we observed 792 people (62%) during the day and 490 people (38%) at night, we were able to explore the idea that people were more likely to wear masks during the day than at night ($B = 0.28$, $z = 2.18$, $d = 0.12$, $p = 0.029$; $r_{\text{district-level}} = 0.44$; **Figure 3**). **Table 1** presents linear regression models for individual and situational factors predicting mask use. In sum, H2a, H2b, and exploratory H2c were supported.

The Significance of Situation and Location (Expansion of Analyses)

In this section, we expand our analyses to explore more district-level factors that might be impacting mask use. For example, population across a large metropolis like Shanghai can range

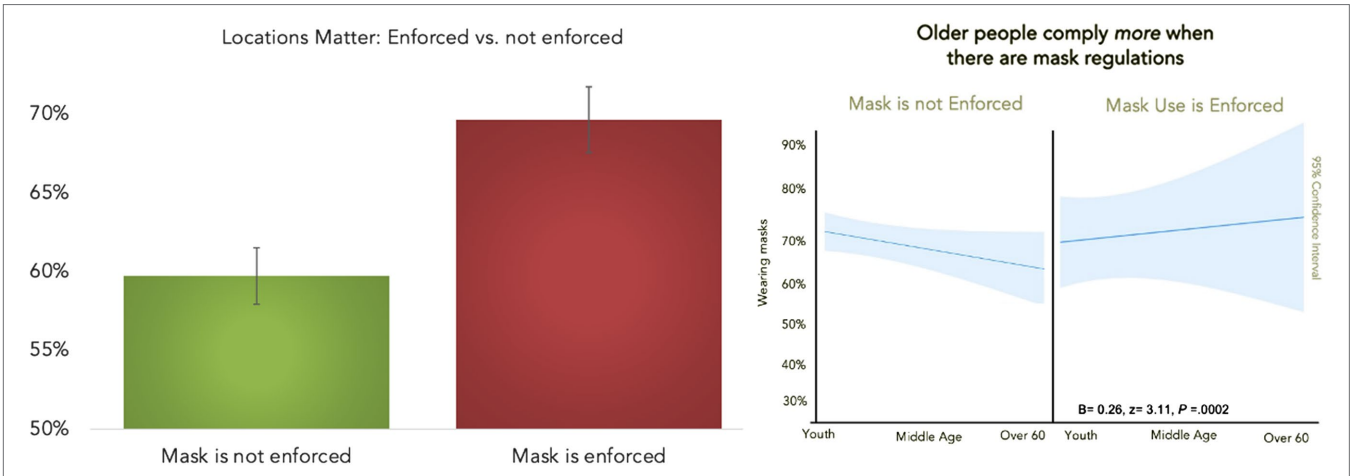

FIGURE 3 | 64.9% wore masks during the day compared to 59.2% at night **(left)**. 65.3% of people wore masks in the city center compared to 59.6 of in suburbs **(right)**.

from densely populated high rises where millions of people live within a few square miles to huge land sprawls with only thousands of people. Thus, it makes sense that these location and situational factors might influence mask use.

We collected data from various districts to test how people in different locations might vary in their mask-wearing behaviors (**Table 2**). We calculated downtown districts vs. suburban districts using the city's classification (Baidu, 2018). This gave us 584 observations in the suburbs and 698 observations in downtown areas. As expected, people in downtown areas generally wore masks more than people in the suburbs ($B = -0.24$, $z = -2.06$, $d = -0.12$, $p = 0.040$). Interestingly, similar with older people, people living in the suburbs were more likely to adhere to mask enforcement ($B = 0.81$, $z = 3.08$, $d = 0.17$, $p = 0.002$). When people were downtown and in areas with mask regulations, 67% of people wore masks compared to 74% in suburban areas where masks are enforced (**Supplementary Figure S2**). In contrast, people in downtown areas where masks were not enforced still wore masks 65% of the time, a sharp contrast to the 54% of people in the suburbs who were not in areas where masks were enforced.

We also gathered other district-level census data to verify the robustness of individual-level findings. People in districts with *fewer* people over 60 years old wore masks more ($B = -0.74$, $z = -3.86$, $d = -0.22$, $p = 0.002$; **Table 1**). This finding seems counterintuitive but suggests that districts with younger people tend to adhere to mask usage. The result resembled our previous study which found that few older adults wore masks at the start of the outbreak (English et al., under review). This might be due to the fact that areas with fewer retired people might reflect the more modernized parts of Shanghai—newer, wealthier, and busier (Zhu et al., 2019). Therefore, young white-collar workers might frequently encounter situations where masks are mandated, such as in office buildings and public transit. Second, districts with more seniors represent secure and stable populations where in-group contact is more prevalent. People might feel more security and trust toward each other in these traditional districts and lower their alertness (Wen et al., 2010).

Next, we calculated district population density based on 2019 district population census data and district land area. Population density is a logical alternative variable to the suburb vs. downtown classification. Using population density gives us more confidence (i.e., robustness test) in the results since each district has variations in population density. For example, Huangpu has a population density of 319,550 per km^2 compared to Baoshan's 75,360 per km^2. As expected, people in areas that are more populated wore masks more than those in less populated areas ($B = 0.14$, $z = 2.05$, $d = 0.11$, $p = 0.041$). Again, identical to our suburb analysis, our robustness check verified the interaction with mask enforcement; people in less population-dense areas complied more and wore masks in required areas more than people in densely populated areas where masks were enforced ($B = -0.89$, $z = 5.10$, $d = 0.29$, $p < 0.0001$; **Figure 4**).

We also obtained statistics on the population inflow in 2017 (Shanghai Statistical Yearbook, 2018). This district-level data would allow us to tease out the total amount of non-local residents from the officially registered population in each district. While the numbers may not reflect all non-local residents, they provide a picture of which districts might represent more transient populations with people coming and going. More outgroup population inflow would mean more risk. The percent of population inflow did not predict mask usage by itself ($p = 0.26$); instead, it interacted with mask enforcement ($B = 0.16$, $z = 4.37$, $d = 0.25$, $p < 0.0001$). When masks were required, people in areas with more inflow of non-locals wore masks to a greater extent than in areas with few non-locals.

Finally, following Takemura et al.' (2016) approach, we created a single district composite measure of "urbanity" by averaging population density and inflow after standardization. We found there was no main effect of urbanity on mask usage ($p = 0.266$). However, it interacted with mask enforcement ($B = 0.03$, $z = 4.37$, $d = 0.25$, $p < 0.0001$) and followed the identical pattern as the inflow migration effect (**Table 2**).

TABLE 1 | Individual and situational factors that impact mask usage in Shanghai.

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	0.53	0.55^{+}	0.76*	0.30	0.30
	(0.34)	(0.33)	(0.34)	(0.22)	(0.23)
Age	−0.03	−0.03	−0.10*	−0.01	−0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Female	0.25*	0.24*	0.25*	0.26*	0.25*
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Daytime (1 = yes; 0 = no)	0.28*				
	(0.13)				
Mask Enforcement		0.34*	−0.46		0.06
		(0.14)	(0.29)		(0.17)
Mask Enforcement x Age			0.26**		
			(0.08)		
Suburbs (1 = yes; 0 = no)				−0.24*	−0.44**
				(0.12)	(0.14)
Mask Enforcement x Suburbs					0.82**
					(0.27)
AIC	1662.50	1661.28	1653.63	1689.55	1673.50
BIC	1688.28	1687.06	1684.56	1710.17	1704.43
Log Likelihood	−826.25	−825.64	−820.82	−840.77	−830.75
District effects/ Deviance	0.44	0.44	0.43	1681.55	1661.50

We do not nest models in the district group level because we are testing how these districts (suburbs) differ in regard to enforcement. $^{**}p<0.01$; $^{*}p<0.05$; $^{+}p<0.10$.

Alongside population density, modernization theory would suggest that those in wealthier areas might wear masks more. We tested modern-day district GDP_{2017} (Shanghai Statistical Yearbook, 2018) and historical GDP_{2007} (Shanghai Statistical Yearbook, 2008). Neither modernization variable was significant (**Table 3**). Another possible factor could be COVID-19 cases. As in our previous paper, we found some evidence for base-neglect theory (Pennycook and Thompson, 2016), where individuals might pay more attention to the raw number of infected cases as opposed to the number of cases *per capita*. In a city like Shanghai, a few daily cases could be significant. Our results showed that the effect of district-level cases *per capita* was not significant ($p = 0.29$), but surprisingly, total district raw cases marginally predicted *less* mask usage ($p = 0.07$; **Table 3**).

DISCUSSION

The purpose of this observational study was to understand various conditions in which individuals would adhere to mask usage. We focused entirely on the metropolitan city of Shanghai because it was at considerable risk early during the pandemic (Zhang et al., 2020) and was later praised for its model role in taming transmissions. Using this urban example, we examined how conformity concerning mask-wearing behaviors shaped the city's population 1 year after the initial outbreak. We found that despite low infection risks, of the 1,282 people observed in Shanghai, 62.7% still wore masks regardless of location, time of day, or district. These results suggest that long-lasting COVID-19 behavior norms are likely to persist well into the future, especially in countries where vaccine rollout is slow. We went beyond other mask studies investigating responses during the early outbreak across different Chinese regions by researching district-level factors that might impact people's compliance (English et al., under review); (Haischer et al., 2020). Integrating our findings, we argue that compliance with mask requirements reflects voluntary conformity to COVID-19 norms due to urbanization factors and COVID-19 prevention.

Our observations yielded a number of novel results that deserve discussion. First of all, our findings are consistent with previous research (Haischer et al., 2020) that females conform more to mask wearing. However, we found no noticeable age difference in mask usage. We replenished previous research by finding that mask wearing is more prevalent during the day than at night. Moreover, age interacted with mask enforcement in predicting mask wearing, suggesting that older people may wear masks because they are required to. In fact, we find that young people wear more masks even *without* enforcement. Put another way, young people's mask-wearing behavior is less influenced by mask rules. These findings correspond with previous cross-country research using extensive data from YouGov from 27 countries which found that people over the age of 50 tended to comply with COVID-19 social distancing measures (Daoust, 2020). Interestingly, the author excluded data from China because the data were not representative. Our data suggest that this trend could be dependent on country-level specificities and is not universal.

Secondly, both situations (whether masks are enforced) and location (suburb vs. downtown) matter for mask conformity. Tests of the interaction between the suburb/downtown dichotomy and district population density with mask enforcement have provided substantial evidence to confirm that mask enforcement is more powerful in suburban areas in achieving mask compliance. Most notably, the percentage of urbanites wearing masks did not differ much whether masks were enforced (67%) or not (65%). These findings suggest that while mask conformity for suburban residents is still susceptible to external factors, such as mandates, masks may have become a behavioral norm for urban dwellers.

Thirdly, we found that districts with a younger population predict more mask usage. This finding, corresponding with the fact that urban districts in Shanghai are home to young white-collar workers (Liu et al., 2015), is consistent with the above finding that mask wearing may have become normative in urban areas.

It is also not surprising that greater population inflow interacted with mask mandates to achieve mask wearing, as inflow migration suggests more outgroup contact, for example, these places tend to have more mobility and inbound and outbound traffic, like as train stations, bus stations, or airports. For clarification, the greatest population inflow in Shanghai

TABLE 2 | District-level factors predict mask usage.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(Intercept)	2.52***	−0.13	0.21	0.68*	0.21	0.68*
	(0.67)	(0.24)	(0.25)	(0.28)	(0.25)	(0.28)
Age	−0.02	−0.02	−0.02	−0.01	−0.02	−0.01
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Gender	0.24*	0.24*	0.25*	0.25*	0.25*	0.25*
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Mask Enforcement	0.37**	0.43***	0.45***	−0.76*	0.45***	−0.76*
	(0.13)	(0.13)	(0.13)	(0.30)	(0.13)	(0.30)
District Population % over 60	−0.74***					
	(0.19)					
District Population Density		0.14*				
		(0.07)				
% of in-migrants $_{2017}$			−0.002			
			(0.002)			
% of in-migrants $_{2017}$				−0.01***		
				(0.00)		
Mask Enforcement x in-migrants $_{2017}$				0.02***		
				(0.00)		
Urbanity					−0.003	−0.02***
					(0.003)	(0.00)
Mask Enforcement x Urbanity						0.03***
						(0.01)
AIC	1668.18	1680.47	1683.46	1665.43	1683.46	1665.44
BIC	1693.96	1706.25	1709.24	1696.36	1709.24	1696.37
Log Likelihood	−829.09	−835.24	−836.73	−826.72	−836.73	−826.72
Deviance	1658.18	1670.47	1673.46	1653.43	1673.46	1653.44

***$p<0.001$; **$p<0.01$; *$p<0.05$.

TABLE 3 | District wealth and COVID-19 cases demonstrate mixed results.

	Model 1	Model 3	Model 4	Model 5
(Intercept)	−0.20	−0.18	−0.06	0.37
	(0.29)	(0.30)	(0.25)	(0.27)
Age	−0.02	−0.01	−0.02	−0.01
	(0.04)	(0.04)	(0.04)	(0.04)
Female	0.25*	0.26*	0.25*	0.25*
	(0.12)	(0.12)	(0.12)	(0.12)
Mask Enforcement	0.38**	0.39**	0.41**	0.42**
	(0.13)	(0.13)	(0.13)	(0.13)
District GDP$_{2007}$	0.004			
	(0.003)			
District GDP$_{2017}$		0.002		
		(0.002)		
District Cases *Per Capita*			1.11	
			(1.05)	
District Total Cases				−0.02+
				(0.01)
AIC	1682.81	1683.43	1683.56	1681.33
BIC	1708.59	1709.20	1709.34	1707.11
Log Likelihood	−836.41	−836.71	−836.78	−835.67
Deviance	1672.81	1673.43	1673.56	1671.33

**$p<0.01$; *$p<0.05$; +$p<0.10$.

represents both urban and suburban areas, such as Yangpu (16,485 in 2017) and Minhang (15,098 in 2017); hence, the interaction with mask enforcement does not counter our previous finding on urbanization and mask conformity. Similarly, Shanghai's wealth is not solely built upon urbanized locations—our major suburban site, Minhang, contributed the greatest amount of GDP in 2017. Since GDP is not a marker of urbanization in our study, it seems logical as to why wealth did not predict mask use.

Finally, only raw cases marginally predicted mask usage but in the *opposite* direction of what would be expected. Perhaps this is because most places in Shanghai have not had local transmissions since February 2020. People city-wide have adopted a behavioral mask norm regardless of district case transmissions. Or, this could be due to the fact that infected cases and their close contacts were put under instant quarantine in Shanghai, and it is possible that people contradictorily felt safer going out even without a mask given reduced threat and uncertainty from accessing public tracking information (Wnuk et al., 2020).

CONCLUSION, LIMITATIONS, AND FUTURE DIRECTIONS

By conducting observational research on mask wearing over a three-day window in Shanghai, China, the current study examined conformance with mask norms in the ongoing COVID-19 pandemic. An observational approach allowed us to tease out the confounding factors in a traditional survey design and enabled us to disentangle the demographic, situational, and locational impact on mask norms. While our study demonstrated the unsurprising role of mask enforcement in strengthening norms, it also revealed how the urban environment especially fosters new norms that may last into the future.

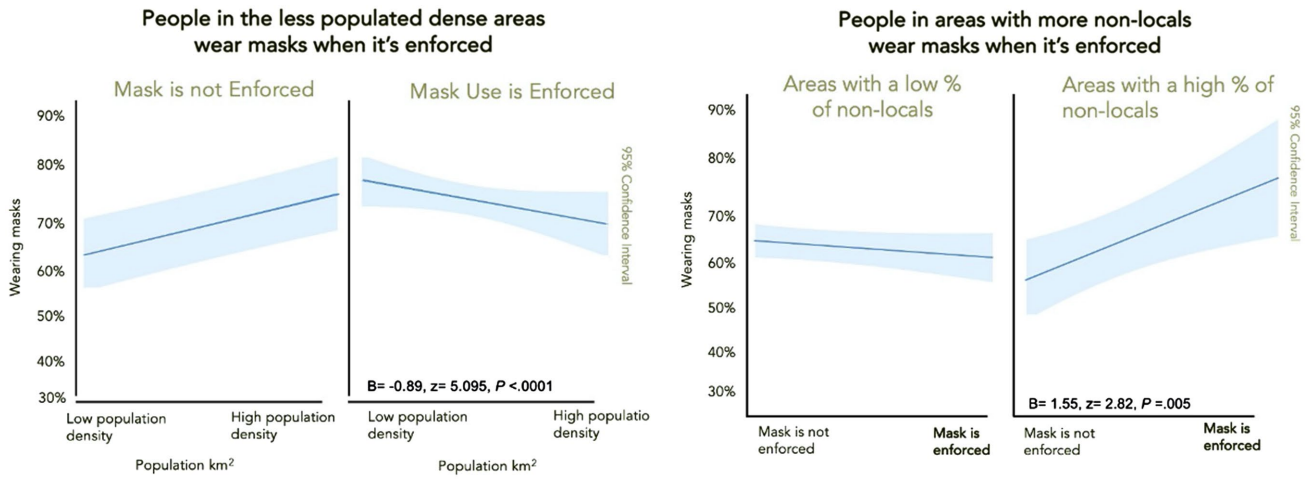

FIGURE 4 | Mask enforcement mattered *less* in populated dense areas and people complied more in areas with less population density **(left)**. People wear masks more in areas with more outgroup members **(right)**.

The observational design is also a limitation of the study. First, the short duration of time limited us from truly unpacking the formation of norms as a process. Second, since we were unable to observe equally (according to location and time of day) across all nine districts, it is possible that there might be some bias or confounding variable at play due to variation in time or location in various districts. Third, researchers also observed locations that were close or nearby their residence or a place they frequented often, this might provide some unknown bias and can be seen as an important limitation. Our sample city, Shanghai, is also different from many other cities in China and the world given its unique administrative and internationalized culture. Therefore, relevant findings may pose limitations to other urban settings due to macro-level factors not included in the study. Unlike other studies, we did not observe mask-wearing behaviors that are technically not protecting people from infection risks and not adhering to health guidelines. Still, our focus is on mask-wearing norms and willingness to follow mask policies, not on how effectively masks are used and whether they are worn properly or not.

CONCLUSION

Our research captured what norms may look like in urbanized settings if COVID-19 becomes the "new normal" of the present era. By utilizing observations from the "model" city of Shanghai in containing this pandemic, we demonstrated that norms are the co-product of enforcement and shared collective responses to protecting others (English et al., under review). Our results prove that what the Shanghai municipal government coined as "normative administration" in its daily press release (The State Council Information Office of the PRC, 2020) has truly taken effect on the societal level. Our findings may serve valuable on the ground observations on how large cities might better tackle the current and future pandemic to increase coordination and compliance with health mandates.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Shanghai International Studies University Institutional Review Board (IRB) Research Project Protocol # 2020-UNI-0211 Entitled "Psychological Experiences during the COVID-19 Outbreak." Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

AE and XL designed the study, collected and coded data, and wrote the paper. AE analyzed the data. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.754102/full#supplementary-material

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The Influence of COVID-19 on Irrational Consumption Behavior in a Chinese Sample: Based on a Serial Mediating Model

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Based on the scarcity theory, this study focuses on exploring the relationship between the severity of public health emergencies (i.e., COVID-19) and individual irrational consumer behaviors through the serial mediating variables of perceived scarcity (PS) and negative mentality (NM). An online questionnaire was used to collect data from participants in China and we obtained 466 effective (115 male and 351 female) questionnaires in total. The findings showed that the relationship between each pair of factors – perceived pandemic severity, PS, NM, and irrational consumption behaviors – was significantly positive. Although the perception of the severity of this public health emergency did not directly predict irrational consumer behavior, the effect was mediated by PS and NM independently and serially. These findings reveal that people who strongly perceive scarcity and are prone to negative attitudes are more likely to demonstrate irrational consumer behaviors (such as rushing to buy and hoard living supplies) once the public perceives a public health emergency as severe. This effect occurs because the PS that results from the epidemic affects people's cognition, emotion, and behavior.

Keywords: COVID-19, public health emergencies, perceived scarcity, negative mentality, irrational consumption behavior

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INTRODUCTION

Since 2020, COVID-19 has ravaged the world. Although countries have taken measures to control its spread, this public health emergency, with its characteristics of suddenness and dangerousness, continues to exert an important impact on individual psychology and behavior (Qin et al., 2021). For example, people's indoor time generally increases during the epidemic, so screen time increases with it. Excessive screen time use has been associated with a range of negative mental health outcomes (Lee et al., 2020). Besides, public health emergencies are often associated with different levels of irrational consumption behavior (ICB), such as the "panic buying of masks and food" in China and the "panic buying of toilet paper" in Japan, Australia, and the United States. ICB refers to unreasonable consumption decisions made by consumers under the influence of various factors which are composed of impulse and blind consumption behavior (Li and Yang, 2016). In general, previous studies have primarily examined the ICB of individuals in general situations and have explored the causes of these ICBs through four main lenses: the personal characteristics of consumption, purchase

motivation, personal resources, and marketing stimulus (Verhagen and Dolen, 2011; Thompson and Prendergast, 2015; Iyer et al., 2020). However, when individuals are exposed to health emergencies, especially those related to their own health, their psychological perception, and consumption behavior may differ. For example, recent studies have pointed out that the public's perceived scarcity (PS) is magnified in emergencies, which can also affect people's cognition and behavior to a certain extent (Liu and Wang, 2020).

However, in the context of health emergencies, a clear explanation remains lacking of the impact of individual psychological perception and consumption behavior, as well as the transmission mechanism of psychological factors, such as PS, on ICB. Thus, this study aimed to investigate the mechanism through which the perceived severity of COVID-19 influences individuals' ICBs.

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Perceived Severity of Pandemics and Irrational Consumption Behavior

Irrational consumption behavior refers to the irrational purchase decision made by consumers when they are affected by various factors (Xinhui and Han, 2016). In a specific performance of ICB, it can also be characterized by impulsiveness (i.e., unconsidered purchase behavior or sudden purchase intention) and blindness (i.e., purchase intention caused by following trends or being influenced by the outside world; Tversky and Kahneman, 1974). The panic buying behavior is a manifestation of ICB (Asiah et al., 2021). A previous study postulated a causative model of panic buying, mentioning that there were primary, secondary, and tertiary factors stimulating this behavior (Arafat et al., 2021). The external environment affects consumers' emotions, thereby stimulating their ICB (Chen and Yao, 2018). In public emergencies, due to concern over their severity, the public often experiences a lack of security, which leads to the social panic mentality and the panic buying of particular products, such as food, medicine, and toilet paper. For example, the panic buying phenomena during COVID-19 was caused by a combination of reasons, including PS, increased demand, necessary goods, anticipated price hike, and other responsible factors (Arafat et al., 2020). The COVID-19 pandemic is a form of public emergency, i.e., a kind of public event that happens suddenly and causes or may cause serious social harm. Public emergencies are characterized by abruptness, derivatization, harmfulness, and unpredictability (Wang et al., 2019). Some studies have pointed out that in the case of emergencies, due to supply shortages and social learning, consumers' purchasing decisions are usually influenced by their peers' choices, which results in greater panic among consumers and large-scale panic buying (Zheng et al., 2020). Therefore, this research proposes the following hypothesis:

> *Hypothesis 1*: Perceived pandemic severity positively predicts irrational consumption behavior.

Perceived Scarcity and Negative Mentality as Mediators

Consumers rely on many resources for survival, including those that take the form of capital or production inputs, such as time and money (Roux et al., 2015), as well as physical resources, such as food, water, and gas (Lene and Bang, 2013; Ravi and Meng, 2016). People experience resource scarcity when they perceive that the resources they possess are insufficient to satisfy their needs and desires, resulting in a series of psychological and behavioral responses. As a universal phenomenon, scarcity plays an important role in individual emotion, perception, and behavior (Fan et al., 2019). Individuals' preoccupation with resource scarcity causes a comprehensive decline in cognition and judgment. For example, Eldar and Sendhil (2015) found that the scarcity of resources (such as time or money) fosters a scarce mindset, resulting in the loss of "bandwidth" needed for decision making. According to the scarcity theory, the individual's attention is unconsciously occupied in the state of scarcity, which reduces the amount of cognitive "bandwidth" to invest in other things, leading to declines in one's computing, concentration, cognitive, planning, and self-control capacities (Mani et al., 2013). Some studies in the consumer field have also shown that the scarcity of goods exerts an impact on consumers' perception of commodity value, which will promote their impulse to consume products (Jang et al., 2015). Based on the scarcity theory, we propose the following:

> *Hypothesis 2*: Individual perceived scarcity mediates the relationship between perceived pandemic severity and irrational consumption behavior.

Emotions can guide people to make decisions under conditions of risk and uncertainty that involve intertemporal choice, social decision making, and ethical decision making. One study found that, in response to the COVID-19 pandemic, 66.4% of the respondents living in Addis Ababa, Ethiopia, experienced moderate to severe psychological problems, including stress, anxiety, and depression (Kassaw, 2020). During this emergency, people are faced with danger, and social emotions will alter their behaviors to a certain extent. A previous study has shown that emotion is one of the most important factors in the irrational decision-making process. Especially under the interference of negative social mentality, people's negative emotion will affect their own decision making (Lerner et al., 2013).

Social mentality is the general social attitude, emotional experience, intention, and other psychological states that people hold toward themselves and their society. This mentality is formed on the basis of the convergence, integration, mutual influence, and mutual infection of different individual psychologies (Wang and Ying, 2020). Social mentality has a strong inductive effect on people's social behavior and is an important psychological basis for social disorder. Changes in panic and anxiety are the most prominent experience and feeling in public health emergencies (Wang and Ying, 2020). One study presented that almost 30% of Mexican individuals presented with clinically significant symptoms of posttraumatic stress during the COVID-19 pandemic, and most people in quarantine experienced negative emotions; moreover, many

TABLE 1 | Demographic characteristics of the sample.

Variable	Category	Frequency (*N*)	Percentage (%)
Gender	Male	115	24.7
	Female	351	75.3
Age	18–25	383	82.2
	≥26	77	17.8
Education status	High school or below	95	20.3
	Bachelor degree	371	79.7
Family income	<¥24,000	145	31.1
	¥24,000–¥60,000	126	27
	>¥60,001	195	41.9

people engaged in irrational behavior, such as panic purchasing, discriminatory behavior, and violence against health professionals (Ramírez et al., 2020). In times of emergency and crisis, due to the resulting environment of fear and insecurity, people will indulge in the behaviors necessary for survival. Furthermore, sensationalized media reporting on the crisis can also trigger negative emotions, such as panic and anxiety, which will lead to more panic buying (Arafat et al., 2020).

Therefore, we believe that public anxiety, panic, and other examples of negative mentality (NM) caused by public health emergencies can affect individual ICB. Based on the abovementioned research, this study proposes the following:

> *Hypothesis 3*: Negative mentality mediates the relationship between perceived pandemic severity and irrational consumption behavior.

According to scarcity theory, PS will change people's mode of thinking and will affect their decision making and behavior. Previous studies have shown that PS exerts an impact on individual cognitive ability and executive control (Arafat et al., 2020). In addition, the scarcity perceived by the public can be seen as a feeling of losing control, which will lead to panic behavior and vastly increased hoarding behaviors (Zheng et al., 2020). Such responses may also occur to reduce the fear and anxiety caused by the loss of control over one's surrounding environment during the pandemic. Therefore, we believe that in the face of public health emergencies, due to the expected lack of access to products or services and the prevalence of NM, the public will demonstrate a strong demand for products, which leads to a sense of urgency to buy and hoard an excessive amount of merchandize. Therefore, this research proposes the following:

> *Hypothesis 4*: Perceived scarcity and negative mentality operate as serial mediators between perceived pandemic severity and irrational consumption behavior.

STUDY METHODS

Participants

This cross-sectional multicenter study was conducted from February 22 to March 17, 2020. According to statistics from the National Health Commission, the total number of confirmed COVID-19 cases in mainland China increased from 76,936 to 82,798 during this period. The investigated sample was recruited online *via* Wenjuanwang,[1] an online platform similar to Mechanical Turk or Qualtrics that is used to launch nationwide e-surveys in China and is widely employed in behavioral and psychological studies. Participants gave their informed consent after being provided with information explicitly stating the research purpose, nature, and procedure of the study. A total of 525 questionnaires were collected. After excluding the ones with missing values, 466 valid data were obtained, with an efficiency rate of 88%. The average participant age is 23.6 years ($SD = 7.4$). **Table 1** presents the demographic characteristics of the participants.

Measures

The measures used were identical to those that have been widely used in previous studies and were translated into Chinese, ensuring that the scale can be understood by respondents in China.

Perceived Pandemic Severity

The existing and internationally accepted definition of a pandemic, as provided by the WHO and the Dictionary of Epidemiology, comprises three dimensions: mortality, morbidity, and comorbidities (Campos, 2020). Therefore, perceived pandemic severity (PPS) was measured through three dimensions: the number of casualties, the scope of spread, and the duration. Each item is rated from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating higher perceived severity. Moreover, the PPS in the current study included country-specific questions (such as: From the perspective of the number of confirmed cases and deaths, do you think this outbreak is serious?"; $\alpha = 0.83$).

Perceived Scarcity

Perceived scarcity was measured by a 5-item scale developed by Roux et al. (2015). The items are rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate higher perceptions of scarcity (indicated by questions, such as "My materials are insufficient"; PS: $\alpha = 0.86$).

Negative Mentality

The NM instrument was revised and adapted from Wang's research on SARS (Wang et al., 2003). The scale consists of eight items, each rated on a scale from 1 to 5 (1 = never and 5 = very often). Higher scores indicate a more NM (indicated by questions, such as "I felt nervous and afraid due to the epidemic situation"). The subscales indicated good internal consistency in this sample (NM: $\alpha = 0.87$).

Irrational Consumption Behavior

The level of individual consumption behavior was measured with a questionnaire originally developed by Kahneman (Xinhui

[1]http://www.wenjuan.com

and Han, 2016) that includes four items. The scale comprises two subscales: impulsiveness (indicated by questions, such as "I will stock up on materials in large quantities") and blindness (e.g., "If the ingredients in a certain drug can prevent new pneumonia, I will buy it even if its messaging is inaccurate"). Each item is rated from 1 (strongly disagree) to 7 (strongly agree), with higher scores indicating higher ICB. The total score of this scale was used in the analysis. The scale demonstrated good internal consistency in this sample (ICB: $\alpha = 0.83$).

Control Variables

Some previous studies have suggested that gender and age may influence ICB; therefore, we controlled for gender and age in the data analysis (Wang et al., 2018). ICB has also been shown to correlate with income (Pati et al., 2020), so we also collected the data on annual household income as an objective indicator.

Data Analysis

All data were analyzed with IBM SPSS 25.0 for correlation, reliability, regression, and confirmatory factor analyses. We used Amos for SPSS to conduct confirmatory factor analyses and Hayes' PROCESS macro for SPSS to test the proposed serial mediation model.

RESULTS

Control of Common Method Biases

First, an anonymous online survey was adopted and questionnaires were distributed and collected at different times, which, in part, controlled common method biases. In addition, Harman's one-factor test was used to ensure statistical control. Exploratory factor analysis was used to examine the four variables. Therefore, the Harman single-factor analysis method was adopted in this study to test all variables, and principal component analysis was conducted. The results shown that the cumulative explanation rate was 63.13%, and there were four factors with eigenvalues greater than 1. The first common factor explains 32.28% of the total variance, which does not exceed 40%. Therefore, no serious problem exists among common method biases.

Measurement Model

Before the theoretical model was tested, confirmatory factor analyses (*CFA*) were performed with Amos to examine the discriminant validity of four key variables. As shown in **Table 2**, the proposed four-factor model (PPS; PS; NM; and ICB) revealed an acceptable fit (Model 1): ($\chi^2/df = 3.22$, $CFI = 0.92$, $TLI = 0.91$, $RMSEA = 0.07$) and fit better than alternative models (Models 2 to 4). The results showed significant discriminant validity for the four key variables. Furthermore, we examined the average variance extracted (*AVE*) and composite reliability (*CR*) of each variable: PPS ($AVE = 0.62$, CR = 0.8273), PS ($AVE = 0.5572$, CR = 0.8577), NM ($AVE = 0.46$, CR = 0.8729), and ICB ($AVE = 0.5994$, $CR = 0.8614$). The *AVE* values of variables, except for NM, are larger than 0.5, and the *CR* of all variables is over 0.8.

Correlations and Descriptive Statistics

Table 3 shows the descriptive statistics and correlations among the research variables. The results show that PPS is positively correlated with PS ($r = 0.138$, $p < 0.01$), NM ($r = 0.287$, $p < 0.01$), and ICB ($r = 0.118$, $p < 0.05$). PS is positively correlated with NM ($r = 0.391$, $p < 0.01$) and ICB ($r = 0.292$, $p < 0.01$). The results also indicated that NM is positively correlated with ICB ($r = 0.496$, $p < 0.01$).

Serial Multiple Mediation Analyses

We used model 6 of the PROCESS macro with 5,000 resamples to conduct a serial mediation analysis. We treated PPS as the independent variable (X), PS as the first mediator (M1), NM as the second mediator (M2), and ICB as the dependent variable (Y). The serial mediation model contains one direct effect ($X \rightarrow Y$) and three indirect effects (Ind1: $X \rightarrow M1 \rightarrow M2$, Ind2: $X \rightarrow M2 \rightarrow Y$, and Ind3: $X \rightarrow M1 \rightarrow M2 \rightarrow Y$).

Direct Effect Testing

According to the results, Hypothesis 1, which predicts a positive relationship between PPS and ICB, is not supported ($\beta = -0.049$, SE = 0.069, $p = 0.479 > 0.05$).

Mediating Effects Testing

First, as presented in **Figure 1**, the results suggest that the indirect effect of PPS on individuals' ICB through PS (Ind1: $X \rightarrow M1 \rightarrow M2$) is significant [$b = 0.27$, boot SE = 0.015, 95% CI = (0.0045, 0.065), excludes zero]. Furthermore, as shown in **Figure 2**, the indirect effect of PPS on individuals' ICB *via* NM (Ind2: $X \rightarrow M2 \rightarrow Y$) is significant [$b = 0.180$, boot SE = 0.036, 95% CI = (0.117, 0.260), excludes zero]. The results suggest that PS and NM exercise complete mediation, respectively,

TABLE 2 | Comparison of measurement models.

Model	Description	χ^2	*df*	χ^2/df	RMSEA	CFI	TLI
Model 1	Four factors: PPS, PS, NM, ICB	528.44	164	3.22	0.07	0.92	0.91
Model 2	Three factors: PPS + PS, NM, ICB	1060.93	167	6.35	0.11	0.80	0.77
Model 3	Two factors: PPS + PS + NM, ICP	1801.87	169	10.66	0.14	0.63	0.59
Model 4	One factor: PPS + PS + NM + ICP	2362.98	170	13.90	0.17	0.51	0.45

N = 466. PPS, perceived pandemic severity; PS, perceived scarcity; NM, negative mentality; ICB, irrational consumption behavior; RMSEA, root mean square error of approximation; CFI, comparative fit index; and TLI, Tucker-Lewis Index.

TABLE 3 | Descriptive statistics and correlations.

S. No.		*M*	*SD*	1	2	3	4	5	6	7	8
1.	Gender	1.75	0.43								
2.	Age	22.49	7.35	−0.105*							
3.	Occupation	2.93	0.55	0.053	−0.239**						
4.	Education status	4.69	0.70	−0.059	−0.206**	−0.136**					
5.	Family income	4.26	1.06	−0.040	0.024	−0.104*	0.071				
6.	PPS	4.56	0.56	0.151**	0.019	−0.008	0.093*	−0.003			
7.	PS	3.42	1.08	0.069	0.081	−0.014	0.122**	−0.042	0.138**		
8.	NM	2.98	0.91	0.158**	0.148**	0.015	−0.023	−0.007	0.287**	0.391**	
9.	ICB	2.11	0.93	0.046	0.140**	0.039	−0.039	−0.015	0.118*	0.292**	0.496**

*$p < 0.05$; **$p < 0.01$; $N = 466$. PPS, perceived pandemic severity; PS, perceived scarcity; NM, negative mentality; and ICB, irrational consumption behavior.

between PPS and ICB. Thus, Hypotheses 2 and 3 are partly supported.

Serial Mediating Effect Testing

As shown in **Figure 3**, the results of bootstrapping through the PROCESS macro indicate that the indirect effect of PPS on individuals' ICB *via* PS and NM (Ind3: X → M1 → M2 → Y) is significant [$b = 0.037$, boot SE = 0.014, 95% CI = (0.014, 0.071), excludes zero]. These findings indicate that mediating effects account for all the observed relationships between PPS and ICB. Therefore, the serial mediation effect is significant, and Hypothesis 4 is partly supported.

Overall, as presented in **Figure 4**, three hypotheses in this study are supported.

GENERAL DISCUSSION

The current study primarily investigated the influence of PPS on irrational consumer behavior in the noninfected general public during COVID-19 and the multiple mediating effects of PS and NM. The results shown that PPS influenced irrational consumer behavior through the indirect paths of PS and NM as well as through their serial mediating path.

Consistent with the previous study and our hypotheses, when the public perceives danger from their surroundings or other places, they are more likely to be motivated by PS, which in turn increases the possibility of irrational consumer behavior. This study indicated that although PPS cannot directly predict irrational consumer behavior, it can indirectly predict such behavior through the mediating role of PS. One possible explanation is that people's perception of pandemic severity primarily exerts a direct effect on their overall perception, which then affects their behavior through the weakening of their ability to perceive situations rather than by directly affecting people's behavior (Zheng et al., 2020). Based on the scarcity theory, due to the decreased circulation of external resources within a short time during a pandemic and the heightened perceived uncertainty of the external environment, individuals will develop a scarcity mentality when faced with resource scarcity, consequently weakening their ability to deal with other tasks (Kim et al., 2020). Thus, such individuals seek external stimuli to reduce their feelings of insecurity and panic, particularly stimuli, such as purchases, thereby producing irrational consumer behavior and hoarding. For example, individuals in a pandemic may lose their common sense in realizing what is useful for them, instead rushing to buy useless medicine and hoard daily necessities (Jang et al., 2015).

Multiple mediation analysis further revealed several reasons why PPS leads to the public's irrational consumer behavior. The first reason is that people perceive more scarcity during the COVID-19 pandemic. According to the scarcity theory, PS affects

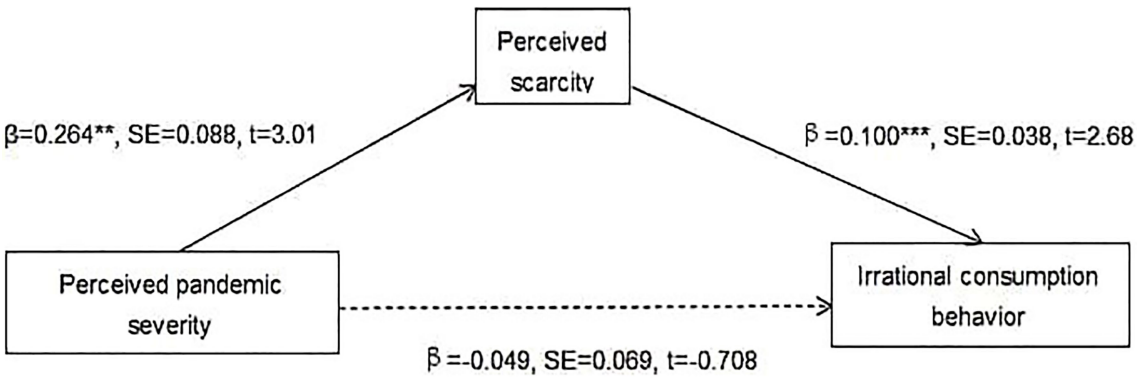

FIGURE 1 | Mediation effect of perceived scarcity (PS). **$p < 0.01$; and ***$p < 0.001$; full lines indicate significant paths; and dashed line indicates a nonsignificant path.

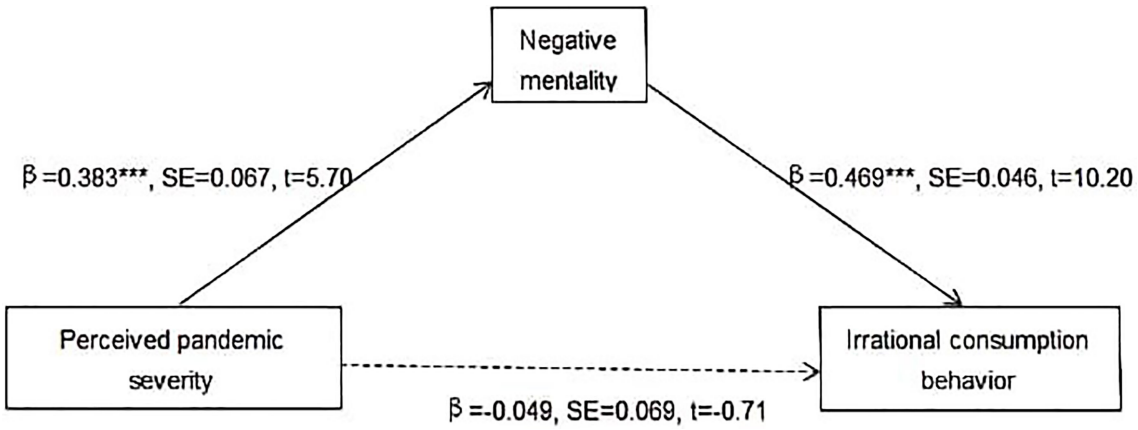

FIGURE 2 | Mediation effect of negative mentality (NM). ***$p < 0.001$; full lines indicate significant paths; and dashed line indicates a nonsignificant path.

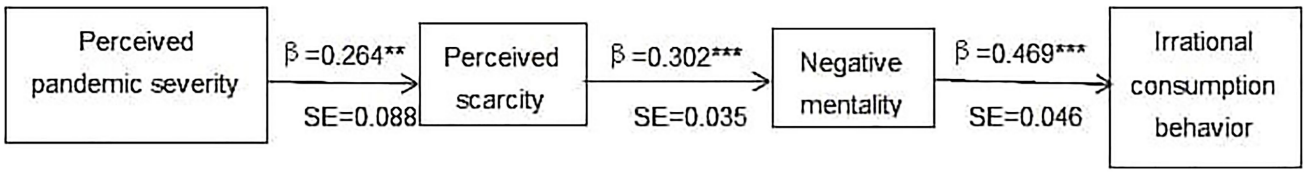

FIGURE 3 | Serial mediation effects of PS and NM. **$p < 0.01$; and ***$p < 0.001$; full lines indicate significant paths; and dashed line indicates a nonsignificant path.

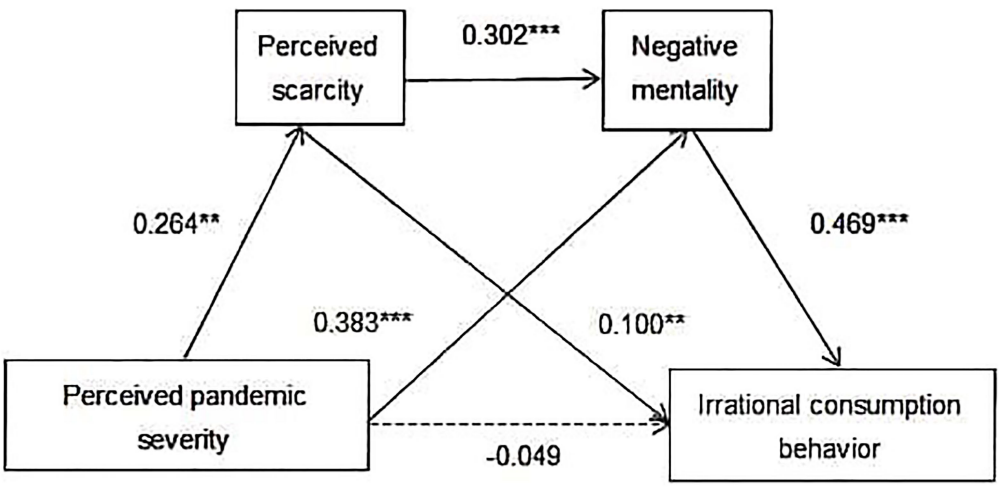

FIGURE 4 | Mediation effects of PS and NM. **$p < 0.01$; and ***$p < 0.001$; full lines indicate significant paths; and dashed line indicates a nonsignificant path.

individuals' thinking patterns, such as their cognitive ability, external perception, and emotions, thereby making them more prone to NM (Arafat et al., 2020). Specifically, the public tends to have relatively low perceptions of the available resources due to the disruption of COVID-19 to the resource supply and the threat to life posed by the virus (Ravi and Meng, 2016). For instance, there was a shortage of masks early in the COVID-19 pandemic. Most people who did not have masks felt their lives

threatened by COVID-19, resulting in a sense of worry and a high level of fear of the external environment. Moreover, the effect of chain mediation was stronger than the unilateral mediation of PS or NM, as shown by the public's stronger willingness to engage in panic buying and hoarding of certain goods.

Another reason is that people experience a negative mindset during the COVID-19 pandemic. NM is a kind of social mentality composed of the attitude and emotions that one holds toward oneself and social reality (Zhang et al., 2018). A NM means that the public is prone to feelings of insecurity and distrust as a result of the suddenness of the crisis within the external environment created by the epidemic (Kassaw, 2020). Individuals who are highly sensitive to the external environment are usually more susceptible to negative emotion and tend to seek external stimuli to ease such experiences during emergencies. Therefore, such individuals engaged in more irrational consumer behaviors during the epidemic (Gu and Luo, 2008). For instance, individuals received all kinds of negative information through friends or on the Internet during the pandemic that made them feel anxious and even experience trouble sleeping, which then led them to believe the various rumors that resulted in panic buying behavior as a psychological compensation for COVID-19 (Arafat et al., 2020).

LIMITATIONS AND FUTURE DIRECTIONS

Despite its contributions, this research has several limitations that leave room for future consideration.

First, all measurement scales in our study were adopted from previous studies, which reduced vague terms and item ambiguity to some extent. However, confounding variables should be addressed. For example, using questionnaires to collect data has some limitations and the possibility of causing recall bias. This study collected data from consumers during the period of COVID-19, but we could not collect data from the respondents while they were purchasing. Moreover, the data used in this study are cross-sectional, so it is still difficult to avoid common method bias by using this approach. Future research should collect data from multiple informants and adopt a more carefully controlled experimental design to investigate the relationship between the variables further.

Second, this research is limited to people from different provinces and cities in China, so it has limitations regarding cultural adaptation. COVID-19 is rampant and has a far-reaching impact worldwide. Although psychological/behavioral constructs are general, they may also be impacted by sociocultural factors. The results can therefore not be generalized to the population as a whole. Thus, in the future, data from different countries can be collected for further study, and culture-related variables can be introduced to conduct cross-cultural studies on individuals' ICBs in different countries and regions. For instance, Jovančević and Milićević carried out a cross-cultural study to examine the factors (e.g., optimism and pessimism) causing COVID-19-related behaviors (e.g., hoarding and preventive behaviors) in Serbia and Latin America (Jovančević and Milićević, 2020).

Third, this study focuses on researching individual ICB from the perspective of scarcity theory within emergent public health events. Although we believe that the scarcity mindset represents an important potential mechanism behind ICB, its mechanism of influence on public health emergencies can be evaluated from other perspectives. For example, individual differences might modulate the relationship between public health emergencies and their associated behavioral consequences. Shahjehan and Qureshi (2019) examined impulsive buying behaviors through the Big Five personality traits and found that people engaged in different levels of impulsive buying behavior had different personality traits (e.g., conscientiousness and neuroticism). Moreover, the impact of COVID-19 on individuals' ICB is a dynamic process (Franch-Pardo et al., 2020). The ICB of individuals will change with the intensity of COVID-19 and the government's policy guidance. For example, Oni et al. (2020) found that governmental interventions influenced residents' diet and physical activity behavior, as well as their buying behavior. Thus, subsequent studies should focus on additional factors, such as the governmental interventions and government's credibility (Bonneux and Van, 2006) to identify other potential mechanisms that influence individual ICB (Coninck et al., 2020).

CONCLUSION

The COVID-19 pandemic has caused changes in consumer behavior. Our study highlights the relationship between the perceived severity of pandemics and ICB. Through the application of scarcity theory, the current study proposes a model that elucidates the relationship between PPS and consumers' irrational consumer behavior.

To summarize, the results show that as: (1) Individual PS mediates the relationship between PPS and ICB. (2) NM mediates the relationship between PPS and ICB. (3) PS and NM operate as serial mediators between PPS and ICB.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethical standards of institutional review board at Guangdong University of Foreign Studies. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SH-L and HY-Q conceived and designed the experiments. HZ-X and WY-T performed the experiments. HY-Q and XP analyzed

the data. SH-L and WY contributed to reagents, materials, and analysis tools. HZ-X and WY-T wrote the paper. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.718797/full#supplementary-material

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The Cassandra Experience: A Mixed Methods Study on the Intragroup Cognitive Dissonance of Italian Expatriates During the First Wave of COVID-19

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In March 2020, Italy was the first European country to be hit severely by the first wave of coronavirus disease 2019 (COVID-19) and to put in place moderate-high containment measures. 594 Italian expatriates participated in a cross-sectional mixed-methods survey focusing on the period that goes from the beginning of March 2020 to the beginning of April 2020. The survey aimed to describe the experiences of participants when it comes to conflicting beliefs and behavior with the Italian or host country communities in relation to COVID-19, using the Intragroup Cognitive Dissonance (ICD) framework. We explored: (1) COVID-19 risk perception (assessed for themselves, the Italian community, and the host country community); (2) COVID-19 risk meta-perception (participants' perception of the Italian and host country communities' risk perception); (3) intensity of emotions (assessed for themselves); (4) national group identification (assessed for themselves in relation to the Italian and host country communities) before and after the first wave of COVID-19 in Italy. An inductive thematic analysis of three open-ended questions allowed an in-depth understanding of the experiences of Italian expatriates. Results describe the ICD of participants with the Italian or host country communities, expressed as a difference between COVID-19 risk-perception and risk meta-perception. ICD predicts that when a dissonance of beliefs and behavior is experienced within an individual's group, a shift in identification with another more consonant group will happen, if identity enhancing strategies with the dissonant group are unsuccessful. Our findings showed that when the ICD was experienced with the host country community, this was solved through a disidentification strategy and mediated by negative emotions. Identity enhancing strategies with the host country community were unsuccessfully enacted as described by the qualitative answers of participants referring to episodes of racism, ridicule, and to a Cassandra experience: predicting a catastrophic future without being believed. Unexpectedly, participants experiencing the ICD with the Italian community did not enact a disidentification strategy. An increase in

virtual contacts, enhanced sense of belonging, a stronger identification baseline, and different features of the two ICDs can be responsible for these results. This study sheds light on the relevance of ICD in natural settings and on international communities, during global crises.

Keywords: COVID-19, negative emotions, identity, expatriates, intragroup cognitive dissonance, Italian COVID-19 pandemic

INTRODUCTION

The coronavirus disease 19 (COVID-19) is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which first emerged in Wuhan, China at the beginning of December 2019 and rapidly spread all over the world (Shereen et al., 2020). COVID-19 was declared a pandemic on March 11, 2020 (World Health Organization, 2020) and it is considered the first documented coronavirus pandemic and the fifth documented pandemic after the 1918 flu pandemic (Liu et al., 2020). Between February 21 and 23, the number of confirmed COVID-19 cases in Italy sharply raised from 3 to 76 (World Health Organization, 2020). On February 29, the number of confirmed cases in Italy was 888 and Italy was the third most affected country all over the world after China and South Korea (World Health Organization, 2020). Italy remained the most affected country in Europe until April 04 with 119,827 confirmed cases (World Health Organization, 2020). On April 05, the number of confirmed cases in Spain (124,736) overtook that of Italy (124,632) and a surge of cases was registered all over Europe (World Health Organization, 2020). In May 2020, the Americas became the most affected area in the world (World Health Organization, 2020).

Thus, Italy was the most affected country in Europe and the third most affected country worldwide between the end of February 2020 and the end of March 2020 (World Health Organization, 2020). On February 24, Italy applied the first COVID-19 mitigation measures in Northern Italy (see Gobbi et al., 2020), about 15 days before any other country outside the Asia Pacific region. In the weeks ahead, Italy was internationally recognized as the European center of the pandemic. Italian media focused on the dangers of the COVID-19 disease, the importance of preventive measures, and the inability of hospitals to deal with the increasing flood of patients (Cinelli et al., 2020). In the same weeks, the progression of contagion in other countries led Italian scientific authorities to warn about the importance to acting immediately to avoid loss of lives (Saglietto et al., 2020). Italian expatriates might therefore have been exposed to a higher level of alarm than the other people living in the country of expatriation, *via* relevant relationships and media (Christiansen, 2004; Navarrete and Huerta, 2006; McKimmie et al., 2013). This might have led them to experience a contrast between their beliefs about the effects of the pandemic and those of the residents of the host country.

Social psychology could describe this experience of Italian expatriates in terms of cognitive dissonance theory (Festinger, 1957). Cognitive dissonance is described as a mental state in which two cognitive elements are in overt contrast with each other, thus generating an adverse feeling and a consequent need to solve the dissonance (Festinger, 1957). Cognitive dissonance can be influenced by intra-individual or intra-group processes. In the latter case, the behaviors of ingroup members provoke dissonance when they are against the attitudes of someone (Cooper and Stone, 2000; Mckimmie, 2015). Previous studies (Glasford et al., 2008, 2009) defined intragroup cognitive dissonance (ICD) as an adverse mental state determined by an inconsistency between an individual value or belief and the values, beliefs, or behaviors of the other members of the dissonant ingroup. Matz and Wood (2005) identified two drivers that lead individuals to seek consistency between their own beliefs and the ingroup beliefs: a normative driver and an informational driver. The normative driver refers to the desire to maintain harmony with other people in the ingroup. This entails conforming to the social norm, the compendium of the accepted and shared beliefs and attitudes within a group (Hovland and Rosenberg, 1960). The informational driver refers to the desire that personal beliefs and values are validated by the other members of the ingroup. When the consistency between personal beliefs and ingroup beliefs are violated, individuals can experience discomfort and negative emotions (Jetten et al., 2003; Matz and Wood, 2005).

Individuals can also provide strategies to reduce cognitive dissonance. Using a social identity framework (Tajfel, 1978; Tajfel and Turner, 1979), previous studies (Glasford et al., 2008, 2009) found that participants reduced their ICD by decreasing their identification with the dissonant group or engaging in pro-value activism (PVA, e.g., information sharing, persuasion). Similarly, Jetten et al. (2003) observed that participants in an ICD condition experienced a decrease in the intensity of negative emotions when allowed to shift from one group to another or persuade the other ingroup members.

In the current study, the ICD is employed as a theoretical framework to investigate risk perception, group identity, and emotions of Italian expatriates focusing on the period that goes from the beginning of March 2020 to the beginning of April 2020. Due to the early exposure of Italian expatriates to the COVID-19 emergency (*via* Italian media and significant relationships in the home country), the ICD was likely to be experienced by Italian expatriates, as a result of their split identity as Italians and as residents of their host countries. Risk perception is a subjective psychological construct depending on cognitive, emotional, social, cultural, and individual variables (Wildavsky and Karl, 1990; Slovic, 2010; Slovic et al., 1982). Risk perception is an important determinant of the willingness of individuals to embrace health-protective behaviors, according to the protection-motivation theory (Rogers, 1975). Recent findings (Dryhurst et al., 2020) showed that the perception of COVID-19 risk correlated with personal experience with

the virus, individualistic and prosocial values, hearing about the virus from friends and family, trust in government, science, and medical professionals, personal knowledge of government strategy, personal and collective efficacy. Social amplification through friends and family was also found to be a significant determinant. Therefore, when the COVID-19 surge of cases in Italy was reported, Italian expatriates who were in contact with their loved ones and exposed to Italian media could have been subject to different attitudes toward COVID-19 than other Italians and the community of their host country. This could lead to ICD with at least one of the two groups and therefore a rise in the intensity of negative emotions (Jetten et al., 2003; Matz and Wood, 2005). The cognitive dissonance might have been solved through disidentification with the most dissonant group and identification with the most consonant group (Glasford et al., 2008, 2009).

The first aim of this study was to describe ICD effects in Italian expatriates by testing the hypotheses that within Italian expatriates the ICDs, i.e., with the Italian community and with the host country community (residents of the host country), correlated to an increase in negative emotions (Hypothesis 1) and that negative emotions were negatively associated with a shift in identification with the Italian or host country community (Hypothesis 2). We also tested the hypothesis that negative emotions partially mediated the relationship between the ICDs of Italian expatriates and the shift in communities identification. Specifically, we assumed that negative emotions activated by the ICDs decreased identification with the dissonant community, and increased identification with the consonant community (Hypothesis 3).

For a better understanding of the real-life ICD phenomenon, we integrated quantitative questions with qualitative questions. Therefore, the second aim of this study was to explore and describe the in-depth personal experience of Italian expatriates with the first wave of COVID-19 in the period examined. This was intended to allow a more detailed picture of the peculiar historical moment explored in this study and possibly inform future research and hypotheses. The qualitative questions depicted the self-reported experience of Italian expatriates concerning risk perception, relationships, and emotions during the COVID-19 emergency in Italy.

MATERIALS AND METHODS

A cross-sectional mixed-methods online survey in the Italian language was developed using MS Forms. This was a self-report survey comprehensive of 21 questions of which 18 were close-ended and 3 were open-ended. The questions were allocated into four sections, namely, demographics, perception of COVID-19 risk, sense of belonging and identity, and feelings and emotions. A final section on coping strategies was also present but will be the subject of further analysis following the current study. Consent approval was the only mandatory field in the survey. Data were collected between March 18, 2020 and April 06, 2020.

Participants

A total of 627 Italian expatriates over the age of 18 and legally able to express their consent, voluntarily participated in the study. To be included in the study participants had to be Italian citizens and reside abroad in any country other than China and South Korea at the time of the study. Eight people opened the link but did not give their consent to participate. Seven participants answered less than 80% of quantitative questions and were therefore excluded from the analysis. For the remaining participants, missing values were computed through the R package "mice" (Van Buuren and Groothuis-Oudshoorn, 2011). We controlled for invariance of answers and multivariate outliers. No response was excluded due to invariance. To investigate multivariate outliers, we calculated Mahalanobis distances. In our dataset 20 cases had a distance score exceeding the critical value (df = 35, $\chi^2 = 66.62$, $\alpha = 0.001$). Three participants were excluded as they were living in Italy (2) or in China (1) at the time and two were excluded as no data was available on the country they were currently living in, therefore not fulfilling our inclusion criteria. One participant was excluded from the analysis because of the low quality of qualitative answers.

The remaining 594 participants included 423 women (71.3%), 165 men (27.8%), 3 non-binary (0.5%), and 2 preferred to not answer (0.3%). The mean age was 33.54 ($SD = 9.13$). A breakdown of the host countries of the respondents and their occupational sector is available in a dedicated additional material page on Open Science Framework (OSF[1]). Participants were recruited using two procedures. First, two of the researchers joined different Facebook groups where Italian expatriates or those wishing to relocate, share information and life experiences. Facebook groups were chosen among different cities and countries within and outside the EU. Researchers consistently shared a designated social network post that was subject to the approval of group moderators and which reported the participant inclusion criteria for this study. Second, two researchers independently emailed a designated invitation letter to a cc-blind list of public contacts of Italian expatriates. The list of the Facebook groups joined by each researcher, social network posts, and invitation letters are provided on the Open Science Framework page of the study[1].

Measures

Risk Perception

The self perception of risk was determined on a single item by asking participants how much they thought that COVID-19 was a threat to their own health on a Likert scale from 1 (very low) to 5 (very high).

Risk perception is defined as how much Italian expatriates think that COVID-19 is an actual threat to the Italian community and the host country community. This was determined by asking participants to estimate on a Likert scale from 1 (very low) to 5 (very high) how much they thought that COVID-19 was a threat to: "friends living in Italy"; "Italian citizens"; "friends living in the host country"; "citizens of the host country." Risk perception for the Italian community was calculated by averaging the answers "friends living in Italy" and "Italian citizens." To calculate

[1]https://osf.io/682a3/

reliability in all the two-item cases we used the Spearman-Brown split-half reliability formula, as suggested by Eisinga et al. (2013). For the risk perception of the Italian community, $\rho = 0.69$. Risk perception for the host country community was calculated by averaging the answers "friends living in the host country" and "citizens of the host country" ($\rho = 0.80$).

Risk Meta-Perception

Risk meta-perception is defined as how much Italian expatriates think that the Italian community and the host country community see COVID-19 as a threat. We asked participants to indicate on a Likert scale from 1 (very low) to 5 (very high) how much they thought that different groups considered COVID-19 as a threat. We collected this in relation to "friends living in Italy"; "Italian citizens"; "friends living in the host country"; "citizens of the host country". The risk meta-perception of the Italian community was calculated by averaging the answers of participants for "friends living in Italy" and "Italian citizens" ($\rho = 0.68$), while the risk meta-perception of the host country community was calculated by averaging the answers for "friends living in the host country" and "citizens of the host country" ($\rho = 0.78$).

Intragroup Cognitive Dissonance

The ICD was calculated as the expression of the difference between risk perception and risk meta-perception in both Italian and host country communities.

Emotions

Participants were asked to indicate the self-reported intensity of a comprehensive range of 20 emotions experienced during the COVID-19 pandemic on a Likert scale from 1 (very low) to 5 (very high). To obtain more meaningful measures, the total number of 20 emotions was reduced by aggregating emotions scores through a Principal Component Analysis in R through the *fa*() function provided by the psych package (Revelle, 2015). The screen plot suggested a 3 factors solution, explaining 42% of the total variance. After varimax rotation Factor 1 was highly loaded to restlessness (0.85), fear (0.82), anxiety (0.75), sense of unsafety (0.71) low mood (0.69), sadness (0.60), frustration (0.57), isolation (0.48), and was labeled "negative emotions". Factor 2 was highly loaded to joy (0.78), happiness (0.73), serenity (0.63), and fun (0.63) and was labeled "positive emotions". The third factor showed high loadings to disappointment (0.71) and anger (0.65) and was labeled "oppositive emotions". Only the negative emotions factor has been used for the models presented in this study. The scale included eight items and reported an alpha reliability value of 0.89.

Group Identification

We used single before-after items to ask participants on a Likert scale from 1 (not important) to 5 (very important) the importance given to the identification with the Italian community and with the host country community, before and after the COVID-19 Italian crisis. We calculated the shift in the identification with both groups as the expression of the difference between before and after items. It is important to note that the identification reported before the pandemic was measured retrospectively, therefore participants could only indicate their previous identification as a memory. This represented a weakness of the measure.

Qualitative Topics

A set of three open-ended questions was provided at the end of each of the following sections in the questionnaire.

(1) Perception of COVID-19 risk: participants were asked to provide additional information about the perception of COVID-19 risk and any difference between them and the following: "friends living in Italy"; "Italian citizens"; "friends living in the host country"; "citizens of the host country".
(2) Relationships: participants were asked to provide additional information about any perceived difference in their relationships with the following: "friends living in Italy"; "Italian citizens"; "friends living in the host country"; "citizens of the host country."
(3) Feelings and emotions: participants were asked to provide additional details regarding the emotional experience during the first phases of the COVID-19 emergency in Italy.

Analysis

Quantitative Data Analysis

Data analysis was conducted using R software (R Core Team, 2019) and the R studio GUI (RStudio Team, 2020). The suite of packages tidyverse[2] (Wickham et al., 2019) was extensively used for data wrangling and data visualization. A path analysis was used to test our three hypotheses using the *lavaan* package (Rosseel, 2012). For all the other quantitative data analyses the base R package stats was employed. The model tested is presented in **Figure 1**. In the model, the ICD with both the Italian community (Path A) and with the host country community (path B) positively associated with negative emotions (H1). Negative emotions predicted the shift in identification with both the host country community (path G) and the Italian community (path H; H2). Negative emotions partially mediated the relationship between the ICDs and the identification with both communities. The ICD with the Italian community is predicted to negatively affect the shift in identification with the Italian community (Path C) and positively affect the shift in identification with the host country community (path D). Vice versa, the ICD with the host country community is predicted to positively relate to the shift in the identification with the Italian community (path E) and to negatively affect the shift in the identification with the host country community (path F), as H3 assumed. The following covariances were also controlled: self perception of risk and the ICD with both the Italian community (1) and the host country community (2); self perception of risk and negative emotions (3); the covariance between the ICDs with the Italian and the host country communities (4); and the covariance between identification shifts with the Italian and host country communities (5).

[2]https://www.tidyverse.org/

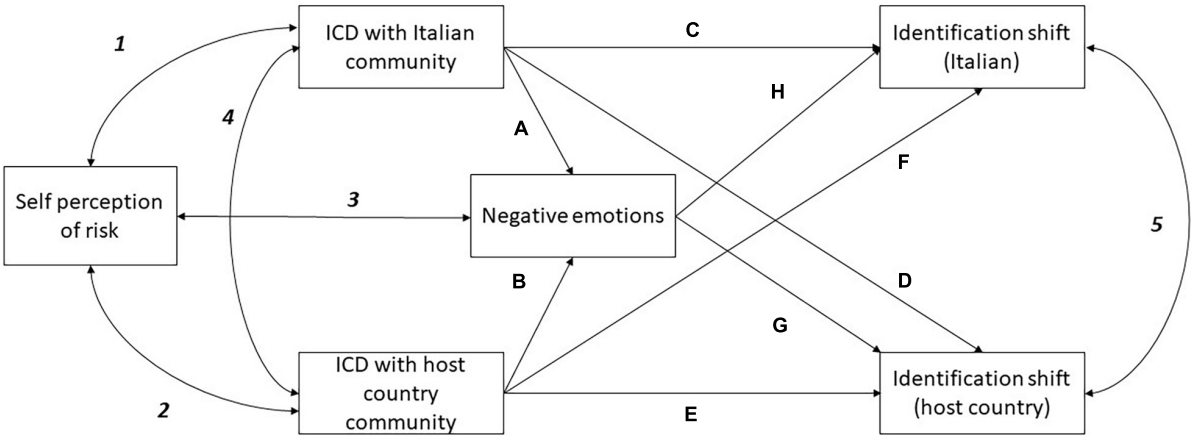

FIGURE 1 | Path model for Hypothesis testing.

Qualitative Data Analysis

For in-depth analysis of qualitative answers collected in this survey, we used an inductive thematic analysis approach (Braun and Clarke, 2006) in which coding and themes were generated without a pre-existing coding scheme. Management and analysis of answers were performed using Nvivo software (QSR International). Analysis began with data immersion, wherein responses were checked and anonymized where necessary. After this, line-by-line coding was conducted. Where the same ideas were identified it was given a code. Codes were subsequently aggregated and themes were identified. The themes were then checked by a second author. The authors that performed and overviewed these analyses have a background in Clinical and Organization Psychology.

TABLE 1 | Mean, standard deviation, and zero order correlations of considered measures.

	M	*SD*	1	2	3	4	5	6
1 Self perception of risk	2.74	1.02	1					
2 ICD with Italian community	−0.17**	0.89	0.31***	1				
3 ICD with host country community	1.06**	1.00	−0.07	−0.40***				
4 Negative emotions	−0.01	0.93	0.21***	0.15***	0.10*	1		
5 Identification shift (Italian)	0.33**	1.07	−0.01	−0.01	0.19***	0.20***	1	
6 Identification shift (host country)	−0.19**	1.09	0.00	−0.01	−0.13**	−0.12**	0.08	1

For cognitive dissonances and identification shifts we also report if the means are significantly different from zero.
**p< 0.05, **p < 0.01, and ***p <0.001.*

RESULTS

Descriptive Analysis

Table 1 shows the *M*, *SDs*, and zero-order correlation for each of the variables employed. The difference between the risk perception and risk meta-perception was significant for both the Italian community (ICD with Italian community) and the host country community (ICD with host country community). However, the Italian community risk meta-perception was on average higher than the relative risk perception, [$t(593) = 4.704$, $p < 0.001$, $d = 0.14$], while the risk meta-perception of the host country community was lower than the relative risk perception, $t(593) = -15.626$, $p < 0.001$, $d = -0.63$), showing that Italian expatriates believed that the risk perceived by the Italian community was higher than the actual risk and that the risk perceived by the host country community was lower than the actual risk.

Also, participants overall felt more identified with the Italian community after rather than prior to the COVID-19 outbreak, [$t(593) = 7.26$ $p < 0.001$, d = 0.29) and less identified with the host country community, [$t(593) = -4.25$, $p < 0.001$, $d = 0.13$).

Path Analysis: Model Testing

Path analysis with listwise deletion of missing cases showed that the model has an excellent fit with data [$\chi 2$ (2, $N = 598$) = 1.019, $p = 0.413$; CFI = 1.00; RMSEA = 0.00)] RMSEA resulted not significant ($p = 0.751$, 90% confidence interval: 0.00–0.067), which is always the case when the Chi-Squared value is smaller than the degree of freedom (Kenny, 2020). The upper and lower limits of the confidence interval are conventionally considered good (Kenny, 2020). All the expected paths were significant except for the one (D) linking the ICD with the Italian community with shifts in identification (**Figure 2**). As expected, regardless of groups the ICD positively correlated with negative emotions (H1). Negative emotions negatively correlated with the shift in the identification with the host country community as expected (H2), but positively correlated with the shift in the identification with the Italian community. Moreover, as expected by H3, the ICD with the host country community negatively correlated with the shift in identification with that group, and positively correlated with the shift in identification with the Italian community; thus, negative emotions partially

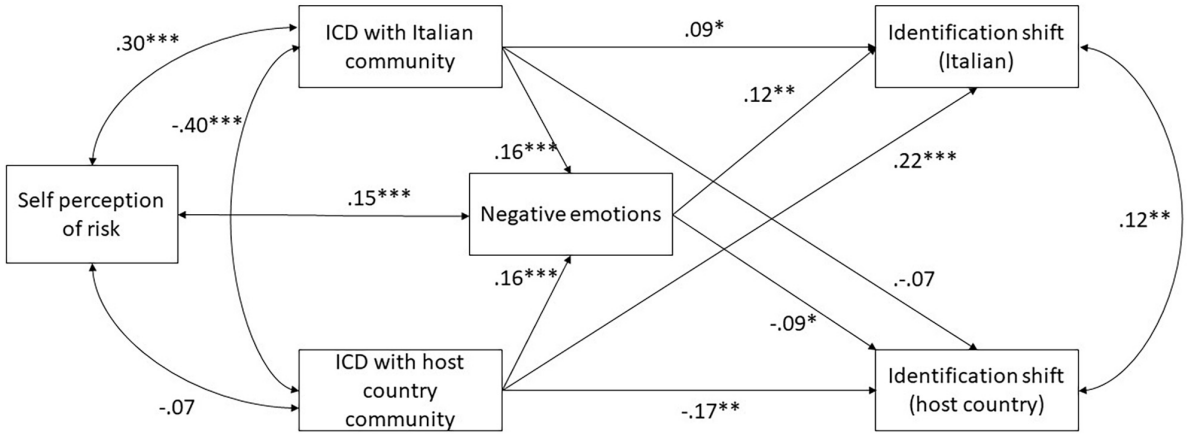

FIGURE 2 | Results of path analysis.

mediated the relationship between the ICD with the host country community and the shift in identification with both groups. However, the ICD with the Italian community presented with an unexpected result. It significantly increased the identification with the Italian community rather than decreasing it. Mediation effects of negative emotions were all significant except the one between Italian expatriates and the host country. In the ICD with the Italian community case, negative emotions significantly and totally mediated its association with shift in both identifications. Nevertheless, contrary to our H3, in this case, negative emotions increased identification with the Italian community and decreased identification with the host country community. The full covariance matrix and the details on the estimates for each parameter are published on the OSF page: see text footnote 1.

Qualitative Results

Five themes were identified during the inductive thematic analysis of the qualitative answers given to the questionnaire. 232 participants answered the first open-ended question (Q1) which related to the perception of COVID-19 related risk. 172 participants answered the second open-ended question (Q2) which related to possible (if any) experienced changes in relationships and contact with other people. 121 participants answered the third open-ended question (Q3) which related to the emotions experienced during the COVID-19 emergency. The total of qualitative answers was 525.

The themes are described below. All the reported quotes generated from the answers given to the questionnaire are translated from Italian to English unless otherwise specified. No location name is reported.

(1) Cassandra Experience, Early Measures Undertaking, Racism, and Ridicule

This theme relates to the perception of foreseeing the future without being believed: "*I felt like I wasn't believed when I said to stay home*" (*Participant 119, Q1*) and includes the perceptions of Italian expatriates in relation to racism and ridicule episodes enacted by the host country community during the COVID-19 crisis in Italy. Comments specifically referred to the Greek myth of Cassandra: *"I was under the impression of being considered by my friends as the Ancient Greeks considered Cassandra, the unheard prophet who only predicted bad news" (Participant 148, Q1)*. Repeatedly Italian expatriates reported having adopted individual COVID-19 containment measures earlier than the host country community: *"Italians (here) started before than locals to limit traveling and social contacts, even before containment measures were put in place" (Participant 106, Q1)*; *"Many Italians started to self-isolate on their own, before the lockdown" (Participant 499, Q1)*, using Italian sources of information: *"I constantly look at Italian news and try to adopt rules suggested by the Italian government" (Participant 118, Q2)*.

Episodes of racism were often reported: *"I am from (Italian city), people who know this (here) don't even say "hello" anymore"; "I felt uncomfortable when talking on the phone in my mother language people started to give me bad looks" (Participant 619, Q2)*. Along with racism, episodes of ridicule were often mentioned: *"I have been discriminated against and people made fun of me" (Participant 215, Q1)*; *"They step back if they see you in a mask and some even laugh at you" (Participant 483, Q1)*. These were associated with a perceived arrogance of the host country community: *"Unable to understand how the virus was going to behave, they arrogantly said that (host country) was better than Italy" (Participant 482, Q1)*. There was a reported perception that the host country community considered COVID-19 exclusively an Italian problem: *"Here it looked like locals pitied Italy without understanding the situation in their own country. In news Italy was depicted as caught up in a social psychosis" (Participant 213, Q1)*, similarly to what happened with Chinese nationals: *"I experienced the same situation with Chinese people. . .I thought they were exaggerating" (Participant 182, Q1)*.

(2) Underestimation of Covid-19 Risk

This theme relates to the perceived underestimation of COVID-19 risk by the host country community: *"My (host country) underestimated the risk since the beginning" (Participant*

212, Q1); *"Initially largely underestimated. Now increased containing measures have increased perception of the risk, but it is still too low compared to what I think it should be" (Quote originally in English, Participant 27, Q1)*, particularly of its health risks: *"I see too many kids around who don't realize that they could represent a threat to their (older) relatives" (Participant 42, Q1)*; *"I feel like (host country people) do not engage in safe behaviors despite my fear of the Covid-19 contagion (I have asthma)" (Participant 481, Q2)*. Most participants reported a delay in implementing containment measures in the host country: *"Only a few measures have been taken and with a huge delay" (Participant 625, Q1)* and a slow risk perception: *"Risk perception here does not seem enough, despite the risk evidence" (Participant 95, Q1)*. Some of them reported that at the beginning of the pandemic they personally underestimated the COVID-19 risk: *"At the beginning, I underestimated the situation too, up until Italy went into lockdown" (Participant 218, Q1)*. Participants also referred to misinformation: *"(Here) the population has not been informed enough" (Participant 321, Q1)* and unclear communication by the media in the host country: *"I have difficulties to get information about the exact number of cases in my county" (Participant 118, Q3)*. Other participants reported that there was inconsistency between population risk perception and the introduction of containment measures by the government of the host countries: *"It was underestimated by people and government at the beginning. Containment measures were then activated in time, but people's perception of risk is still insufficient" (Participant 594, Q1)*; *"In my host country, despite the government not introducing containment measures, people are being good citizens" (Participant 400, Q1)*.

(3) Increase of Contacts

This theme relates to changes in the frequency and/or quality of contacts with friends and/or family determined by the COVID-19 emergency: *"Having lost my job, I managed to be in contact more frequently with friends and family in Italy and with friends and colleagues in my host country" (Participant 39, Q2)*. The increase of contacts was mostly related to family and friends living in Italy: *"We are more in contact, we try to stay close especially with friends and family in Italy" (Participant 133, Q2)*; *"I call my family much more often and I am in contact every day with friends in Italy to check on them" (Participant 54, Q2)*, followed by friends and family living in the host country or other countries: *"I have more contacts with friends and family in Italy but also with friends living in other countries who are facing the same experiences" (Participant 11, Q2)*. Some of the participants reported an increase in contacts with other Italian expatriates living in the host country: *"With this situation, relationships between Italian expatriates consolidated much more, given that we were all in the same situation" (Participant 264, Q2)*. Some participants along with reporting an increase of contacts with people in Italy also reported a decrease of contacts with the host country community: *"My relationship with friends and family in Italy has intensified. In my host country, I had only few relationships, based primarily on casual meetings and some chats, things that do not happen anymore" (Participant 553, Q2)*. One participant reported a decrease of contacts with family and friends in Italy caused by anxiety [see also: theme (4)]: *"Lately I can't call my family and friends very often because I experience anxiety and a bad mood when I call them" (Participant 35, Q2)*. There was a reported change in the content of calls: *"More sensitivity to health topics* (e.g., *Are you ok? How is the isolation going?)" (Participant 335, Q2)* and communication methods: *"More relationships via the web" (Participant 103, Q2)*.

(4) Prevalence of Negative Emotions, Followed by Positive and Mixed Emotions

This theme relates to the emotional experience of participants. Most of the experiences related to negative emotions: *"Lost, nervous and very confused. I don't know how to react to the whole situation" (Participant 11, Q1)*. Negative emotions were predominantly associated with a preoccupation with loved ones living in Italy: *"preoccupation with their family in Italy unites all Italian expatriates" (Participant 367, Q2)*, preoccupation with the healthcare system of the host country: *"healthcare here is awful" (Participant 35, Q1)*; *"I feel very worried, should anything happen to me here I'd die for sure, they won't take care of me" (Participant 537, Q1)* and life disruption:*"(the closure of places) has a huge impact on my everyday life" (Participant 551, Q3)*. Losses of relatives were reported: *"I've lost two relatives" (Participant 185, Q1)* and change in life decisions: *"I started to question my decision of living abroad" (Participant 198, Q2)*. Fear for economy: *"My preoccupation, being young and healthy, is mainly with economic repercussions" (Participant 530, Q3),* and critics to Italy were also mentioned: *"Italy is sinking itself not only at the healthcare level but also at the economic level" (Participant 117, Q3)*. Comments related to the perception that economy was preferred over health in the host country: *"(here) they're more preoccupied of the impact on the economy of the country than of coronavirus risks" (Participant 529, Q2)*. The preoccupation with present and future was also reported: *"preoccupation with present and near-long future" (Participant 16, Q1)*, along with anger at the host countries: *"I felt angry listening to the words of authorities stating that Italy's containment measures were excessive" (Quote originally in English, Participant 28, Q1)*. Nostalgia was also reported: *"real nostalgia, that makes you appreciate every call or text" (Participant 316, Q2)* and fear of infecting relatives should Italian expatriates return to Italy: *"I fear returning home (to Italy) because this would increase my risk of being infected and therefore infecting (my parents)" (Participant 21, Q1)*.

Despite all of this, positive emotions were often mentioned with a predominance of pride for Italy: *"I am proud of how the Italian government acted fast and with strong containment measures" (Participant 28, quote originally in English, Q3)*; *"I am increasingly proud of my country (Italy)" (Participant 215, Q3)* and validation of the host countries COVID-19 response: *"I am in good hands" (Participant 509, Q1)*: *"I feel safe" (Participant 611, Q1)*. Participants also mentioned to have experienced relief when measures were undertaken in their host country, especially when measures were similar to the ones adopted in Italy: *"in a short time containment measures were adopted and similar to the Italian ones: I felt relieved and with a revenge sensation" (Participant 182, Q3)*, and to find comfort in other Italian expatriates: *"My sole source of comfort was my Italian friends in the host country who were able to understand what was happening"* (*Participant*

198, Q1). Mixed emotions were also reported: *"At the moment we are numbed by anger but I am actually starting feeling some beneficial effects" (Participant 10, Q3)*; *"Often contrasting and swinging emotions" (Participant 132, Q3).*

(5) Sense of Belonging

This theme relates to a reported sense of common will and belonging to a community: *"This common feeling united people" (Participant 367, Q2)*; "*Very High sense of Belonging" (Participant 5, Q1)*. Most of the time this was referred to the Italian community: *"Increased closeness with Italian friends" (Participant 120, Q2)*. Participants reported feeling closer to the Italian community and expatriates even in the presence of a previous greater or good identification with the host country community: *"I never really felt Italian. I ran away (here) when I was 18, but now I also feel Italian" (Participant 321, Q3); "to me, it has always been important to be part of the host country community. During the emergency, however, I felt stronger my closeness to Italian expatriates" (Participant 137, Q2)*. However, one participant mentioned that the emergency increased their sense of belonging to both communities: *"Emergency increases the sense of belonging to the original community (Italian) and the host country community"(Participant 400, Q2).* There was also a reported sense of belonging without national distinctions: *"This made me discover the feeling of living in a community without national distinctions" (Participant 87, Q2)*.

DISCUSSION

Summary of Results

Quantitative

Quantitative results of this study showed that the ICD with both the Italian community and host country community determined an increase in the intensity of negative emotions experienced by Italian expatriates. However, the ICD was associated with the hypothesized shift in identification only when experienced with the host country community. Conversely, the ICD with the Italian community produced an unexpected shift in identification in favor of the Italian community rather than the host country community. Negative emotions partially mediated the ICD with the host country community and the shift in identification with both groups. Finally, the identification of Italian expatriates with the Italian community was stronger than with the host country community even before the pandemic.

Qualitative

The qualitative results of this study outlined that many Italian expatriates started to perceive COVID-19 as dangerous and implemented the containment measures before the host country community, mostly referring to Italian sources of information and distrusting host country sources [themes (1) and (2)]. This led to a perception of foreseeing the future and feeling "*like Cassandra" (Participant 51, Q1)* referring to the Greek heroine who predicted a catastrophe but was not believed by her fellow citizens [theme (1)]. This perception was echoed by reported experiences of racism, ridicule, and arrogance enacted by the host country communities [theme (1)]. In addition, a reported concern that the host country community was underestimating the COVID-19 health risk was identified [theme (2)]. An increase of contacts, mostly online, was also identified, moreso with the Italian community than with the host country community [theme (3)]. Negative emotions were mostly related to preoccupation with loved ones living in Italy and with the healthcare system of the host country, and sometimes they led to questioning life decisions such as living abroad [theme (4)]. However, fear for the economic consequences of the COVID-19 emergency and criticisms of the Italian response were also mentioned [theme (4)]. Despite this, positive emotions were reported and associated with pride for the Italian response to the emergency. This sentiment was not associated with the host countries. However, the host countries were sometimes associated with a sense of security and good management. Finally, an increased sense of belonging was mentioned and was mostly referred to the Italian community, even alongside with a good identification with the host country community [theme (5)].

Interpretation of Results

This study demonstrated that ICD effects can be found in real-life situations, but differently from laboratory findings, other uncontrolled variables may also play a role in the ICD effects. For instance, this study found a Cassandra experience, indicating that Italian expatriates perceived that people in the host country did not believe them when they remarked the dangerous health risks of COVID-19, potentially undermining their attempt to maintain good identification with the host country community. Their situation was similar to that of Cassandra, the Trojan heroine who was aware of the danger determined by bringing the wooden horse of Greeks within the city walls, but who was cursed not to be believed (Schapira, 2016). Confirming previous literature, this study shows that when the consistency between personal beliefs and group beliefs is violated, individuals experience ICD, leading to discomfort and negative emotions (Jetten et al., 2003; Matz and Wood, 2005). Furthermore, in line with previous literature (Glasford et al., 2008, 2009), this study showed that decreasing identification with the dissonant group was a chosen strategy among Italian expatriates experiencing the ICD with the host country community. However, this was not the chosen strategy when participants were experiencing the ICD with the Italian community. On the contrary, this study showed an unexpected increase in identification with the Italian community, despite the ICD with this community.

These findings showed that strategies to solve ICD can vary according to the group with which the ICD is being experienced. When the ICD was experienced with the host country community, this was solved through a disidentification strategy. This is in line with previous literature showing that ICD is solved through disidentification with the most dissonant group and identification with the other (Glasford et al., 2008; 2009). Unexpectedly, the ICD with the Italian community did not produce a disidentification with this community. This unexpected result may be due to a major identification with the

Italian community, constituting a major source of self-esteem, as postulated by the Social Identity Theory (Tajfel, 1978).

Qualitative results from this study confirm this interpretation. In theme (5) we were able to identify experiences of good baseline identification with the host country community. In theme (1) it was also reported that Italian expatriates were trying to raise awareness in their host country communities of the risks connected with COVID-19, indicating that actions to promote group identification were enacted. However, these actions were not positively valued by members of the host country community. On the contrary, experiences of ridicule and racism were reported, leading to a Cassandra experience [theme (1)]. Cassandra represents a violation of the two factors shown to play a role in group identification: the normative and informational drivers (see Matz and Wood, 2005). On the one hand, Italian expatriates who were experiencing the ICD with the host country community perceived a violation of their desire to maintain harmony with other people of their group (normative driver). On the other hand, the perception of not being believed, as well as the racism and ridiculing actions enacted by the other members of the host country community represented a violation of the desire that personal beliefs and values were validated by the other members of their group (informational driver).

Quantitative analysis showed that Italian expatriates had stronger and more stable national group identification with the Italian community than with the host country community even before the pandemic. Previous literature shows that the identification with new national communities is a complex phenomenon that might involve the amount of time spent in a territory, beliefs of an individual, and their willingness to move or relocate (Faist, 2000; Gustafson, 2006; Castles et al., 2014). We amplify these results showing in our qualitative analysis how experiences of integration are threatened by the ICD with the host country community. A qualitative study published in 2015 (Scotto, 2015) outlines that Italian expatriates show an overall sense of belonging and participation in Italian public affairs and emotional bonding with their homeland. This is echoed by the qualitative results of this study which showed a sense of belonging to the Italian community and interest to maintain contacts with the homeland [themes (3) and (5)]. This might explain why the ICD with the Italian community, although emotionally challenging [theme (4)], did not affect their identification with this national group. Conversely, the identification with the host country community, already being subject to integration processes more recently acquired, might have been weaker and therefore more susceptible to shifts if cognitively and emotionally threatened.

Qualitative findings in this study pointed out that participants were experiencing an overall increment of contacts with family and friends, most of them living in Italy [theme (3)]. This might have contributed to keeping the identification with this community high and undermined the identification with the host country community, with which contacts were decreased. However, an increment of the communication might also be an effect of an already strong baseline identification with the Italian community. In addition, qualitative results showed that positive emotions such as pride for the Italian response to COVID-19 were reported. These might have played a role in the willingness of participants to shift their identification in favor of the Italian community. Despite positive emotions associated with the host country [theme (4)] such as "feeling safe", most of the comments related to negative emotional experiences concerning the healthcare systems of the host countries [theme (4)]. While this might seem contradictory, based on our analysis the perception of feeling safe was related to the perceived attention to economic consequences by the host country, while the preoccupation with the healthcare system of the host country was related to the perceived underestimation of the COVID-19 risk.

Based on our qualitative results that suggest that the ICD with the host country community bared the perception that the host country community was underestimating the COVID-19 health risk [theme (2)], while the ICD with the Italian community bared mostly preoccupation with economic consequences [theme (4)], we suggest that the ICD with the Italian community was smaller in terms of magnitude, impacts, and consequences in comparison to the ICD with the host country community. The ICD with the Italian community related to the perception that this community was overestimating the COVID-19 risk and was marginal in both quantitative and qualitative data.

COVID-19 containment measures relate to decreasing the proximity of people and increasing personal hygiene and can determine indeed the closure of places in which people congregate, including shops, retail establishments and theatres, causing economic struggle (Pak et al., 2020). Although Italian expatriates might have been affected by the economic and psychological consequences of COVID-19 measures in Italy, not being in direct contact with the Italian community might have limited their effect. Conversely, the health risk of COVID-19 might have had a major effect on Italian expatriates who were experiencing an ICD with the host country community, given their direct contact with this community. In other words, if an ICD with the host country community could represent the exposure to behaviors that were considered unsafe and health-threatening by Italian expatriates (e.g., not following the social distancing measures; not wearing a face covering), this could not be true for the ICD with the Italian community. Recent studies have challenged some aspects of the Cognitive Dissonance Theory, as empirical findings suggested that people can use subtle tactics of negotiations to deactivate the conflict generated by inconsistent ideas (Panagiotou and Kadianaki, 2019). When the sense of urgency was enhanced by concrete personal and community threats, as in the case of the more relaxed behaviors of the host country community toward COVID-19, these more nuanced tactics might have been less likely to be applied, contributing to the disengagement from the host country community. Furthermore, we only explored the differences in the COVID-19 risk perception, but other elements and emotions (particularly, mixed emotions) towards the host or the Italian communities (see Santos et al., 2021) might have played a role in creating an even more contradictory picture. In theme (4) of this study, participants refer to mixed emotions but these were not mentioned in relation to the Italian or host country community but rather to the COVID-19 pandemic in

general. It is worth mentioning that a limitation of this study is represented by the way participants reported their identification. While participants reported the identification with the Italian community and the host country community in real-time, they also reported their identification with the two groups before the pandemic as a memory and this is subject to potential distortion.

CONCLUSION

This study shed light on the experience of Italian expatriates living through the COVID-19 emergency in another country when Italy was the first European country to be hit severely by the first wave of this pandemic. A combination of quantitative and qualitative methods depicted the complexity of the historical moment in terms of its contribution to social psychology. The COVID-19 emergency has helped to demonstrate the relevance of ICD in natural settings and on a larger social scale. Using this theory, we were able to correctly predict the shift in identification of Italian expatriates in favor of the Italian community when experiencing an ICD with the host country community. We were also able to predict that this was mediated by negative emotions. However, traditionally, ICD predicts similar effects regardless of the direction of the dissonance, while this study found that this was the case only when the ICD was related to the host country community but not when it was related to the Italian community. Italian expatriates experiencing the ICD with the Italian community also reported an increase in identification with the Italian community, despite the ICD. These findings indicate that other variables may play a role in modulating ICD effects.

First, we found that identity enhancing strategies in favor of the host country community were enacted by Italian expatriates resulting in the "Cassandra experience", the perception of foreseeing the future, enacting actions to raise awareness in the community, but without being believed and therefore discriminated against and ridiculed. Second, we found that the ICD of Italian expatriates with the host country community featured the underestimation of COVID-19 health risks, while the ICD of Italian expatriates with the Italian community featured economic preoccupation. Therefore, the two ICDs bared different connotations. Third, Italian expatriates described an increase of contacts, increase of sense of belonging, and positive emotions toward the Italian community that can be responsible for the identification shift in favor of this community. Fourth, a stronger identification baseline with the Italian community can be responsible for the non-engagement in a disidentification strategy by those experiencing an ICD with the Italian community.

Despite the limitations due to the circumstances of the COVID-19 emergency, having used a mixed-methods survey we were able to add a more nuanced and comprehensive interpretation to our quantitative data, partially overcoming methodological barriers. This study showed that the COVID-19 pandemic had impacts on international communities and shed light on a particular kind of ICD experience, namely the Cassandra experience, that deserves future investigation in natural and/or laboratory settings.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://osf.io/682a3.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RD and DC: conceptualization, methodology, formal analysis, validation, investigation, resources, data curation, writing-original draft, writing-review and editing, visualization, and project administration. TM: conceptualization, resources, formal analysis, writing review and editing, validation, visualization, and supervision. All authors contributed to the article and approved the submitted version.

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Buying to Cope With Scarcity During Public Emergencies: A Serial Mediation Model Based on Cognition-Affect Theory

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Panic buying is a common phenomenon that occurs during public emergencies and has a significant undesirable impact on society. This research explored the effect of scarcity on panic buying and the role of perceived control and panic in this effect through big data, an online survey and behavior experiments in a real public emergency (i.e., COVID-19) and simulative public emergencies. The findings showed that scarcity aggravates panic buying (Studies 1–3), and this aggravation effect is serially mediated by perceived control and panic (Studies 2–3). Moreover, this serial mediation model is more suitable for public health emergencies (Study 3). These findings enrich the understanding of panic buying and provide important enlightenment for guiding rational public behavior and managing public opinion during public emergencies.

Keywords: public emergency, panic buying, scarcity, perceived control, panic

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INTRODUCTION

Panic buying refers to when consumers purchase an extraordinary number of items to cope with the probability of future shortages before or during a disaster or perceived disaster (Islam et al., 2020; Yuen et al., 2020; Herjanto et al., 2021). This phenomenon was globally witnessed in different countries or regions following the outbreak of COVID-19, as well as during many historical natural disasters and health crises such as SARS (Loxton et al., 2020; Li et al., 2021). This behavior has essential negative effects on social stability because it harms the balance of the supply chain, inflates prices and hinders vulnerable groups from obtaining protective resources (Yuen et al., 2020). However, at present, the empirical research on the causes and psychological mechanisms of this phenomenon during public emergencies is scarce and scattered (Garbe et al., 2020; Yuen et al., 2020; Li et al., 2021). Therefore, it is vital to further determine what happens behind panic buying, especially in the context of public emergencies.

To bridge this gap, the current paper started from a crucial variable that affects consumer behavior—scarcity (Hamilton et al., 2019), and developed a cognitive-affective serial model to explain the effect of scarcity on panic buying.

Scarcity implies a real or perceived state of having less than is needed (Shah et al., 2012; Hamilton et al., 2019). Specifically, in consumption, scarcity is defined as "a real or perceived threat to the consumer's ability to meet their needs and desires due to a lack of, or a lack of access to, goods, services or resources" (Hamilton et al., 2019). Preventing and solving scarcity is an important purpose of panic buying during public emergencies (Yuen et al., 2020). From this perspective, scarcity may play a significant role in the cause of panic buying. Some studies, although only a few, have provided evidence for this suggestion. Limited time and limited quantity strengthen consumers' urgency to buy (Gupta and Gentry, 2016) and hoarding (Gupta and Gentry, 2019).

Anticipating food shortages improves consumers' acceptance of food prices and incurs hoarding (Yangui and Aoud, 2015). The purchaser also increases hoarding to mitigate the negative impact of supply shortages when there is a shortage crisis in the supply chain (Yoon et al., 2018). These studies in daily consumption situations suggest that scarcity is one of the antecedents of panic buying.

Noteworthy, while hoarding consists of not only excessive acquisitions but also difficulty discarding (Cannito et al., 2021), the term "hoarding" in the mentioned studies mainly represents excessive acquisitions. Although excessive acquisition is a main behavioral characteristic of panic buying (Yuen et al., 2020; Herjanto et al., 2021; Li et al., 2021; Omar et al., 2021; Yoshino et al., 2021), excessive acquisitions in the daily context and panic buying during public emergencies are different in many aspects, such as behavior context, consumption objects, motivation and magnitude. Panic buying is a kind of herd behavior (Gao and Liu, 2017; Di Crosta et al., 2021) aiming at essential products and necessities to cope with crises (Ballantine et al., 2014; Herjanto et al., 2021; Yoshino et al., 2021) based on utilitarian motivation (Ballantine et al., 2014), whereas daily excessive acquisition is more individual according to people's own interests based on both utilitarian and hedonic motivation (Islam et al., 2020). Particularly, a recent study clarified that, during the first peek of COVID-19 in Italy, the level of spending on necessities increased far more than that on non-necessities (Di Crosta et al., 2021), which suggested the consumer behavior changes more in necessities during emergencies and provided evidence for the notion that panic buying often occurs in necessities. Therefore, considering the different psychological antecedents of the utilitarian shopping (i.e., necessities products) and hedonic shopping (i.e., non-necessities products) (Di Crosta et al., 2021), further exploration of the effect of scarcity on panic buying during public emergencies and the mechanism is still needed.

To address this issue, we draw on the standard learning hierarchy model of consumption decision making (Lee and Goudeau, 2014) and the cognition-affect-coping model of coping behavior (Jung and Park, 2018). The standard learning hierarchy model illustrates a cognition-affect-behavior approach to consumers' decision making (Oliver, 1999; Lee and Goudeau, 2014). For instance, beliefs about health and ecological welfare benefits have been shown to enhance affects in the form of hedonic attitudes and then improve attitudinal loyalty and behavioral loyalty to organic food (Lee and Goudeau, 2014). As a kind of consumption behavior, panic buying may also be serially impacted by cognition and affect.

Panic buying is also a kind of coping behavior exhibited during public emergencies (Bacon and Corr, 2020; Islam et al., 2020; Yuen et al., 2020). People generate a cognition-affect-coping model when facing threats and pressure; that is, an individual's cognition and judgment of risk stimuli produce a corresponding affect and then influence the individual's response behavior (Jung and Park, 2018). For example, when people perceive privacy threats, they feel angry and anxious and then refuse or restrict the use of private data by applications and complain about developers (Jung and Park, 2018). Hence, in view of coping, cognitive and affective factors still have vital effects on panic buying.

According to these models, the impact of scarcity on panic buying should also have a cognition-affect process. Specifically, perceived control as a cognitive factor and panic as an affective factor come to the surface.

Perceived control, which refers to the cognition that one can impact the environment and event results (Chen et al., 2017), is the most important, common and basic need for dealing with stress or traumatic events (Frazier et al., 2011; Kemp et al., 2014). Acquiring or strengthening one's perceived control is the main motivation and goal of individuals when making decisions during public emergencies (Atalay and Meloy, 2020). According to compensatory control theory, people restore and rebuild their perceived control in other ways when their perceived control is threatened (Kay et al., 2010). During public emergencies, individuals produce compensatory consumption behaviors such as impulsive consumption to obtain perceived control (Sneath et al., 2009; Li et al., 2020). Panic buying also has a compensatory function, which allows individuals to regain control over their freedom (Gupta and Gentry, 2016) and defend against perceived risk (Li et al., 2021). Thus, perceived control appears to be a predictor of panic buying during public emergencies.

At the same time, scarcity has been shown to impair perceived control. For example, people experiencing the scarcity of material resources have a hard time resisting risks; thus, scarcity increases their perception of environmental uncertainty (Kraus et al., 2009). Moreover, the shortage of relevant information also reduces their perceived control over corresponding events (Yuen et al., 2020). Taken together, these studies indicate that perceived control mediates the effect of scarcity on panic buying.

Panic, which is characterized by anxiety and fear, is one of the main antecedents of panic buying (Tsao et al., 2019; Yuen et al., 2020). Panic directly drives self-protection behavior as a functional projection of individual self-protection motivation in a stress state (Maner et al., 2005). Hoarding the necessities of life in anticipation of or during a crisis is an adaptive survival strategy (Bentall et al., 2021) that addresses the possible shortage of resources (Gao and Liu, 2017) and reduces harm to health and property (Fung and Loke, 2010). Moreover, panic buying brings a temporary sense of security to individuals and relieves their sense of pressure (Sneath et al., 2009; Sterman and Dogan, 2015). Recent studies carried out during the early phase of the COVID-19 outbreak verified that anxiety is positively related to more overpurchasing (Garbe et al., 2020; Bentall et al., 2021).

At their root, anxiety and fear can be traced to scarcity (Islam et al., 2020; Omar et al., 2021). The scarcity felt during public emergencies emphasizes the lack of resources to help one resist threats and thus strengthens the perception of risk. These objective and subjective threats, which serve as information to hamper the possibility of survival and reproduction, stimulate individual self-protection motivation and ultimately result in panic (Maner et al., 2005). Therefore, panic explains the effect of scarcity on panic buying through the affective channel.

Moreover, perceived control and panic not only play solo roles but also have sequential roles. Low levels of perceived control encourage people to rethink and imagine various scenes, which then causes fear and anxiety about the unknown future (Kemp et al., 2014; Sterman and Dogan, 2015).

In summary, during public emergencies, scarcity affects panic buying through a cognitive-affective path; that is, scarcity reduces the level of perceived control, which intensifies panic, and this increase in panic further strengthens panic buying (see **Figure 1**). To verify this model, this paper conducted three studies. The recent COVID-19 pandemic is a typical public emergency and thus provides a natural field experiment setting for this study. Hence, Study 1 and Study 2 were conducted during the early breakout of this real public emergency in China through the use of big data and an online survey, respectively, to explore the relationship between scarcity and panic buying. In addition, Study 3 was carried out to further test the effect of scarcity on panic buying causally in simulated different types of public emergencies and to explore the universality and boundaries of the theoretical model.

STUDY 1

Study 1 aimed to preliminarily explore the relationship between scarcity and panic buying using big data from Chinese online users during the early period of the COVID-19 pandemic. During the home quarantine phase in the early outbreak period, the usage time and number of active users of China mobile internet increased significantly,[1] which suggests that Chinese emotional and behavior trajectories on the internet increased significantly. Thus, it is feasible to observe Chinese attitudes and behaviors during the COVID-19 outbreak through the use of these online big data.

Previous studies have taken cultural products (such as words and names related to cultural values in books) as "out of mind" indicators (i.e., objective indicators) to reflect the values or cultural tendencies of groups or times (Grossmann and Varnum, 2015). According to this approach, network information containing keywords related to scarcity and panic buying, such as news, new media soft articles, and users' publishing content in social networks, is also an objective embodiment of public attitudes and behaviors in social life. The amount of information represents the intensity of corresponding attitudes and behaviors. Therefore, Study 1 used the number of information containing keywords related to scarcity and panic buying as the indicators of scarcity and panic buying, respectively.

Methods

The amount of information that contained corresponding keywords related to scarcity and panic buying every day during the most serious stage of the COVID-19 pandemic in China (i.e., January 21, 2020 to April 9, 2020) was obtained from 11 channels (including web pages, WeChat, Weibo, APP, online forum, newspapers, short video platforms, TouTiao, Sohu, online question-and-answer website and other online platforms)[2] through a Chinese data platform.[3] Two steps were involved in this process.

Step 1: The Selection of Keywords

Scarcity

Based on the definition of scarcity, that is, "having less than is needed" (Shah et al., 2012), five groups of words describing shortages in the COVID-19 pandemic in Chinese, such as "yi qing (referring to 'COVID-19' in Chinese) and duan que (referring to 'shortage' in Chinese)," were taken as keywords for scarcity. We set "or" as the parallel logic between each group of keywords and "and" as the logic between the two words of each group of keywords. That is, the information was required to contain at least one group of keywords and the two words involved in one group of keywords at the same time.

Panic Buying

Since "qiang gou" is a more common word used by Chinese media and people to express panic buying, it was used as the keyword for panic buying. The key materials for epidemic prevention and control,[4] such as medicinal alcohol, masks, and medicine, were also included in the word groups to ensure the relevance of the information to the epidemic. Finally, ten groups of keywords about panic buying were applied; the example items were "qiang gou (referring to panic buying in Chinese) and kou zhao (referring to masks in Chinese)." Likewise, the two words in the same group were based on "and" logic, whereas each group of keywords followed "or" logic.

Step 2: Data Preprocessing

Data preprocessing, including the following two steps, was carried out to denoise the obtained information. First, the platform's de-duplication function was used to exclude information from different media channels that had duplicate or similar content. Second, since scarcity and panic buying are negative events, only the information that reflected negative emotions was retained according to the emotional attributes of each piece of information provided by the platform. After preprocessing, a total of 218,953 pieces (2,270,178 pieces before preprocessing) of scarcity-related information and 116,593 pieces (1,761,705 pieces before preprocessing) of panic buying-related information were obtained.

Results

Figure 2 shows the covariant trend of the amount of scarcity-related information and the amount of panic buying-related information. A linear regression analysis performed by SPSS 26.0 showed that the amount of information about scarcity was marginally positively related to the amount of information

[1]QuestMobile. (2020-02-12). *2020 China mobile Internet "Fighting epidemic" Special Report – Hot industry development Report (in Chinese)*. https://www.questmobile.com.cn/research/report-new/81

[2]WeChat is one of the most popular multi-purpose messaging APPs in mainland China and users can express their views through WeChat's official accounts which are similar to blogs. Weibo is one of the most popular social media in China, which is similar to Facebook and Twitter. TouTiao and Sohu are the two most active news and information platforms in Chinese mainland. Other online platforms refers to some small online information platforms and the platforms which cannot be categorized into the former groups.

[3]yuqing.gsdata.cn

[4]Ministry of Industry and Information Technology of the People's Republic of China. (2020-02-14). List of key supplies for epidemic prevention and control (medical emergency). https://www.miit.gov.cn/ztzl/rdzt/xxgzbdgrdfyyqfkgz/tzgg/art/2020/art_8ac3f70d70a14e8abbce47d08bdbfd8d.html

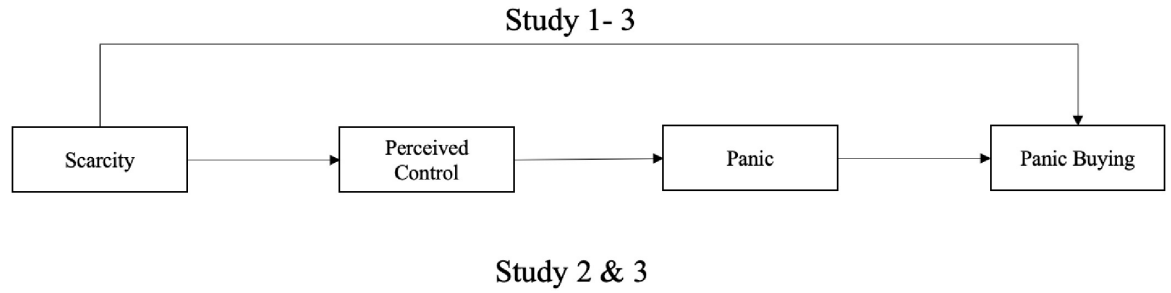

FIGURE 1 | The overall framework.

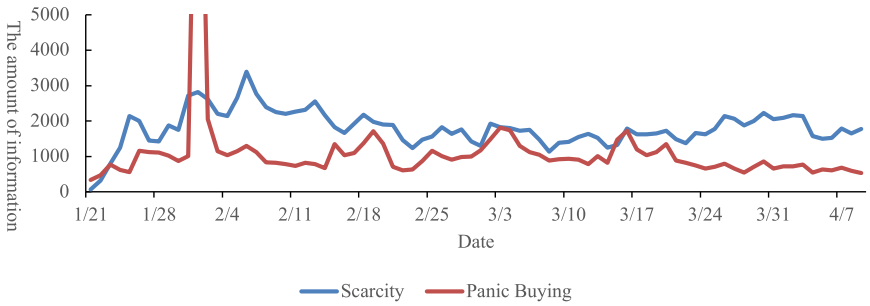

FIGURE 2 | The trend of the amount of information.

about panic buying, $\beta = 0.21$, $t(78) = 1.92$, $p = 0.059$, 95%CI (−0.02, 0.94). And the significant positive relation existed in every channel independently (βs = 0.30–0.48, $ts = 2.82$–4.89, $ps \leq 0.001$) except in the online question-and-answer website [$\beta = -0.05$, $t(78) = -0.40$, $p = 0.693$] (see **Table 1**).

Discussion

Study 1 initially illustrated the positive correlation between scarcity and panic buying during a real public emergency using the amount of information as the objective indicator of scarcity and panic buying at the group level. To further test the relationship between scarcity and panic buying and, more importantly, to investigate the psychological mechanism behind the relationship, Study 2 was conducted using individual self-report indicators. In addition, considering that news mostly reflects objective phenomena in social life, Study 1 paid attention to objective scarcity. However, scarcity is a multifaceted concept that contains both objective and subjective aspects (Hamilton et al., 2019). Therefore, referring to previous research (Piff et al., 2010), we decided to develop Study 2 from subjective scarcity.

STUDY 2

Study 2 was designed to examine the effect of scarcity on panic buying again, along with the serial mediating role of perceived control and panic, through a nationwide online survey administered during the early period of the COVID-19 outbreak in China.

Methods

Participants and Procedure

According to Fritz and Mackinnon (2007), a sample size of at least 462 is necessary to detect a small effect in both the pathway between the independent variable and the mediator and the pathway between the mediator and the dependent variable, under 0.8 power, using the bias-corrected bootstrap test to estimate the indirect effect. A total of 658 samples (234 males, $M_{age} = 32.94$, $SD = 11.92$) from 29 provinces in mainland China and Hong Kong, Macao and Taiwan regions were collected through an online survey conducted from the 11th to the 20th of February 2020. Approximately 83.7% of the respondents reported having a college degree or above. Moreover, 94.4% of the participants reported being healthy, and 88.8% of participants reported that there were no cases of infection in the community where they lived.

The survey was distributed on various platforms, including WeChat, Weibo, QQ, etc. After the participants clicked on the survey hyperlink, they could read the electronic informed consent following the Declaration of Helsinki's ethical standards and approved by Institution Review Board for Human Participants at the university where authors are, which clearly explained the aims and the procedure of the study and the participants' rights and reward. Participants then chose "agree" or "disagree" to participate, according to their own wishes. Each participant who completed the survey eventually received 3 Chinese yuan as a reward.

TABLE 1 | Summary of regression analysis of panic buying to scarcity for different channels ($N = 80$).

	All channels	1	2	3	4	5	6	7	8	9	10	11
Scarcity	0.21†	0.39***	0.48***	0.43***	0.41***	0.39***	0.44***	0.30**	0.38***	0.36**	−0.05	0.40***
F	3.67†	13.59***	23.86***	17.71***	15.92***	13.86***	18.66***	7.94**	13.52***	11.51**	0.16	15.24***
R	0.21	0.39	0.48	0.43	0.41	0.39	0.44	0.30	0.41	0.36	0.05	0.40
Source proportion-Scarcity		13.32%	27.03%	19.50%	13.20%	1.80%	0.49%	0.32%	8.53%	4.82%	1.62%	9.39%
Source proportion-Panic buying		30.94%	25.14%	13.46%	8.94%	1.71%	0.23%	0.74%	5.83%	3.26%	3.12%	6.61%

1 = Weibo, 2 = WeiChat, 3 = APP, 4 = web pages, 5 = online forum, 6 = newspapers, 7 = short video platforms, 8 = TouTiao, 9 = Sohu, 10 = online question-and-answer website, and 11 = other online platforms.
****$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{\dagger}p < 0.10$, the same below.*
Source proportion refers to the proportion of information quantity of each channel in the total information quantity.

Measures

Perceived Scarcity

Perceived scarcity was evaluated with four self-developed items. The four items are "The prevention measures against COVID-19 I adopt," "The prevention equipment against COVID-19 I have," "The knowledge about epidemic prevention I know," and "The useful information about COVID-19 I know." The participants used a 7-point Likert scale (ranging from 1 = very sufficient to 7 = very insufficient) to rate each item. A higher mean score indicated a stronger scarcity perception. The Cronbach's α of these items was 0.74 in the present study, and the exploratory factor analysis (CFA) showed a one-factor structure that explained 57.57% of the total variance (see **Supplementary Material** for more details of CFA at: https://osf.io/sfj52/?view_only==9574c3d59a5e4d8c94dac620afdb416b).

Panic Buying

Panic buying was measured by a behavioral indicator, namely, payment degree, which depicted the highest price that people were willing to pay for a good or resource. Although hoarding or over-purchasing is the key behavioral characteristic of panic buying, in view of the performance of panic buying in real life, panic buying is reflected not only in the quantity of consumption but also in the acceptance of prices or willingness to pay (Yangui and Aoud, 2015). In addition, since some epidemic prevention materials were still in shortage at the time of our survey, people could not hoard a large number of them but could obtain them at any cost. Therefore, we detected panic buying *via* payment degree in study 2.

In this part, the participants were shown four popular pieces of epidemic prevention equipment, including masks, alcohol, disinfectant and cold medicine, and then decided how much they were most willing to pay for these items at the moment. The more money that the participants were willing to pay, the greater the cost they were willing to pay for resources and the greater their urgency of obtaining resources. The payment amount of the four materials was standardized and averaged to develop the overall payment degree.

Perceived Control

The 8-item perceived present control subscale of the Perceived Control Over Stressful Events Scale (Frazier et al., 2011) was used to assess perceived control. Perceived present control estimates the individual's perceived control over the current events and reflects the individual's general beliefs that they can better control important results (Frazier et al., 2011). An example item is "How I deal with this event is now under my control." The participants were asked to rate each item on a scale ranging from 1 (very strongly disagree) to 4 (very strongly agree) based on their feelings about COVID-19. A higher mean score indicated a stronger level of perceived control. The Cronbach's α of these items was 0.73 in the present study.

Panic

Four items from the negative affect subscale of the Positive and Negative Affect Schedule (Watson et al., 1988) were used to assess panic, that is, "scared," "afraid," "nervous," and "jittery." The items were rated on a scale ranging from 1 (very slightly or not at all) to 5 (extremely) based on the extent to which the participants had felt those emotions over the past 2 weeks. A higher mean score indicated a stronger panic. The Cronbach's α of these items was 0.88 in the present study.

Demographic

Several demographic variables were measured as covariates, including biological gender (1 = males, 0 = females), age, per capital monthly household income and physical (1 = there is a confirmed or suspected case at home, 7 = there is a confirmed or suspected case in the province) and psychological distance (1 = very close, 7 = very distant) from COVID-19.

Results

Common Method Bias

The data for Study 2 were collected completely by the self-reported method. Scholars have proposed that when data are collected from a single source, there is the possibility of common method bias (CMB) in the dataset (Podsakoff et al., 2012). To reduce concerns over CMB, as suggested by Podsakoff et al. (2003), we conducted Harman's single-factor test to check if CMB was an issue in the current study. The results of the Herman test revealed that a single factor has a value of variance of less than 50% (unrotated: 29.42%, rotated: 18.62%). In addition, **Table 1** indicates that the intercorrelation of all the constructs was less than 0.90 (Pavlou and El Sawy, 2006). These findings indicated that CMB was not a major issue in the present study.

Hypothesis Testing

A correlation analysis conducted on the variables of interest showed significant correlations between all measured constructs (see **Table 2**). Hayes' PROCESS macro (version 3.4, Model 6,

bootstrapping $N = 5000$) was then employed to conduct a regression-based serial mediation model to further investigate the association between perceived scarcity and panic buying, as serially mediated by perceived control and panic, taking gender, age, income (after logarithm transformation to correct the skew distribution) and distance from COVID-19 as covariates.

After controlling for all covariates, under the significance level of 0.05, a significant serial mediating effect of perceived control and panic (i.e., perceived scarcity → panic → perceived control → panic buying) was found (0 was not included in the 95% confidence interval, 95%CI), and the direct effect of perceived scarcity became smaller and marginally significant when the indirect effects were separated from the total effect. However, the independent mediating effects of perceived control and panic were not proven in the whole serial mediation model. When taken as mediation separately, panic played a mediating role, whereas perceived control did not (see **Table 3** and **Figure 3**). In addition, the possible competitive model (i.e., perceived scarcity → panic → perceived control → panic buying) was not supported [*Effect* = −0.001, *SE* = 0.004, 95%CI (−0.01, 0.01)].

Discussion

Study 2 again demonstrated the aggravating effect of scarcity on panic buying from the perspective of perceived scarcity and verified that this effect is serially mediated by perceived control and panic.

It is worth noting that perceived control has never played an independent mediating role, whether as a serial mediator or as a mediator alone, because it has no effect on panic buying. However, herein, perceived control indirectly affected panic buying through panic [95%CI (−0.09, −0.004)]. These results suggest that the mechanism by which perceived control affects panic buying could be different from that by which it affects other consumption behaviors such as impulsive consumption (Sneath et al., 2009; Li et al., 2020). While this mechanism may not be based on the need to compensate control, it may exist because low perceived control intensifies individual panic and panic then exacerbates panic buying. On the other hand, panic played a complete mediating role when it was used as a mediator alone. However, when perceived control was included as a mediator at the same time, this mediation disappeared because the effect of scarcity on panic was completely mediated by perceived control [95%CI (0.11, 0.19)] at this time, which led to the insignificant direct effect of scarcity on panic. This result implies that the effect of scarcity on panic is realized through perceived control. To summarize the above results, in the "black box" of scarcity affecting panic buying, the serial mediation of perceived control and panic is more essential and stable.

Study 1 and Study 2 both tested the effect of scarcity on panic buying using big data and an online survey, respectively, but they did not check the causal link between these two variables (Kofta et al., 2020). Meanwhile, since the first two studies are conducted in the same context of COVID-19—a real public emergency—more studies are needed to examine the existing findings during other public emergencies to explore the generalization and boundaries of the current model (Zhou et al., 2019; Kofta et al., 2020). Therefore, Study 3 was performed with the paradigm of priming to examine the causal link between scarcity and panic buying in different public emergencies.

STUDY 3

Study 3 concentrated on the causal link between scarcity and panic buying through three experiments regarding different public emergencies and the generalization and boundaries of the current results.

Public emergencies comprise four categories: natural disasters, accident calamities, public health emergencies, and social security emergencies (The State Council, 2006). In reality, panic buying usually occurs during hurricanes and public health emergencies (such as SARS, COVID-19 and nuclear leakage crises) (Loxton et al., 2020). Therefore, the experimental contexts of Study 3 were set around these public emergencies.

Study 3a was implemented to directly verify the existing results by priming scarcity in a simulated respiratory epidemic context, which was similar to COVID-19. Study 3b was designed to explore whether the existing results are specific to the epidemic situation in another public health emergency (i.e., pollutant leakage) that suggests serious harm to life and health and a long duration. Study 3c was executed to further examine whether the existing model was applicable to public emergencies other than public health emergencies, such as hurricanes, with a shorter duration than an epidemic and characteristics of forewarning (Kemp et al., 2014).

Study 3a

Methods

Participants and Design

This study adopted a between-subjects single-factor design (primed scarcity: scarcity or non-scarcity). Using G*Power 3.1 (Faul et al., 2007), we determined that we required at least 172 samples under a sufficient power ($1 - \beta = 0.90$) and the significance level of 0.05 to detect a medium-sized effect (*Cohen's d* = 0.5), using *t*-tests to test the difference between two independent groups. Finally, a total of 252 Chinese adults (96 males, $M_{age} = 21.91$, $SD = 2.59$) recruited online through Sojump (a Chinese online data collection platform[5]) participated in this study, during the last week of June 2020 to the middle of August 2020. Every participant read the online informed consent similar to the one used in Study 2 and then decided whether to participant the study or not. The protocol was following the Declaration of Helsinki's ethical standards and approved by Institution Review Board for Human Participants at the university where authors are. Everyone who completed the experiment received 3 Chinese yuan as a reward.

Procedure and Materials

The participants read two short paragraphs. The first paragraph outlined an assumed respiratory epidemic background, including the route of transmission, incidence pattern, risk of epidemic and possible prevention measures. The second paragraph

[5]https://www.wjx.cn

TABLE 2 | Descriptive statistics and correlations among variables assessed in Study 2.

	M ± *SD*	Perceived scarcity	Panic buying	Perceived control	Panic
Perceived scarcity	2.91 ± 0.84	0.74			
Panic buying	0.03 ± 0.89	0.08*	NA		
Perceived control	2.81 ± 0.50	−0.30***	−0.08*	0.73	
Panic	2.77 ± 0.98	0.19**	0.11**	−0.52***	0.88

The numbers on the diagonal are Cronbach's α.
****p < 0.001, **p < 0.001, *p < 0.05.*

TABLE 3 | Summary of indirect effects in study 2.

Indirect effects	Effect (SE)	95%CI
Total (for serial mediation model)	0.014 (0.01)	[−0.01, 0.04]
perceived scarcity → perceived control → panic buying	−0.003 (0.02)	[−0.03, 0.03]
perceived scarcity → panic → panic buying	0.003 (0.004)	[−0.004, 0.01]
perceived scarcity → panic → perceived control → panic buying	0.013 (0.01)	[0.001, 0.03]
perceived scarcity → perceived control → panic buying (singlemediation model)	0.01 (0.01)	[−0.01, 0.04]
perceived scarcity → panic → panic buying (single mediation model)	0.02 (0.01)	[0.002, 0.03]
perceived scarcity → perceived control → panic (single mediation model)	0.15 (0.02)	[0.11, 0.19]
perceived control → panic → panic buying (single mediation model)	−0.05 (0.02)	[−0.09, −0.01]

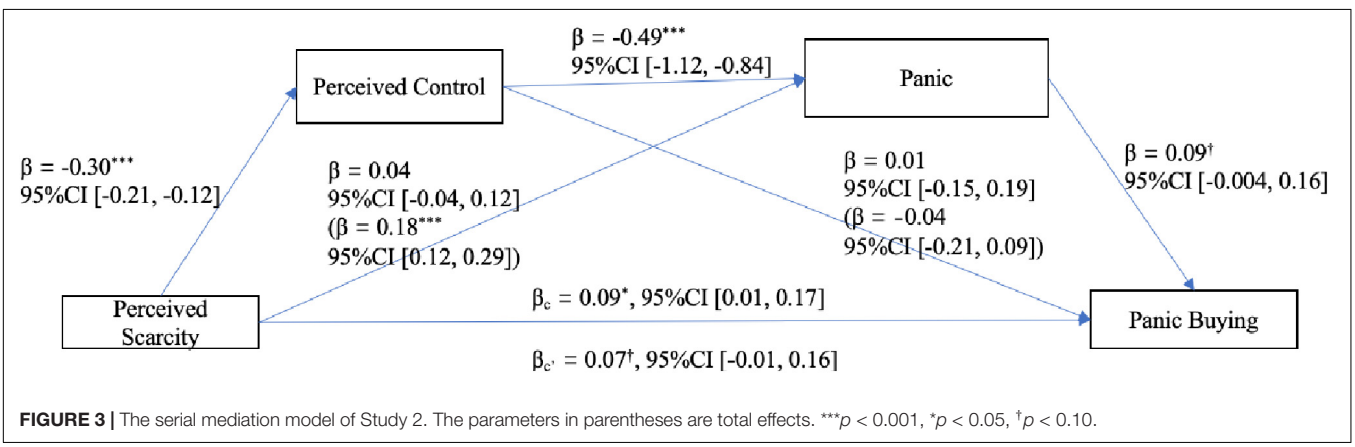

FIGURE 3 | The serial mediation model of Study 2. The parameters in parentheses are total effects. ***$p < 0.001$, *$p < 0.05$, †$p < 0.10$.

referred to the experimental manipulation. For the scarcity group, the paragraph described the surge in demand for protective supplies and information related to the emergency and the shortage of inventory. For the non-scarcity group, the paragraph described the stable supply and demand of materials and information and the sufficient inventory (see more details in **Supplementary Material** at: https://osf.io/sfj52/?view_only==9574c3d59a5e4d8c94dac620afdb416b). The participants were randomly divided into the two experimental groups. After reading the two paragraphs, the participants were asked to accomplish the manipulation checks and questions about perceived control, panic, and panic buying in turn. To ensure that the participants carefully read all two paragraphs, the presentation length of time of this page was set to 60 s (Kofta et al., 2020).

Measures

Manipulation Check. Two items adapted from Kristofferson et al. (2017) were used as manipulation checks, namely, "How would you describe the quantity of the protective supplies in the above situation?" and "How would you describe the quantity of the information related to epidemic in the above situation?" Each item was rated on a scale ranging from 1 (very sufficient) to 7 (very insufficient). The individual items were averaged to create a composite scarcity score. Higher scores signaled a higher scarcity perception, whereas lower scores signaled a higher abundant perception.

Panic Buying. Two behavioral indicators were used to measure panic buying: payment degree and hoarding. For payment degree, the participants declared the highest price they were willing to

pay for the four protective supplies previously mentioned in the reading material, namely, surgical masks, medical alcohol, cold medicine and basic food, after being reminded of the regular price of each item. The payment degree for each item was calculated by the subtraction of the payment price over the regular price [i.e., (payment price − regular price)/regular price]. Since the term basic food is a general name used for a class of commodities, and the regular price could not be set directly, the participants declared the highest percentage they were willing to pay more than usual for basic food, and this percentage was divided by 100 to obtain the payment degree of basic food. The payment degree for each commodity was then averaged to develop the overall payment degree.

For hoarding, the participants answered how many/much surgical masks/medical alcohol/cold medicine/basic food they planned to buy in the described situation. The overall hoarding index was obtained by standardizing and averaging the amount of hoarding for the four commodities.

Perceived Control. One item assessing perceived control in general was used to measure perceived control. The item was "How I deal with this epidemic is now under my control" (Frazier et al., 2011). The participants were asked to rate this item on a scale ranging from 1 (very strongly disagree) to 4 (very strongly agree). A higher mean score indicated a stronger perceived control.

Panic. The assessment of panic was identical to that used in Study 2. The Cronbach's α of these items was 0.87 in the present study.

Demographic. Gender (1 = males, 0 = females), age, per capita monthly household income, physical distance from COVID-19 (1 = there is a confirmed or suspected case at home, 7 = there is a confirmed or suspected case in the province), physical health condition in COVID-19 (from 1 = uninfected to 4 = infected) and epidemic level of the place where participants were during the COVID-19 outbreak (1 = mildly affected area, 4 = central affected area) were measured as covariates.

Results

Preliminary Analysis

The participants perceived more scarceness in the scarcity condition than in the non-scarcity condition, which suggested the scarcity manipulation was successful. Furthermore, the results of *t*-tests showed the significant effects of primed scarcity on participants' perceived control, panic and panic buying (see **Table 4**).

Serial Mediation Analysis

Similar to Study 2, Hayes' PROCESS macro (version 3.4, Model 6, bootstrapping $N = 5000$) was employed to conduct a regression-based serial mediation model. The results showed that, after controlling for all covariates, under the significance level of 0.05, for payment degree (see **Figure 4A**), a significant total effect and a significant direct effect of primed scarcity (0 = not scarcity group, 1 = scarcity group) were found. However, no significant indirect effect was found (see **Table 5** and **Figure 4A**). In addition, the possible competitive model (i.e., perceived scarcity-panic-perceived control panic buying) was not supported [*Effect* = 0.01, $SE = 0.01$, 95%CI (−0.01, 0.04)].

For hoarding (see **Figure 4B**), the total effect of primed scarcity was significant, and it was serially mediated by perceived control and panic and independently mediated by panic, which made the direct effect of primed scarcity non-significant. In addition, the possible competitive model was not supported [*Effect* = 0.002, $SE = 0.01$, 95%CI (−0.02, 0.03)].

Discussion

Study 3a directly verified the causal link between scarcity and panic buying in a similar context as that of COVID-19. The serial mediating role of perceived control and panic was confirmed in the relationship between scarcity and hoarding. However, although participants primed with scarcity were willing to pay higher prices for protective supplies than their counterparts in the non-scarcity group, it seemed that this was not because scarcity reduced their

TABLE 4 | Descriptive statistics of key variables and the effect sizes of scarcity manipulation in study 3.

Study	Variable	Scarcity manipulation	Payment degree	Hoarding	Perceived control	Panic
Study 3a	Scarcity group	6.04 ± 0.84	1.09 ± 0.70	0.11 ± 0.63	2.38 ± 0.73	3.45 ± 0.81
	Non-scarcity group	2.81 ± 1.00	0.67 ± 0.52	−0.11 ± 0.68	2.76 ± 0.64	2.93 ± 0.79
	t (250)	27.81	5.50	2.64	−4.43	5.19
	p	<0.001	<0.001	0.009	<0.001	<0.001
	Cohen's d	3.52	0.70	0.33	0.56	0.66
Study 3b	Scarcity group	6.07 ± 0.76	1.30 ± 1.60	0.13 ± 0.76	2.08 ± 0.65	3.63 ± 0.74
	Non-scarcity group	2.51 ± 0.90	0.61 ± 0.98	−0.12 ± 0.67	2.67 ± 0.67	3.00 ± 0.84
	t (260)	34.57	4.23	2.80	−7.27	6.48
	p	<0.001	<0.001	0.005	<0.001	<0.001
	Cohen's d	4.29	0.52	0.35	0.90	0.80
Study 3c	Scarcity group	5.62 ± 0.81	1.08 ± 1.36	0.24 ± 0.96	2.39 ± 0.64	3.11 ± 0.83
	Non-scarcity group	2.29 ± 0.71	0.58 ± 0.67	−0.24 ± 0.47	2.81 ± 0.37	2.74 ± 0.80
	t (254)	34.91	3.75	5.06	−4.89	3.65
	p	<0.001	<0.001	0.009	<0.001	<0.001
	Cohen's d	4.38	0.47	0.64	0.61	0.46

This table showed descriptive statistics of key variables and the effect sizes of scarcity manipulation in Study 3a, 3b, and 3c.

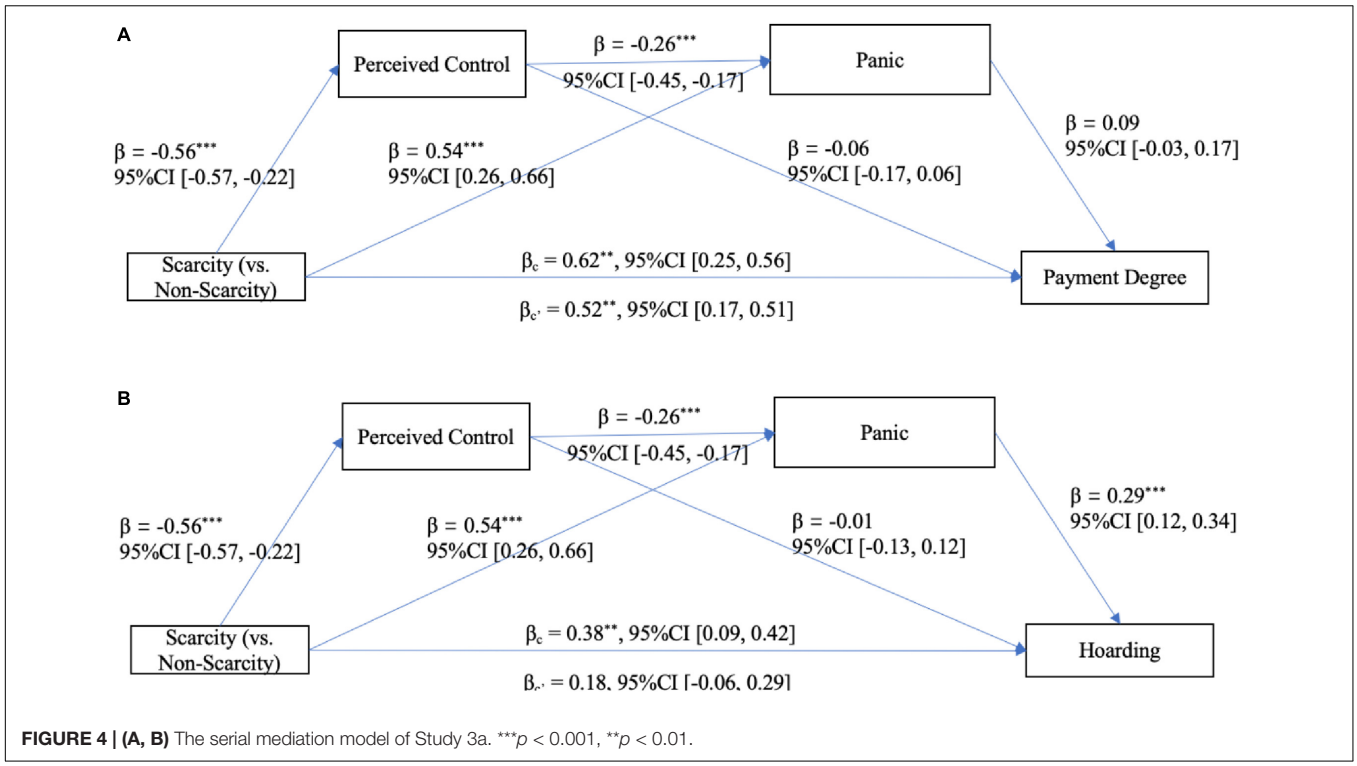

FIGURE 4 | (A, B) The serial mediation model of Study 3a. ***$p < 0.001$, **$p < 0.01$.

TABLE 5 | Summary of indirect effects in study 3a.

Indirect effects	Effect (SE)	95%CI
Payment degree		
Total	0.08 (0.06)	[−0.02, 0.20]
scarcity → perceived control → panic buying	0.03 (0.03)	[−0.015, 0.12]
scarcity → panic → panic buying	0.04 (0.03)	[−0.01, 0.11]
scarcity → panic → perceived control → panic buying	0.01 (0.01)	[−0.003, 0.04]
Hoarding		
Total	0.20 (0.07)	[0.08, 0.35]
scarcity → perceived control → panic buying	0.004 (0.04)	[−0.07, 0.10]
scarcity → panic → panic buying	0.16 (0.05)	[0.07, 0.27]
scarcity → panic → perceived control → panic buying	0.04 (0.02)	[0.01, 0.09]

perceived control and then intensified their panic. The possible reason is that the government's price-limiting measures have strengthened people's perceived control and reduced the panic about price increase.

Based on the results, to further certify the stability of the serial mediation model and explore whether this model is specific to the epidemic context, we carried out Study 3b in relation to another public health emergency (i.e., leakage crisis).

Study 3b

Methods

Participants and Design

Study 3b adopted the same design as that used in Study 3a. A total of 262 Chinese adults (95 males, $M_{age} = 22.35$, $SD = 2.90$) recruited online during the first week of July 2020 to the middle of August 2020 through Sojump participated in this study. The participants read the online informed consent same as study 3a and obtained 3 Chinese yuan as a reward.

Procedure and Materials

Similar to Study 3a, the participants first read a paragraph depicting the leakage of radioactive pollutants, including the route, the degree, the risk and the protective measures of pollution. Then, they received a similar scarcity manipulation and answered questions similar to those used in Study 3a.

Measures

The assessments of the manipulation checks, perceived control, panic (Cronbach's $\alpha = 0.87$) and demographic variables[6] were identical to those used in Study 3a. The indicators of panic

[6]The distance from the leakage of radioactive pollutants in real life was measured by familiarity with this kind of events (1 = very unfamiliar, 7 = very familiar).

buying remained payment degree and hoarding. However, the specific measurements had a few differences. To exclude baseline differences in individuals' own reserve habits, hoarding was measured by the highest amount of emergency supplies (including bottled water, fruits and vegetables, basic food, antidotes and tickets) that the participants would stockpile more than usual in the given condition. The overall hoarding index was obtained by standardizing and averaging these amounts. Meanwhile, to rule out the influence of price anchoring and the participants' own consumption levels, payment degree was measured by the highest percentage that the participants were willing to pay above the usual. These percentages were then divided by 100 and averaged to develop the overall payment degree.

Results

Preliminary Analysis

Participants in the scarcity group perceived higher scarceness, less control, more panic, and showed more panic buying than participants in the non-scarcity group (see **Table 4**).

Serial Mediation Analysis

Hayes' PROCESS macro (version 3.4, Model 6, bootstrapping $N = 5000$) was employed to conduct the mediation analysis. After controlling for all covariates, under the significance level of 0.05, for payment degree (see **Figure 5A**), a significant total effect and a significant direct effect of primed scarcity (0 = not scarcity group, 1 = scarcity group) were found. And the serial mediating effect of perceived control and panic and the independent mediating effect of panic were also significant, whereas the independent mediating effect of perceived control was non-significant (see **Table 6** and **Figure 5A**). In addition, the possible competitive model was not supported [*Effect* = 0.02, *SE* = 0.02, 95%CI (−0.02, 0.06)].

For hoarding (see **Figure 5B**), similarly, a significant total effect of perceived scarcity, a significant serial mediating effect of control and panic and the independent mediating effect of panic were found, whereas the direct effect of primed scarcity was not significant when the indirect effects were separated from the total effect (see **Table 6** and **Figure 5B**). In addition, the possible competitive model was not supported [*Effect* = 0.002, *SE* = 0.02, 95%CI (−0.04, 0.04)].

Discussion

Using a new public health emergency different from the epidemic scenario, Study 3b once again confirmed that scarcity exacerbates panic buying and that this aggravation is transmitted *via* reduced perceived control and intensified panic. These results indicate that the serial mediating pathway is not specific to epidemic-related emergencies but also applies to other public health emergencies.

Considering that people's panic buying in real life is also common in some natural disasters, such as hurricanes, which are

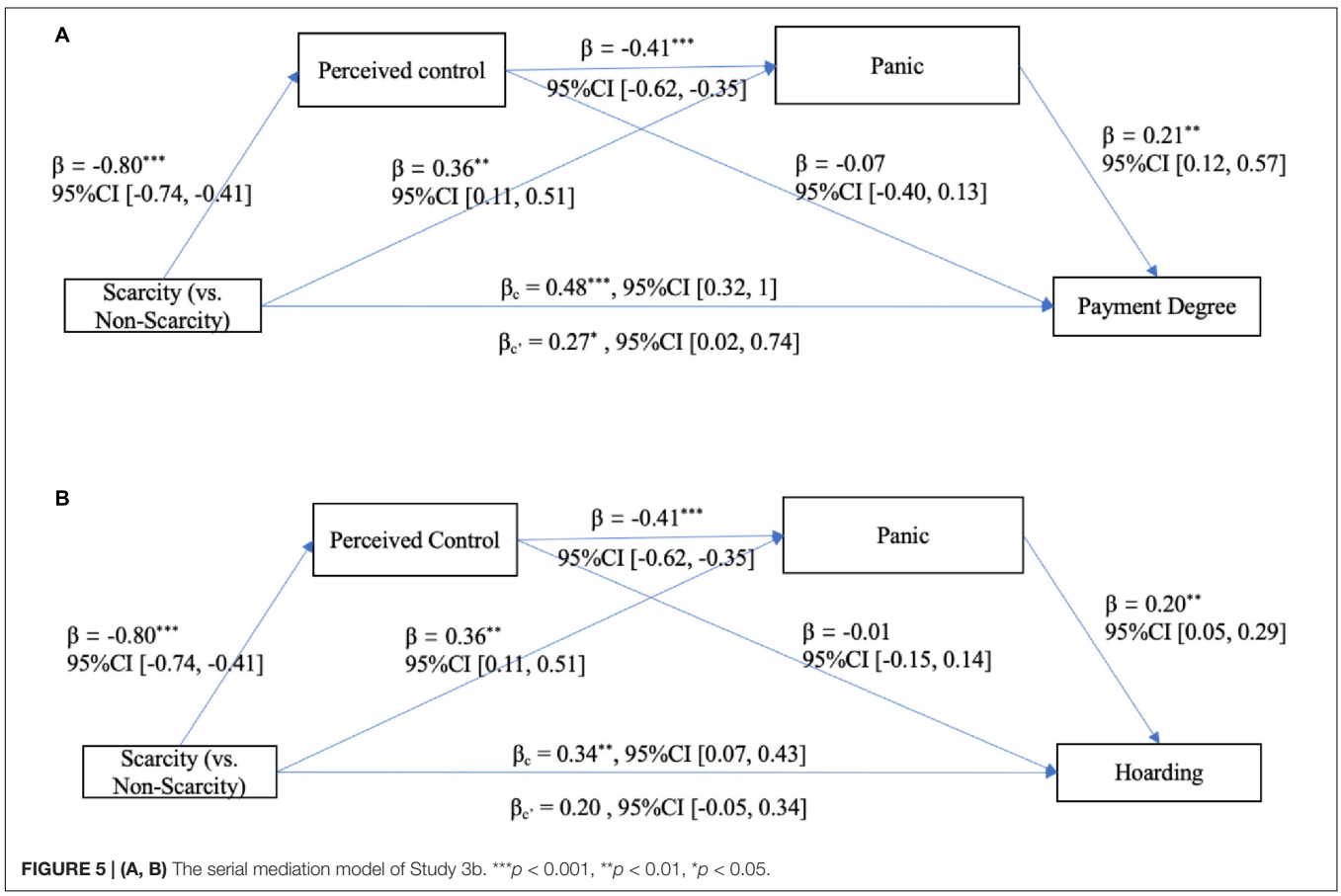

FIGURE 5 | (A, B) The serial mediation model of Study 3b. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

TABLE 6 | Summary of indirect effects in study 3b.

Indirect effects	Effect (SE)	95%CI
Payment degree		
Total	0.20 (0.07)	[0.08, 0.34]
scarcity → perceived control → panic buying	0.06 (0.06)	[−0.05, 0.18]
scarcity → panic → panic buying	0.08 (0.03)	[0.02, 0.15]
scarcity → panic → perceived control → panic buying	0.07 (0.02)	[0.03, 0.13]
Hoarding		
Total	0.14 (0.06)	[0.02, 0.27]
scarcity → perceived control → panic buying	0.01 (0.06)	[−0.10, 0.11]
scarcity → panic → panic buying	0.07 (0.03)	[0.02, 0.14]
scarcity → panic → perceived control → panic buying	0.06 (0.02)	[0.02, 0.12]

different from public health emergencies, with shorter durations and characteristics of forewarning and being of less threat to people's lives and health (Kemp et al., 2014), Study 3c was implemented to further explore the generalization and boundary of the existing results in a simulated hurricane context.

Study 3c

Methods

Participants and Design

Study 3c adopted the same design as that used in both Study 3a and Study 3b. A total of 256 Chinese adults (103 males, $M_{age} = 21.40$, $SD = 2.25$) recruited online during the middle of July 2020 to the middle of August 2020 through Sojump participated in this study. Similarly, the participants read the online informed consent form same as study 3a and obtained 3 Chinese yuan as a reward.

Procedure and Materials

The procedure and manipulation materials were similar to those used in both Study 3a and Study 3b.

Measures

The assessments of all the variables were identical to those used in Study 3b.[7] The participants made consumption decisions regarding five emergency supplies, namely, bottled drinking water, fruits and vegetables, basic food, flashlights, and tickets, and the five commodities were presented at random.

Results

Preliminary Analysis

Participants in the scarcity group perceived higher scarceness, less control, more panic, and showed more panic buying than participants in the non-scarcity group (see **Table 4**).

Serial Mediation Analysis

Hayes' PROCESS macro (version 3.4, Model 6, bootstrapping $N = 5000$) was employed to conduct the mediation analysis. After controlling for all covariates, for payment degree (see **Figure 6A**), a significant total effect and a significant direct effect of primed scarcity (0 = not scarcity group, 1 = scarcity group) was found, whereas no significant indirect effect was found (see **Table 7** and **Figure 6A**). In addition, the possible competitive model was not supported [*Effect* = −0.01, *SE* = 0.01, 95%CI (−0.03 0.01)].

Similar results were obtained for hoarding (see **Table 7** and **Figure 6B**). In addition, the possible competitive model was not supported [*Effect* = −0.01, *SE* = 0.01, 95%CI (−0.04, 0.01)].

Discussion

Study 3c attempted to expand the existing findings of former studies to another type of public emergency that had a different nature from that of a public health emergency. The aggravating effect of scarcity on panic buying was repeated. Nevertheless, the "perceived control → panic" pathway was not tenable to explain this effect this time.

People's risk assessment of crises usually consists of two aspects: dread and unknown (Slovic, 1987). Compared with public health emergencies, hurricanes/typhoons are more frequent and more common (low uncertainty). Thus, the related forewarning mechanisms and emergency plans are relatively mature. As a result, the threat to life is relatively controllable (low worry) in hurricanes/typhoons. Therefore, individuals' risk assessments of hurricanes/typhoons and panic in this kind of crisis are lower than those found during public health emergencies.[8] Therefore, low levels of panic have no impact on panic buying, which leads to the final failure of serial mediation in Study 3c.

In summary, Study 3 certified the causal link between scarcity and panic buying in different public emergencies and the psychological mechanism of this link and discovered the boundary of this mechanism. Specifically, the serial mediating pathway (i.e., perceived control → panic) only explains the aggravating effect of scarcity on panic buying during public health emergencies but not during public emergencies with lower risk levels, such as hurricanes.

[7] The Cronbach's α of items assessing panic was 0.88.

[8] Significant differences among the risk assessment of the emergencies in studies 3a–3c were found using items developed by Xie et al. (2005) [$F(2,1145) = 34.88$, $p < 0.001$, $\eta_p^2 = 0.06$]. Specifically, participants perceived lower risk in the hurricane situation ($M = 4.49$, $SD = 1.34$) than that in epidemic situation ($M = 5.08$, $SD = 1.29$) and leakage situation ($M = 5.17$, $SD = 1.31$) ($ps < 0.001$), whereas there was no significant difference between the latter two ($p = 0.312$). Moreover, there were significant differences in panic among the three emergencies, $F(2,1145) = 21.54$, $p < 0.001$, $\eta_p^2 = 0.04$. Panic in hurricane situation ($M = 2.84$, $SD = 0.83$)was lower than that in epidemic ($M = 3.02$, $SD = 0.86$) and leakage ($M = 3.22$, $SD = 0.82$) ($ps < 0.001$).

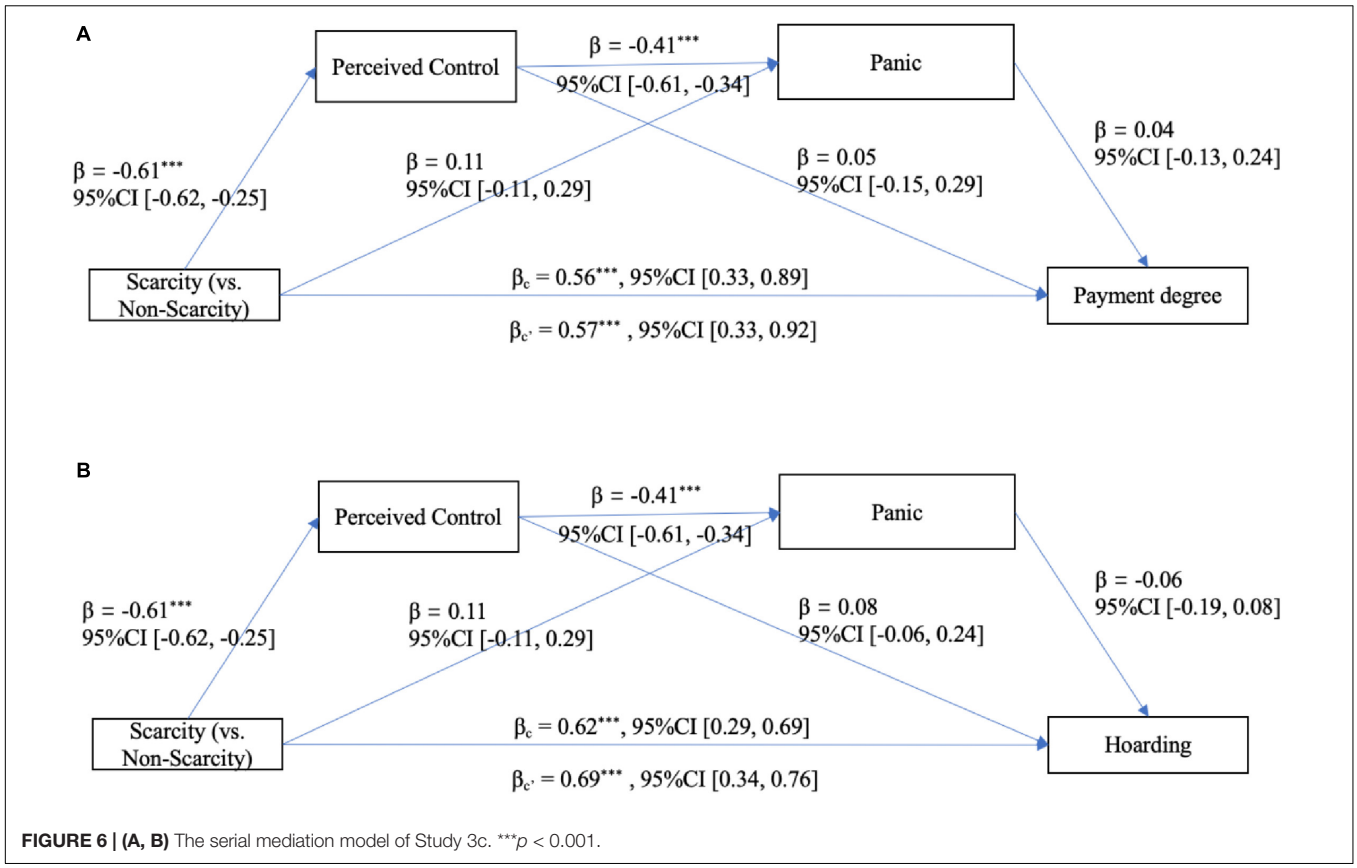

FIGURE 6 | (A, B) The serial mediation model of Study 3c. ***$p < 0.001$.

TABLE 7 | Summary of indirect effects in study 3c.

Indirect effects	Effect (SE)	95%CI
Payment degree		
Total	−0.01 (0.04)	[−0.09, 0.06]
scarcity → perceived control → panic buying	−0.03 (0.04)	[−0.11, 0.04]
scarcity → panic → panic buying	0.004 (0.01)	[−0.01, 0.03]
scarcity → panic → perceived control → panic buying	0.01 (0.01)	[−0.02, 0.04]
Hoarding		
Total	−0.07 (0.04)	[−0.16, 0.02]
scarcity → perceived control → panic buying	−0.05 (0.05)	[−0.14, 0.04]
scarcity → panic → panic buying	−0.01 (0.01)	[−0.04, 0.02]
scarcity → panic → perceived control → panic buying	−0.01 (0.02)	[−0.06, 0.02]

GENERAL DISCUSSION

Panic buying, which is socially undesirable, is usually observed during public emergencies, such as natural disasters like hurricanes, and health crises like SARS and the recent COVID-19 outbreak (Loxton et al., 2020). Discovering the causes and underlying processes of this phenomenon is of paramount significance for both individuals and society. However, the scientific research on this topic is still in its infancy (Yuen et al., 2020; Li et al., 2021; Sherman et al., 2021) despite the increasing focus on panic buying during the recent COVID-19 outbreak. To address this issue, the current study focused on scarcity and explored how scarcity impacts panic buying from a cognition-affect pathway using big data, an online survey and behavioral experiments. Several valuable results were found.

First, the findings suggest that scarcity aggravates panic buying. Scarcity is vital to consuming behavior (Hamilton et al., 2019), and it always occurs during public emergencies. Some studies have previously discussed the effect of scarcity on hoarding (excessive acquisition) in the retail industry (Yangui and Aoud, 2015; Gupta and Gentry, 2016, 2019) and supply chains (Yoon et al., 2018). Although excessive acquisition is a key indicator of panic buying, excessive acquisition in the daily context and panic buying during public emergencies are different in many aspects, such as background, targets, motivation, and magnitude, which may lead to distinctive mechanisms. On the

other hand, since the repeatability crisis of psychological research attracts attention, the background of the results and the extent to which the results can be generalized have become important concerns of researchers (Simons et al., 2017; Anderson et al., 2019). Therefore, while it is of great value to further explore the effect of scarcity on panic buying during public emergencies, few studies have concentrated on this perspective. Our study seems to bridge this gap for the first time.

It is worth mentioning that during our preparation of this article, the work of Islam et al. (2020) was published. They also focused on the aggravating effect of scarcity on "panic buying" through psychological arousal during the COVID-19 outbreak. However, their study used impulsive and obsessive buying as indicators of "panic buying," both of which are essentially different from panic buying (Yuen et al., 2020) and excessive acquisition (Cannito et al., 2021). Based on the academic definition of panic buying and its performance in real life, our study evaluated panic buying from two aspects, namely, the increase of consumption quantity and the increase of consumption price, thus employing hoarding and payment degree as the indicators. This approach better reflects the essence of panic buying and improves the stability of the results. Moreover, our study employed various manifestations of scarcity, which enhanced the robustness of the results (Piff et al., 2010). The results implied that not only subjective scarcity but also perceived scarcity should be considered during public emergencies. When objective scarcity is difficult to alleviate, we can start with subjective scarcity in order to reduce panic buying or other undesirable mindsets.

Second, drawing on the standard learning hierarchical model of consuming decisions (Lee and Goudeau, 2014) and the cognition-affect-coping model of coping behaviors (Jung and Park, 2018), we determined that the link between scarcity and panic buying is transmitted *via* reduced levels of perceived control and enhanced levels of panic, especially in life-threatening crises such as public health emergencies.

As vital psychological variables that impact individual behaviors during public emergencies, perceived control and panic have been found to have independent impacts on panic buying (Sterman and Dogan, 2015; Garbe et al., 2020; Yuen et al., 2020; Bentall et al., 2021); however, few studies have investigated their roles in the relationship between scarcity and panic buying. Our results suggested that perceived control and panic serially mediate the effect of scarcity on panic buying. This serial mediation is a deeper and more stable mechanism of the link between scarcity and panic buying than the independent mediation effects of panic and perceived control. At the same time, the "perceived control → panic" pathway was also previously found to affect individual emotion regulation consumption in disasters (Kemp et al., 2014). These findings implicated the understanding of individuals' consumption behavior during public emergencies from a more comprehensive perspective integrating cognition and affect. Furthermore, the serial mediating pathway suggested, in practice of emergency management, effective policies which compensate perceived control and relive panic subsequently, such as price control, are essential to lessen panic buying.

On the other hand, the serial mediating pathway has boundaries. The pathway is more suitable for public health emergencies such as epidemics and pollutant leakage compared to situations with lower levels of risk. In a public emergency with lower risk, higher familiarity and higher predictability, such as hurricanes, perceived control and panic cannot account for the aggravating effect of scarcity on panic buying. A previous study found a "perceived control → fear/anxiety → hedonic rationalizations → emotion regulation consumption" pattern in hurricanes (Kemp et al., 2014). Integrating our results with those of the previous work reminds us that during public emergencies such as hurricanes, scarcity may impact panic buying through other processes, while perceived control and panic may influence other consumption behaviors.

There are still some limitations of this research. First, the capital (i.e., financial, social, cultural) or other production inputs (i.e., time) that the consumer invests in order to acquire and use goods and services is another type of scarcity found in consumer decision journeys (Hamilton et al., 2019). Whereas the current study mainly focused on product scarcity, future studies can continue to explore the effect of capital scarcity on panic buying and its interaction with product scarcity on panic buying. Second, we used information containing relevant keywords as the objective indicator of scarcity and panic buying in Study 1. Although we did our best to reduce the noise of the information to ensure the highest relevance, more objective and more direct indicators such as supply data and consumer data from authority agencies is needed for future studies. Finally, more investigations on the understanding of the "black box" of the effect of scarcity on panic buying are needed. On the one hand, future research can continue to explore the combination of other psychological variables under the current "cognition-affect" framework to expand the psychological mechanism of the link between scarcity and panic buying. On the other hand, while the current research has mainly focused on the generalization of the serial mediation model in various types of public emergencies, some individual characteristics, as they could affect buying pattern directly or indirectly, should be considered in the future. For example, studies indicated some personality traits (e.g., Yoshino et al., 2021) and the psychological need for necessities products (Di Crosta et al., 2021) were positively correlated to excessive acquisition and spending level. Moreover, health anxiety (HA) predicted attentional bias toward virus-related stimuli (Cannito et al., 2020), and hoarding level affected temporal discounting of mask (Cannito et al., 2021), suggesting HA and hoarding level could influence the relation between scarcity and panic buying they could change individuals' buying pattern. At the same time, the current research has not verified the roles of perceived control and panic in the effect of scarcity on panic buying in emergencies with lower risk, such as hurricanes. This lack of verification suggests that more studies are needed to clarify the effect of scarcity in panic buying in such a context.

Taken together, the present study is an initial attempt to explore the cause of panic buying during public emergencies from the perspective of scarcity. Moreover, it puts forward the cognition-affect serial pathway to interpret the link between scarcity and panic buying during public emergencies, which

integrates a comprehensive formwork of the contextual and psychological antecedents of external behaviors and examines the boundaries of this pathway. This study enriches the relevant research on panic buying and provides some practical guidance for the social management of public emergencies, especially public health emergencies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board for Human Participants at Tsinghua University. The patients/participants provided their online informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JL developed the idea, organized the studies, and revised the manuscript. XM collected and analyzed the data, and drafted the manuscript. Both authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.791850/full#supplementary-material

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Moral Foundations Predict Perceptions of Moral Permissibility of COVID-19 Public Health Guideline Violations in United States University Students

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In the United States, the COVID-19 pandemic has become highly politicized and highly moralized. The current study explored whether participants' ($N = 118$) endorsements of binding (promoting group cohesion) versus individualizing (promoting care for individuals) moral foundations explained partisan differences in views and behaviors regarding COVID-19. Participants completed the Moral Foundations Questionnaire before they indicated how morally permissible they thought it was to violate COVID-19 mandates, report others' violations, or not get vaccinated. Additionally, they indicated their own prevention behaviors. Results show that endorsement of both individualizing and binding foundations explain partisan differences in moral permissibility ratings. Political conservatism predicted greater endorsement of binding foundations which in turn predicted seeing COVID-19 violations and not getting vaccinated as more morally permissible, and predicted fewer self-reported prevention behaviors. Endorsement of individualizing foundations predicted seeing violations as less morally permissible and reporting others' violations as more morally permissible.

Keywords: moral foundations, COVID-19, public health guideline adherence, prevention behaviors, moral judgments

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MORAL FOUNDATIONS PREDICTS PERCEPTIONS OF COVID-19 PUBLIC HEALTH VIOLATIONS

During the COVID-19 pandemic, the decision not to follow public health recommendations can result in negative health consequences, and negative social consequences. For example, if a person chooses not to wear a mask indoors, social-distance from others, or get vaccinated, it could result in their family or friends choosing not to see them, or a business or venue not allowing them to enter. Additionally, these types of behaviors might elicit strong moral judgments from others. Indeed, the moralization of COVID-19 mitigation practices is thought by some to be responsible for the tensions between those who do adhere to practices and those who do not (Prosser et al., 2020). While around the world, strong national identification has been a predictor of adherence to COVID-19 guidelines (Van Bavel et al., 2021), in the United States specifically, political affiliation is one of the strongest predictors of adherence to mitigation practices (Deane et al., 2021); that is, Republicans have been less likely to follow mandates than Democrats.

Indeed, political conservatives have reported being less concerned about the threat of getting COVID-19 (Malloy and Schwartz, 2020; Conway et al., 2021), and less concerned about the threat it might have to the United States population (Deane et al., 2021). Some research suggests that this is due to conservatives' opposition to COVID-related restrictions, which makes them motivated to downplay the threat of COVID-19 (Conway et al., 2021). Republicans have been less supportive of government-mandated shutdowns, masking policies, and social-distancing compared with Democrats since the onset of the pandemic (Deane et al., 2021), and have been less likely to stay at home (Clinton et al., 2021) or report wearing masks (Howard, 2021). But why are attitudes about and compliance with COVID-19 restrictions so partisan?

One possible explanation is the endorsement of different morals. According to Moral Foundations Theory (e.g., Graham et al., 2009), liberals are more likely to endorse "individualizing" morals of *care for others* and *fairness or justice* than conservatives, whereas conservatives are more likely to endorse the "binding" morals of *loyalty to the ingroup*, *respect for authority* (particularly conservative authorities; Frimer et al., 2014), and *physical or spiritual purity* more than liberals. The individualizing morals focus on the treatment of individual people, while the binding morals are centered around group cohesiveness and duty (Graham et al., 2009). However, there is evidence that in the United States, conservatives often endorse both individualizing and binding foundations; that is, liberals show a larger gap between their endorsement of individualizing and binding foundations than conservatives do (Turner-Zwinkels et al., 2021). The five moral foundations have been shown to be stable across cultures (Dogruyol et al., 2019); however, a recent meta-analysis suggests that the relationship between politics and the endorsement of specific foundations may vary by context (Kivikangas et al., 2021).

Over the past decade, research has found that endorsement of moral foundations can explain political differences on a variety of issues, including support for stem cell research (Clifford and Jerit, 2013), attitudes toward the poor (Low and Wui, 2015), willingness to act on climate change (Dickinson et al., 2016), blaming victims versus perpetrators of violence (Niemi and Young, 2016; LaPierre and Bruchmann, 2021), and willingness to befriend political outgroup members (Bruchmann et al., 2018). Additionally, relevant to the COVID-19 pandemic, research has found a link between endorsement of the purity foundation with vaccine hesitancy (Amin et al., 2017; Karimi-Malekabadi et al., 2021); this is likely due to the belief that a vaccine would compromise physical purity.

Moral Foundations and COVID-19

Since the onset of the COVID-19 pandemic, researchers have begun to focus on how moral foundations are related to COVID-19 related behaviors and moral transgressions. Ekici et al. (2021) found that people perceived moral transgressions as more permissible if they happened because of attempts to mitigate COVID-19 threats. For example, participants who endorsed the moral foundations of care, fairness, and purity were more likely to rate a target who missed a sibling's wedding more favorably if they did so to minimize COVID-19 exposure than for another reason. Additionally, research has found that endorsement of care (Díaz and Cova, 2021) and fairness foundations (Chan, 2021) predicted more COVID-19 prevention behaviors. Some evidence suggests that this is because individualizing foundations predict a greater trust in science (Pagliaro et al., 2021). Across these articles, we see consistent evidence that endorsement of the individualizing foundations is important for COVID-19 behaviors and perceptions. But the question remains if moral foundations predict perceptions of *violations* of COVID-19 public health guidelines.

The Present Research

The goal of the present research was to test whether endorsement of moral foundations would predict how permissible people thought it was to violate COVID-19 public health regulations and recommendations, and whether endorsement of moral foundations predicted actual COVID-19 prevention behaviors. Undergraduates completed the moral foundations questionnaire before rating the moral permissibility of behaviors violating COVID-19 guidelines, reporting others' violations of these policies, and not receiving the COVID-19 vaccine. Additionally, participants rated their own prevention behaviors.

We predicted an asymmetrical mediational model such that endorsement of individualizing and binding foundations would both explain the partisan differences in perceptions of COVID-19 related behaviors, but in opposing ways. More specifically, we predicted that endorsement of individualizing foundations would be related to viewing violations of COVID-19 guidelines as less permissible, reporting others' violations as more permissible, and not receiving the vaccine would be less permissible because violations of guidelines both could cause harm to others, and be seen as unfair to those that are adhering. Additionally, we expected that individualizing foundations, consistent with other work, would predict more prevention behaviors. However, we predicted that endorsement of binding foundations would be related to viewing violations of COVID-19 guidelines as more morally permissible. Specifically, due to conservatives' belief in the moral importance of respecting conservative authorities (see Frimer et al., 2014 for examples), messaging from Republican authorities would likely play a large role in citizen's attitudes and subsequent behaviors. In the United States specifically, President Donald Trump and other conservative leaders downplayed the threat of COVID-19 early on, often in opposition with the messages from the United States Chief Medical Advisor and infectious disease specialist Dr. Anthony Fauci and other public health experts (Durkee, 2021). We also predicted that binding foundations would be related to viewing reporting others' violations as less morally permissible because it would violate loyalty to the ingroup, which would consist of other conservatives that are less likely to participate in COVID-19 prevention behaviors. Finally we predicted that binding foundations would be associated with viewing not receiving the vaccine as more permissible because endorsement of the purity foundation is associated with vaccine hesitancy (Amin et al., 2017).

METHODS

Participants and Design

Undergraduates ($N = 118$) at a private Jesuit university in California participated in exchange for partial course credit. We made the *a priori* decision to recruit as many participants as possible during the school term. A *post hoc* Monte Carlo power analysis (Schoemann et al., 2017) suggests that we achieved between 55 and 62% power. Participants were on average 19.3 years old ($SD = 0.90$) and 60% self-categorized as women (35% men and 2% non-binary). Fewer than half self-categorized their race as white (39.2%), 39.2% self-categorized as Asian, 14.4% self-categorized as Hispanic or Latinx, and 7.2% self-categorized as other races. Participants' political orientation skewed liberal with 58.4% identifying as Democrat, 14.4% as Independent, 7.2% as Republican, 2.4% as Libertarian, 1.6% as Green, 9.6% as other (mostly "not political"). Recruitment took place during spring 2021 when most courses were still online, and only a small number of first-year students were living in dorms. Only 17.8% were confirmed to have had COVID-19; of those, only one participant reported severe symptoms. The majority of the sample (75.4%) reported having a loved one who had been diagnosed with COVID-19, and 9.3% reported having lost a loved one to COVID-19. At the point of data collection, vaccinations were widely available; 82.2% reported already being vaccinated. This study was approved by the (Santa Clara University) IRB (ID: 20-11-1530), and all participants provided informed consent online before beginning the study.

Materials and Procedures

First, participants completed the 30-item Moral Foundations Questionnaire (MFQ; Graham et al., 2009). In the first section of the MFQ, participants indicate how relevant statements such as "whether or not someone suffered emotionally" (*care*) are to their judgments of right and wrong (1 = *not at all relevant*, 6 = *extremely relevant*). In the second section of the MFQ, participants indicate their agreement with statements about each foundation (e.g., "people should be loyal to their family members, even when they have done something wrong", *loyalty*; 1 = *completely disagree*, 6 = *completely agree*). Items were aggregated to form composites for individualizing foundations ($\alpha = 0.82$), and binding foundations ($\alpha = 0.86$).

Next, participants completed the 7-item Fear of COVID-19 scale (FCV-19; Ahorsu et al., 2020; $\alpha = 0.89$ in the present sample). Participants indicated their agreement with items such as "When I watch news and stories about COVID-19 on social media, I become nervous or anxious" (1 = *strongly disagree*, 5 = *strongly agree*).

Permissibility of Behaviors

Participants then rated how morally permissible a series of 15 COVID-19 related behaviors were, independent of local, state, or federal guidelines. Participants were asked to assume all parties involved in the scenarios were not vaccinated. Behaviors were categorized as "major violations" (e.g., spending time with people after knowingly testing positive for COVID-19; $\alpha = 0.84$), "minor violations" (e.g., playing contact sports without masks; $\alpha = 0.87$), or "reporting violations" (e.g., telling authorities when someone does not comply with COVID-19 mandates; $\alpha = 0.69$). One item also assessed how morally permissible it would be to not receive the COVID-19 vaccine after becoming eligible. Participants rated each of these behaviors on their moral permissibility (1 = *not at all morally permissible*, 6 = *totally morally permissible*).

Next, participants rated their compliance with specific COVID-19 related behaviors: how often they wash their hands, how often they maintain social-distance with others in public or how often they wear masks in public (1 = *never*, 5 = *frequently*; $\alpha = 0.601$)[1]. And, participants rated their agreement with statements about their behaviors being in total compliance with local and state mandates, and CDC recommendations regarding COVID-19 (1 = *strongly disagree*, 6 = *strongly agree;*$\alpha = 0.98$).

Finally, participants indicated their demographic information, including their political ideology (1 = *extremely liberal*, 6 = *extremely conservative*) before being probed for suspicion and debriefed.

RESULTS

Preliminary Analyses

See **Table 1** for descriptive statistics of all variables. From this table, we see that our participants reported exhibiting COVID-19 prevention behaviors; as a group, they reported social-distancing, masking, and handwashing, $t(117) = 24.75$, $p < 0.001$, $d = 2.28$, far above the midpoint of the scale (3). Similarly, participants reported their compliance with local, state, and federal COVID-19 guidelines to be above the midpoint of the scale (3.5), $t(117) = 10.09$, $p < 0.001$, $d = 0.93$. Consistent with previous research (Atari et al., 2020), women ($M = 4.85$, $SD = 0.54$) were more likely to endorse individualizing foundations than men [$M = 4.48$, $SD = 0.72$; $t(111) = 3.14$, $p = 0.002$, $d = 0.62$]; additionally, as seen in other research (e.g., Capraro and Barcelo, 2020; Galasso et al., 2020), women ($M = 4.37$, $SD = 0.49$) reported more prevention behaviors than men [$M = 4.12$, $SD = 0.65$; $t(111) = 2.24$, $p = 0.027$, $d = 0.56$].

[1]This low value is likely due to low variability in self-reported masking, perhaps because this study took place in California with strict public masking laws.

TABLE 1 | Descriptive statistics for all study variables.

Measures	Possible	Mean	SD
1. Political ideology	1–6	2.21	0.98
2. Individualizing foundations	1–7	4.73	0.64
3. Binding foundations	1–7	3.34	0.73
4. Fear of COVID-19	1–5	2.27	0.94
5. Permissibility of major violations	1–6	2.11	0.99
6. Permissibility of minor violations	1–6	3.10	1.18
7. Permissibility of reporting	1–6	4.16	1.29
8. Permissibility of not receiving vaccine	1–6	2.50	1.44
9. Prevention behaviors	1–5	4.27	0.56
10. Compliance	1–6	4.68	1.27

Do Moral Foundations Explain Political Differences?

In order to test whether moral foundations explain political differences in perceptions of the moral permissibility of COVID-19 guideline violations and prevention behaviors, we conducted mediation analyses using PROCESS (Hayes, 2017) model 4 with continuous political ideology as the predictor (x), our outcomes (ratings of moral permissibility of major COVID-19 violations, minor violations, reporting others' violations, not getting vaccinated, and actual compliance behaviors) as the dependent measures (y), Individualizing and Binding foundations as the mediators (m), and FCV-19 as a covariate[2]. See **Figure 1** for the predicted model. All analyses used 5,000 bootstrap samples.

For all outcomes, the *a* paths to binding foundations from political ideology were significant, $\beta = 0.30$, SE = 0.06, $t = 4.88$, $p < 0.001$, 95% CI (0.18, 0.43). The more conservative participants were, the more they endorsed binding foundations, consistent with previous research. The *a* paths to individualizing foundations from political ideology were also significant, $\beta = -0.16$, SE = 0.06, $t = -2.67$, $p = 0.009$, 95% CI (−0.28, −0.04); the more conservative participants were, the less they endorsed individualizing foundations.

Major Violations

The overall model was significant for major violations, $R^2 = 0.09$, $F(4,112) = 2.72$, $p = 0.033$. The *b* path from binding foundations to major violations was significant, $\beta = 0.41$, SE = 0.15, $t = 2.73$, $p = 0.007$, 95% CI (0.11, 0.70), as was the *b* path from individualizing foundations, $\beta = -0.37$, SE = 0.15, $t = -2.38$, $p = 0.019$, 95% CI (−0.67, −0.06). The direct effect of political ideology on the moral permissibility of major violations (*c* path) was not significant; however, the indirect effect was, $\beta = 0.18$, SE = 0.07, 95% CI (0.05, 0.34). The mediation went through both binding, $\beta = 0.12$, SE = 0.07, 95% CI (0.01, 0.28), and individualizing foundations $\beta = 0.06$, SE = 0.04, 95% CI (0.00, 0.14). In other words, the more participants identified as liberal, the more they endorsed individualizing foundations, and, in turn, the more morally permissible they viewed reporting other people's COVID-19 guideline violations to be.

Minor Violations

The overall model was significant for minor violations, $R^2 = 0.17$, $F(4,112) = 5.84$, $p < 0.001$. The *b* path from binding foundations to the moral permissibility of minor violations was significant, $\beta = 0.46$, SE = 0.17, $t = 2.72$, $p = 0.008$, 95% CI (0.12, 0.79), but the *b* path from individualizing foundations was not, $\beta = -0.23$, SE = 0.17, $t = -1.33$, $p = 0.187$, 95% CI (−0.58, 0.11). Additionally, there was an effect of the covariate FCV-19 on minor violations, $\beta = -0.42$, SE = 0.11, $t = -3.86$, $p < 0.001$, 95% CI (−0.64, −0.21), such that a greater FCV-19 was associated with viewing minor violations as less morally permissible. The direct effect of political ideology on minor violations (*c* path) was not significant, $\beta = -0.28$, SE = 0.12, $t = -0.22$, $p = 0.824$, 95% CI (−0.27, 0.21), however, the indirect effect was, $\beta = 0.18$, SE = 0.08, 95% CI (0.04, 0.34). The mediation went through binding, $\beta = 0.04$, SE = 0.03, 95% CI (−0.01, 0.12), but not individualizing foundations, $\beta = 0.14$, SE = 0.07, 95% CI (−0.01, 0.12). In other words, the more conservative participants were, the more they endorsed binding foundations, and the more morally permissible they found minor COVID-19 guideline violations to be.

Reporting Others' Violations

The overall model was significant for reporting others' violations, $R^2 = 0.18$, $F(4,114) = 12.57$, $p < 0.001$. The *b* path from binding foundations to the moral permissibility of reporting others' violations was not significant, $\beta = -0.26$, SE = 0.18, $t = -1.47$, $p = 0.144$, 95% CI (−0.62, 0.09), but the *b* path from individualizing foundations was, $\beta = 0.63$, SE = 0.19, $t = 3.38$, $p = 0.001$, 95% CI (0.26, 1.00). Additionally, there was an effect of the covariate FCV-19 on reporting, $\beta = 0.38$, SE = 0.12, $t = 3.31$, $p = 0.001$, 95% CI (0.15, 0.62), such that a greater fear of FCV-19 was associated with viewing reporting others' violations as more permissible. The direct effect of political ideology on reporting violations (*c* path) was not significant, $\beta = -0.14$, SE = 0.13, $t = -1.09$, $p = 0.278$, 95% CI (−0.40, 0.11), nor

[2]When including gender as an additional covariate, all patterns remained the same; however, the mediation through Individualizing foundations dropped to marginal significance for the Major Violations outcome.

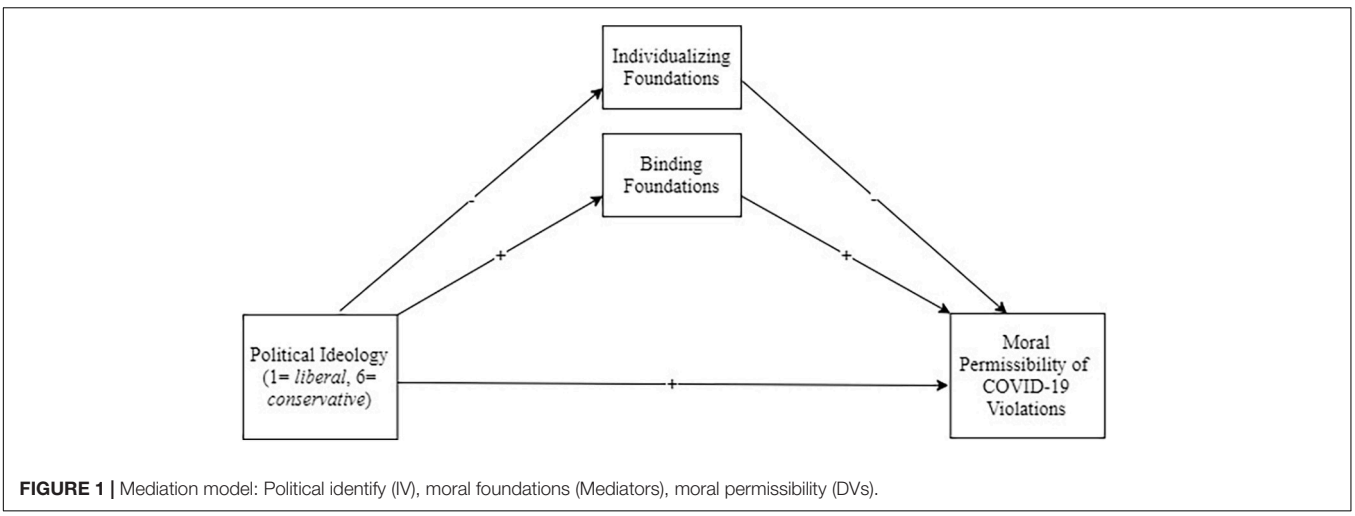

FIGURE 1 | Mediation model: Political identify (IV), moral foundations (Mediators), moral permissibility (DVs).

was the overall indirect effect, β = −0.18, SE = 0.09, 95% CI (−0.36, 0.00). However, there was significant mediation through individualizing foundations, β = −0.10, SE = 0.06, 95% CI (−0.23, −0.02). In other words, the more liberal participants were, the more they endorsed individualizing foundations, and the more morally permissible they viewed reporting other people's COVID-19 guideline violations to be.

Vaccines

The overall model was significant for moral permissibility of not receiving the COVID-19 vaccine, $R^2 = 0.09$, $F(4,112) = 2.63$, $p = 0.038$. The *b* path from binding foundations to the permissibility of not being vaccinated was significant, β = 0.48, SE = 0.16, $t = 2.18$, $p = 0.032$, 95% CI (0.04, 0.91), as was the *b* path from individualizing foundations, β = −0.48, SE = 0.23, $t = -2.12$, $p = 0.038$, 95% CI (−0.93, −0.03). The direct effect of political ideology on permissibility of not getting vaccinated (*c* path) was not significant, β = 0.01, SE = 0.16, $t = 0.05$, $p = 0.961$, 95% CI (−0.31, 0.33); however, the overall indirect effect was, β = 0.22, SE = 0.09, 95% CI (0.04, 0.42). There was significant mediation through individualizing, β = 0.08, SE = 0.05, 95% CI (0.00, 0.18), but not binding foundations (despite the significant direct effect), β = 0.15, SE = 0.08, 95% CI (−0.00, 0.32). In other words, the more liberal the participants were, the more they endorsed individualizing foundations, and thus, the less morally permissible they thought it was for people to choose not to get vaccinated.

Prevention Behaviors and Compliance With Guidelines

The overall model was significant for prevention behaviors, $R^2 = 0.14$, $F(4,112) = 4.46$, $p = 0.002$. The *b* path from binding foundations to prevention behaviors was significant, β = −0.21, SE = 0.08, $t = 1.29$, $p = 0.01$, 95% CI (−0.38, −0.05), but the *b* path from individualizing foundations was not, β = 0.11, SE = 0.09, $t = 1.29$, $p = 0.201$, 95% CI (−0.06, 0.28). Additionally, there was an effect of the covariate FCV-19 on prevention behaviors, β = 0.15, SE = 0.05, $t = 2.78$, $p = 0.007$, 95% CI (0.04, 0.25), such that a greater FCV-19 was associated with exhibiting more prevention behaviors. The direct effect of political ideology (*c* path) on prevention behaviors was not significant, β = −0.01, SE = 0.06, $t = -0.25$, $p = 0.808$, 95% CI (−0.13, 0.10), however, the indirect effect was, β = −0.08, SE = 0.03, 95% CI (−0.16, −0.02). The mediation went through binding, β = −0.07, SE = 0.03, 95% CI (−0.13, −0.01), but not individualizing, β = −0.02, SE = 0.02, 95% CI (−0.06, 0.01). In other words, the more politically conservative participants were, the more they endorsed binding foundations, and the less likely they were to report engaging in COVID-19 prevention behaviors.

For self-reported compliance with COVID-19 guidelines, the model was non-significant, $R^2 = 0.05$, $F(4,112) = 1.54$, $p = 0.221$.

DISCUSSION

This study demonstrates that moral foundations are important to consider when examining attitudes and behaviors during the COVID-19 pandemic. As predicted, both endorsement of binding foundations and individualizing foundations mattered for perceptions of the moral permissibility of COVID-19 related behaviors. Specifically, we saw evidence that higher endorsement of individualizing foundations was associated with viewing major violations of COVID-19 regulations as less morally permissible; likely because major violations of COVID-19 guidelines, such as spending time with someone after knowingly testing positive for the illness, can be seen as both causing harm to others and as unjust or unfair for those who are adhering to guidelines. Additionally, we saw evidence that higher endorsement of the binding foundations was associated with viewing both major and minor violations of COVID-19 regulations as more morally permissible. Research suggests that conservatives—despite being more likely to endorse the authority foundation— view obedience as more positive when it is toward conservative or in-group authorities (Frimer et al., 2014); throughout the COVID-19 pandemic, experts in the United States such as the Center for Disease Control have often been directly at odds with conservative leadership which might undermine their authority.

Inconsistent with previous research (Chan, 2021; Ekici et al., 2021; Pagliaro et al., 2021), we did not see that individualizing foundations predicted more self-reported COVID-19 prevention behaviors, but we did see that binding foundations were related to reporting fewer prevention behaviors such as hand-washing, masking, and social-distancing. This is contrary to recent research in a French population that found that endorsing the binding foundations of authority and purity were associated with *increased* prevention behaviors (Díaz and Cova, 2021), suggesting that the effects we found may be unique to the U.S. American population. Indeed, the COVID-19 pandemic is more politicized and polarized in the United States than other countries (Mordecai and Connaughton, 2020). Despite this, we saw overall that our sample reported very high levels of prevention behaviors, which could be due to social desirability; testing behaviors more objectively would perhaps provide greater variability in results.

Those who endorsed individualizing foundations less were also more likely to view reporting violations as morally permissible. This finding is interesting when considering that generally individualizing foundations are associated with less punitiveness (Silver and Silver, 2017). However, since regulations are in place in order to prevent harm and protect those who are more vulnerable, it may be that endorsing the care foundation makes reporting COVID-19 violations more acceptable. Indeed Ekici et al. (2021) found that moral violations were seen as more permissible when people were exhibiting them to avoid the spread of COVID-19.

Finally, we saw that higher endorsement of individualizing foundations was linked to viewing not getting vaccinated against COVID-19 as *less* morally permissible, and endorsement of binding foundations was linked to viewing not getting vaccinated as *more* morally permissible. Because vaccinations are designed not just to protect the self but to protect the

public from transmission, it is logical that endorsement of the care/harm foundation would be related to seeing vaccination as a moral obligation. Similarly because of the disparities in access (e.g., Joseph and Dore, 2021) to vaccinations worldwide, not getting vaccinated when able may be seen as unjust. However, endorsement of the binding foundation of purity has also been linked to vaccine hesitancy (Amin et al., 2017), which can explain why others' hesitancy might be seen as more permissible.

Limitations

This study was not without limitations. First and foremost, our sample was small, and homogeneous in terms of age (young), politics (liberally skewed), and gender (predominantly female). All three of these factors could influence our results given that age is one of the strongest predictors of risk and severity of COVID-19 infections (Hu et al., 2021), political liberalism is associated with both perceptions of COVID-19 (Conway et al., 2021) and moral foundations (e.g., Graham et al., 2009), and that women are more likely to endorse individualizing foundations than men (Atari et al., 2020), and follow COVID-19 prevention behavior guidelines than men (e.g., Galasso et al., 2020). Future research should test these effects in a sample with more demographic variability in order to replicate or extend these findings. Additionally, the timing of our study may have influenced results; vaccines were already available to our participants (and, most were vaccinated), but the delta variant and other waves of cases had not arrived yet, so participants may have been thinking more retrospectively. Testing these effects during outbreaks of new strains to test how current case rates influence people's perceptions of moral permissibility would help to paint a full picture.

Additionally, future research should include a measure of participants' endorsement of the moral values of liberty, which has become recognized as a sixth moral foundation in recent years (Iyer et al., 2012). Mentions of violations of personal freedoms are rampant among conservative politicians (e.g., Perry et al., 2020) who are against masking laws and other COVID-19 mandates, and personal endorsement of liberty may be a strong predictor of how COVID-19 violations are viewed, and particularly whether people view it as morally permissible to not receive the COVID-19 vaccine (e.g., Amin et al., 2017). And finally, future research should consider other factors such as religiosity (e.g., Malka et al., 2012), (mis)trust in science and/or medicine (e.g., Pagliaro et al., 2021) as tests of alternate mechanisms of the political differences in perceptions of COVID-19 related behaviors.

Conclusion

The political polarization of the COVID-19 pandemic in the United States can be further understood by considering the role of moral foundations. The present study is important both in understanding the far-reaching implications of Moral Foundations Theory, but is also important in understanding what contributes to whether or not people follow COVID-19 guidelines, and how people who do not follow guidelines are viewed. As policies continue to be informed by social science (see Van Bavel et al., 2020), understanding what makes people view violations as morally permissible or not can help public health officials generate targeted campaigns to liberals versus conservatives to be more effective in curbing the spread of COVID-19.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Santa Clara University IRB. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KB and LL contributed to the formulation of the research question and edited and revised the manuscript. KB completed the analyses and wrote the initial draft of the manuscript. Both authors contributed to the article and approved the submitted version.

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Understanding Compliant Behavior During a Pandemic: Contribution From the Perspective of Schema-Based Psychotherapy

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Objective: The current study examined whether compliance with anti-pandemic measures during the COVID-19 pandemic relates to (a) importance of the fulfillment of core psychological needs, namely, *relationship, self-esteem, efficacy,* and *pleasure*; (b) coping behavior styles, namely, *surrender, self-soothing, divert attention,* and *confrontation*; and (c) worries or concerns beyond COVID-19 which may impair wellbeing.

Methods: This study used a cross-sectional design and online survey data from responses to a structured questionnaire developed within the theoretical framework of schema-based psychotherapy on psychological needs and coping behavior styles from 740 participants in Central Europe and West Africa.

Results: Analysis indicated that people with the psychological needs of "pleasure" and "efficacy" and the coping style of "surrender" were more likely to comply with anti-pandemic measures. We also found that people with the coping style of "confrontation" were less likely to comply. There were no statistically significant relationships between compliance and "relationship," "self-esteem," "self-soothing," "divert attention," and "existential concerns."

Discussion: Our findings indicate that how likely a given individual is to comply with prescribed pandemic countermeasures varies based on their specific psychological needs and behavior styles. Therefore, to control contagion during a pandemic, authorities must recognize the relevance of human need fulfillment and their behavior styles and accordingly highlight and encourage admissible and feasible actions. The findings demonstrate that some individual differences in core psychological needs and coping behavior patterns predict compliance behavior.

Keywords: compliance, coping, core psychological needs, COVID-19 pandemic, schema-based psychotherapy

INTRODUCTION

The COVID-19 pandemic has become an unprecedented global threat. The Emergency Committee of the World Health Organization (2020a) declared it a public health emergency of international concern on January 30, 2020, and a pandemic on March 11, 2020. The virus that causes COVID-19, scientifically named SARS-CoV-2, is highly contagious, and the risk of transmission particularly depends on individual and collective behavior. While the disease may be mild for most patients, the risk of hospitalization and mortality increases with age and some underlying conditions (Robert Koch Institut, 2021); the surge of infections and congestion of intensive care units by severe cases have encumbered healthcare infrastructure worldwide. To combat the pandemic, the World Health Organization (2020b) and the disease control organizations of national governments have recommended a series of precautionary measures, including restrictions on travel, public gatherings, in-school teaching, and face-to-face interactions. Several of these measures were unusual prior to pandemic and are fiercely debated both in public and private as they have raised important questions about the meaning of life when basic needs are not met; the intrusive nature of preventive policies with their potential psychological and social consequences; and the risk of creating a new normal with restricted human rights and liberties, among other controversies.

In this study, we sought to understand *compliant* behavior during the pandemic in the light of schema-based psychotherapy with regards to (a) the fulfillment of core psychological needs (CPNs) and (b) coping behavior styles (CBSs). Both concepts are pillars of schema-based psychotherapy. Further, we sought to understand these in the context of people's concerns beyond the pandemic, as potential impediments to wellbeing, analog to the context of concepts of schema-based therapy. As the pandemic may not be the only present threat to wellbeing, we viewed it reasonable to investigate the effects of diverse concerns people have on compliance beyond the pandemic.

This study was motivated by the controversies mentioned above and the fact that pandemics may occur more frequently in the future (*cf.* United Nations, 2020). On the one hand, the anti-pandemic directives tend to facilitate survival, and humans by nature strive to survive. On the other hand, some people comply while others do not. Hence, we are furthermore motivated to understand the reason. From a therapeutic point of view, we infer that compliance can also have a negative connotation when clients should thereby be constrained to grievously suppress their own needs, which can lead to clinical disorders, psychological distress, or impairment of wellbeing. In addition, although there have been several studies on individual coping strategies during the pandemic, to the best of our knowledge, there is no study aimed at understanding compliant behavior during a pandemic from the perspective of schema-based psychotherapy.

THEORETICAL FRAMEWORK

Schema-based psychotherapy (also known as schema therapy) is becoming increasingly popular both among psychotherapy researchers and practitioners. There are two independently developed influential traditions. One tradition particularly conceptualized as *consistency-schema theory* is given by Grawe (2000, 2004). The other tradition, conceptualized as *schema-mode-model*, is given by Young et al. (2007).

Core Psychological Needs

According to the consistency theory (Grawe, 2000; *cf.* Fries and Grawe, 2006; *cf.* Grosse-Holtforth et al., 2008), the striving for consistency of psychic processes is a superordinate principle of psychic functioning. Among others, the core teachings of the consistency theory model are that humans strive for the equilibrium of gratification of the basic psychological needs and that incongruence (a significant form of inconsistency) is a major cause of the development and maintenance of psychopathological symptoms and poor wellbeing. In this theory, Grawe developed the concept of *motivational schemata*, where he differentiates between "avoidance motivational goals" (which are defined as mental representations of undesired transactions with the environment) as opposed to "approach motivational goals" (which are representations of desired transactions). The function of *approach motivational goals* is to ensure that basic needs are satisfied, while *avoidance motivational goals* serve to protect the individual from repetition of aversive experiences. However, if the avoidance schema dominates an individual's life, what originally had the function of protecting the individual's needs (e.g., being separated from others and being criticized) can paradoxically hinder the satisfaction of these same needs. In general, the schemas, which have neurological imprinting, are viewed by Grawe as organized units of psychological regulation for the purpose of reduction of complexity through classification in patterns, according to which they thus govern behavior. In particular, a person's *plan structur*e includes all the conscious and unconscious strategies developed throughout life to instrumentally fulfill one's needs. Thus, in *vertical analysis* (generally in behavioral therapy) or *plan analysis* (particularly in the consistency-schema theory) gratification of basic needs is at the topmost level; accordingly, these needs are the ultimate driving factors of human behavior (*cf.* Caspar et al., 2005; Caspar, 2009, 2018).

The doctrine of basic psychological needs teaches that certain requirements must be fulfilled to sustain a psychological healthy life beyond mere physical existence (Becker, 1995). In his consistency theory, Grawe (2004) proposed the importance of balance in the fulfillment of CPNs, which he regards as the highest *desired value* ("*Sollwert*") of psychological activity. He describes these basic psychological needs as the need for attachment, increasing self-esteem, orientation and control, and gaining pleasure and avoiding displeasure. He views them as pervasive, in that they permeate all mental events.

The innate *desired value* of the need described in psychology as bonding, connection, or connectedness is stated as the basic need for "*relationship*." Grawe's (2004) need for "*self-esteem*" is often misunderstood as the need for *permanently elevating* one's self-worth ("*Selbstwerterhöhung*"). However, it refers to the innate need for an *elevated* self-value (Offurum, 2019). This CPN comprises self-esteem, dignity, respect, autonomy,

and self-determination. The need for orientation and control should be broadly understood as the innate *desired value* of the need to have "freedom of action," self-efficacy, and locus of control or actionability, and includes the need for performance and achievement (Offurum, 2019, 2021). This need is referred to as "*efficacy*," "handling," or "actionability" in the current study. The basic need for "*pleasure*" includes the need for enjoyment, pleasurable experiences, play, fun, relaxation, ease, and esthetics. Grawe emphasizes that the underlying concepts, not the names, are decisive; thus, diversion in terms has existed and may still exist in psychology. To our knowledge, there is no questionnaire in schema-based therapy to examine basic psychological needs during a pandemic. Our items for this study were thus formulated based on preliminary interviews in this field (Offurum, 2021).

Coping Behavior Styles

Young's schema approach (Young et al., 2007; *cf.* Lobbestael et al., 2007; *cf.* Roediger, 2011) is based, among other concepts, on the concept of the *early maladaptive schemas (EMS)*, *maladaptive coping styles and responses,* and the *mode model*. The early maladaptive schemas are emotionally anchored unconscious maladaptive self-defeating core cognitive patterns that an individual develops during childhood, which are elaborated throughout one's lifetime. Young has presented 18 EMSs like *abandonment*, *mistrust/abuse*, *enmeshment*, *grandiosity*, *hypercriticalness,* and *emotional deprivation* (*neglect*). One could view these as person's *sore spots*, which seem compatible with the *avoidance schemas* in Grawe's concept. In Young's theory, behavior is embedded in the three coping styles that form the second main feature in his model. Therein, individuals develop dysfunctional coping styles in order to cope with challenges when their schemas are triggered. These styles are maladaptive in his concept because, although initially they were strategies in coping with painful experience in childhood, paradoxically they are later applied at inadequate situations, thereby contributing to reinforcement and perpetuation of the maladaptive schemas.

In psychology, the transactional model of coping with psychological stress is well established (Folkman et al., 1986). If coping patterns are applied across situations and maintained over a long time, situational (reaction) *states* can transcend time and situations to become personality *traits*. Therefore, coping can be seen as both a situational and a trans-situational response to challenges. It can be studied from different perspectives, such as personality disposition (habitual pattern or schema), situational ego-state (mode), or systemic (transactional dynamic; *cf.* Rexrode et al., 2008).

In psychotherapy, current conceptualizations of coping correspond to the theory of *ad hoc coping strategies* (Horney, 1992) in psychoanalysis, according to which humans have three *ad hoc* strategies to cope with the world at their disposal. The first is the strategy of *moving toward* people. Here, the person exhibits consent or approval and considers others but neglects themself (Smith, 2007). In systemic psychotherapy, Satir (1988) calls this the placating communication style. The current study uses the term *subjugation*. Horney's second strategy, *moving against* others, emphasizes hostility and aggression. Here, life is considered a struggle and the individual exhibits the coping strategy of *fighting*, corresponding to Satir's (1988) blaming communication style. The individual primarily considers themself while neglecting others in the third strategy, *moving away,* the individual *flees*, separating themself and potentially becoming neurotically detached from others, and preventing anyone or anything from touching or mattering to them (Smith, 2007). Horney does not view these *ad hoc* strategies as invariably maladaptive.

Schema therapy, as influenced by Young et al. (2007), emphasizes the maladaptive nature of coping patterns and contains three methods for adapting to one's schema. The first strategy is known as "*surrender*" (in German, the term *Erduldung,* or "*endurance*," is preferred; see Roediger, 2011). The second style is termed "*confrontation*" *or* "*overcompensation*," and the third is called "*avoidance*." A bifocal approach is useful to examine these maladaptive coping behavior styles. The primary perspective defines them as behavioral strategies *vis-à-vis* the overwhelming *feeling* of psychological distress by maladaptive schemas. In the secondary perspective, however, they are also used to explain behavioral maneuvers *vis-à-vis* the *counterparts* that trigger the maladaptive schemas. Regardless of perspectives, the styles are regarded as behavioral responses to the schemas from which they differ. Further, while "surrender" ("subjugation" or "placating") and "confrontation ("fight" or "counter attack") exhibit proximity, avoidance can be seen in a passive and active manner: active in the sense of fleeing, or diverting attention (rationalizer or distractor style), and passive in the sense of *pacifying* or *self-soothing*. The categorization may seem ambiguous, as some authors (e.g., Atkinson, 2012; Faßbinder et al., 2016) write that *freezing* belongs to the same category as *surrender/subjugation*, while others (Roediger and Zarbock, 2015) categorize it under *avoidance*.

Existing questionnaires explore coping behaviors from various theoretical perspectives. The Ways of Coping Questionnaire is based on Lazarus's cognitive theory of psychological stress and coping (Folkman et al., 1986). Similar to various adaptations (Sawang et al., 2010; Senol-Durak et al., 2011; Kolokotroni, 2014), the items used in our study are based on Folkman et al.'s (1986) concept, which have been incorporated within the framework of *schema-oriented psychotherapy.*

Worry or Concerns

Both Grawe's and Young's traditions of schema-based psychotherapy dwell in the context of impairment of wellbeing, here conceptualized as worry or concerns in a non-clinical context. Concern or worry may be attributed to cognitive-emotive preoccupation with uncertainty, anxiety, and apprehension about the future. Excessive and uncontrollable worry constitutes the main diagnostic criterion for generalized anxiety disorder. Pathological worry is experienced as emotionally distressing and impairing. Although uncomfortable and potentially detrimental to health, worry can have the advantage of helping people avoid or solve problems (Borkovec et al., 1983). With novel threats, as in the present pandemic, and when individuals do not feel in control of the risk, they are more concerned (Carlucci et al., 2020).

The current study focuses on the concept of worry or concern, regardless of pathological status. We investigated whether concerns/worry about issues beyond the pandemic affected compliance with pandemic-related restrictions by asking participants how worried they were about the following: (a) health issues, (b) crime and social insecurity, (c) setback at school or work, and (d) financial or economic problems.

Compliance

Compliance is the dependent variable in this study. In medical practice, compliance or adherence describes the degree to which a patient follows medical advice. In this research, compliance refers to the application of therapeutic suggestions, both for treatment and prevention. Compliance with pandemic-related recommendations can generally be compared with adherence to medical guidelines. However, while non-adherence to personal medical advice may have no legal repercussions, defiance of pandemic regulations may carry severe legal consequences because the success of these measures rests on the individual's compliance.

Although governmental responses to the pandemic have varied, most are comparable in their severity, duration, and types (Ritchie et al., 2021). To investigate compliant behavior, we employed the World Health Organization's (2020b) recommendations, representing the cardinal guidelines imposed worldwide: regularly and thoroughly washing one's hands with soap and disinfecting them to eliminate germs and viruses; wearing a mask or face shield in public; avoiding close contact, particularly shaking hands and hugging; cleaning and disinfecting surfaces frequently, especially those which are regularly touched, such as door handles, faucets, and phone screens; reduction of public transport; avoiding crowds; and fostering one's immunity. At this stage of the pandemic, no vaccine was available, and because eradication of the virus is not possible, the main purpose of these prescriptions was to "flatten the curve" of its spread to prevent the congestion of intensive care units and prevent triage.

There have been many studies on compliance during the present pandemic: Some studies (Brouard et al., 2020; Carlucci et al., 2020; Raude et al., 2020) discuss the socio-demographics of individuals with regard to their compliance. Others, like Blais et al. (2021) and Dinić and Bodroža (2021), have studied personality differences that may relate to compliance. Farias and Pilati (2021) studied political ideology, while some others (Plohl and Musil, 2021; Wright et al., 2021) studied trust in science, government, and/or medical professionals. Baloran (2020) and Wang et al. (2020) studied coping during this pandemic. Orgilés et al. (2021) and Donato et al. (2020) studied disturbance, worry, or concern. Eisenbeck et al. (2021) studied meaning-centered coping. While these studies are very informative, none examine behavior in the light of an (influential) psychological/psychotherapy concept like schema-based therapy; thus, the present study aims to fill this gap.

Hypotheses

This study sheds light on the effect of CPNs (Hypotheses 1–4), coping styles (Hypotheses 5–8), and concerns other than the pandemic (Hypothesis 9) on participant's compliance with anti-pandemic measures (**Supplementary Figure 1**).

Hypotheses 1, 2: The more essential the fulfillment of fundamental needs of (i) ("relationship" or "self-esteem") are during the pandemic, the less compliant people are as: H0[1, 2]: $\beta i \geq 0$ versus H1[1, 2]: $\beta i < 0$.

Hypotheses 3, 4: The more essential the fulfillment of fundamental needs of (i) ("efficacy" or "pleasure") are during the pandemic, the more compliant people are as: H0[3, 4]: $\beta i \leq 0$ versus H1[3, 4]: $\beta i > 0$.

Hypotheses 5, 6: The higher the value of the coping behavior style of (i) ("self-soothing" or "surrender") are, the more compliant people are as: H0[5, 6]: $\beta i \leq 0$ versus H1[5, 6]: $\beta i > 0$.

Hypotheses 7, 8: The higher the value of the coping behavior style of (i) ("confrontation" or "divert attention") are, the less compliant people are as: H0[7, 8]: $\beta i \geq 0$ versus H1[7, 8]: $\beta i < 0$.

Hypothesis 9: With regard to concerns, we hypothesize that the stronger the concerns (i) are, the more compliant people are as: H0[9]: $\beta i \leq 0$ versus H1[9]: $\beta i > 0$.

βi = Regression coefficient of individual predictor.

MATERIALS AND METHODS

Study Design

Having developed the items for our study with care and in line with the theoretical framework mentioned above, we performed "face-to-face item-pretests." These were performed *via* video telephony due to movement and travel restrictions. The interviewers were similar to the intended participants, being males or females who were not experts in the field of research. We chose five individuals from each area targeted for dissemination and provided them with the pretest questions. While completing the questionnaire, they were repeatedly requested to be very critical and to comment on anything that crossed their mind (simply think aloud approach); especially, where something seemed unclear or ambiguous. Notes of the testers' comments were taken, and further questions asked (verbal probing approach) to ensure, for example, that the questions were understood and answered in terms of the construct. The questionnaire was improved accordingly after each pretest followed by further rounds of pretests.

This method of pretesting as provided by the applied software (SoSciSurvey, 2020) corresponds to the concept of cognitive interviews. In cognitive interviews, ensuring validity of the research instrument involves examining how respondents (a) understand the question, (b) retrieve relevant information, (c) judge their answer, and (d) assign their response into the questionnaire (Ryan et al., 2012). The goal was therefore to utilize the information during the various pretests to improve the quality of the questionnaire, and thus, the quality of responses. Cognitive interviews were primarily developed to test each question in a

questionnaire but not to check the technical functionality of a questionnaire. For this reason, it was supplemented with further "online pretests" (pretest without the researcher's presence). The pretest hyperlink was thus distributed to testers who accessed the questionnaire without the involvement of the researchers. They were requested to leave comments about the questionnaire in the test-comment area provided by the software. The questionnaire was improved accordingly and as a result, the best qualified items were selected. Finally, additional tests of technical functionalities were performed using a PC, tablet, and smart phone with various browsers, prior to questionnaire administration.

In September 2020, we launched the comprehensive cross-sectional online survey. The questionnaire was provided on the survey platform *SosciSurvey* and, for security and data protection reasons, hosted on the server of the Sigmund Freud University, Vienna, Austria. The survey was conducted until January 2021.

Participants

The prospective participant had to be a literate individual aged 18 years or above who had a PC or smartphone and Internet access at the time. Individuals under 18 years were explicitly excluded, while those who were not literate or lacked Internet access or access to a PC or smartphone were *de facto* excluded. Our objective was to recruit participants from Central Europe, West Africa, and America, along with the help of our research colleagues in those regions. However, due to unforeseen circumstances, the colleague in America was unable to disseminate the questionnaires. In the other locations, the the invitation with link to participate was disseminated, particularly *via* the administration offices of educational institutions, to all members of the institution (not just students). We additionally disseminated directly to our students or clients during lectures. The invitation contained a request to forward the link to friends or colleagues who met the inclusion criteria. The research was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki, 1964) and with the approval of the Ethics Commission of the Institut *für Verhaltenstherapie* (Institute for Cognitive Behavior Psychotherapy Training and Research), AVM, Salzburg, Austria. Participants were informed of the study's purpose and procedure, guarantee of anonymity and data protection, and voluntariness of participation, and informed consent was obtained from all respondents prior to participation. To answer our research questions, we extracted the relevant sections from the comprehensive survey. The questionnaire was structured such that no missing items were allowed. After data cleaning (Leiner, 2019), 740 responses were analyzed.

Respondents' demographics were as follows: 450 women (60.8%) and 290 men (39.2%); 380 from Austria (51.4%), 44 from Germany (5.9%), 290 from Nigeria (39.2%), and 26 from other countries (3.5%); mean age was 32.06 years, median of 28.50, standard deviation of 12.547, variance of 157.429, minimum of 18, and maximum of 83 years.

Regarding the COVID-19 status in the countries where major participants were situated, Nigeria and Austria were in their second wave of infections, and Germany was in its third (or extended second) wave. Nigeria restricted public gatherings between 10 and 100 people and workplace closures were recommended. In Austria and Germany, public gatherings were limited to less than 10 people and workplace closures were required, except for essential workers. In all three countries, school closures were mandatory, and face covering policies were implemented in all public spaces. According to a stringency index where 100% denotes the most strict protocols, Nigeria, Austria, and Germany scored 58.33, 82.41, and 82.41%, respectively, at the time. The nine metrics used to calculate the Stringency Index are school closures, workplace closures, cancelation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls (Ritchie et al., 2021).

Based on age, social-generational groups were represented as follows: 254 participants (34.3%) belonged to Generation Z, with a maximum age of 23 years; 294 (39.7%) to Generation Y (millennials), aged 24–39; 151 (20.4%) to Generation X at ages 40–55; 41 (5.5%) to the Baby Boomers; and traditionalist/silent generation, aged 56–92.

Thirty-five (4.7%) participants had junior secondary education (e.g., GED and GCSE) or lower, 249 (33.6%) had senior secondary education or a high school diploma/A-levels, 121 (16.4%) had an undergraduate diploma degree (OND, HND, or equivalent), 175 (23.6%) had a bachelor's degree (BA, BSc, or equivalent), 104 (14.1%) had a master's degree (MA, MSc., MPhil., or equivalent), 23 (3.1%) had a doctorate (PhD or equivalent), and 33 (4.5%) had other education or qualifications (**Supplementary Table 1**).

Instrument, Procedure, and Preliminary Data Analyses

The Statistical Package for Social Science was employed for data analyses. To elicit meaningful and valid meta-scales based on the items, and to empirically verify our hypotheses, we conducted exploratory factor analyses (EFAs) of (1) compliance with the anti-pandemic recommendations, (2) the CPNs, (3) the CBSs, and (4) concerns. The EFAs were conducted to establish unidimensional scales, ensuring that an individual scale is not influenced by confounding factors, thereby obtaining valid measurements of the underlying concepts.

These preliminary analyses were performed according to the following unitary pattern: (a) presenting the items and checking the suitability of the data as per Bartlett's and Kaiser–Meyer–Olkin (KMO) tests; (b) factor analyses using the scree plot and rotated component matrix to determine the optimal number of factors, followed by the interpretations; and (c) defining suitable terms for each factor.

EFA of Compliance

We applied the World Health Organization (2020b) pandemic prevention guidelines at the time to investigate compliant behavior. On a five-point Likert scale (1 = never; 5 = always), we rated participants' compliance with the following items: "I

cleanse my hands with soap and water and/or use hand-sanitizer more regularly," "I wear a mask or face shield at public premises to protect myself and/or others," "I avoid shaking hands or hugging people," "I clean or disinfect surfaces I might touch more often," "I have stopped or reduced traveling by public transport," "I avoid group events or crowded places," and "I am trying to boost my immunity (e.g., with vitamins, healthy food, sports)" (**Supplementary Table 2**). To check the suitability of the data for the EFA, the KMO criterion and Bartlett's test of sphericity were calculated. Bartlett's test yielded $p \leq 0.001$, indicating high significance. The KMO value was 0.84, ensuring highly suitability for the EFA.

To verify the unidimensionality of compliance items, a scree plot analysis was conducted (**Supplementary Figure 2**). The scree plot showed that only one eigenvalue exceeds the Kaiser criterion of 1, thus confirming the unidimensionality of the compliance items being suitable to be combined to one scale. The unidimensional factor is termed "compliance."

EFA of Relevance of Fulfillment of CPNs

On a five-point Likert scale (1 = not; 5 = very), participants rated the necessity for them to get their CPNs fulfilled during/despite the pandemic. The items used in this analysis are listed in **Supplementary Table 3**. To check the suitability of the data for the EFA, the KMO criterion and Bartlett's test of sphericity were employed. Bartlett's test yielded $p \leq 0.001$, indicating high significance. The KMO value was 0.90, ensuring high suitability for the EFA.

To elicit the optimal number of factors, a scree plot was drawn, and the Kaiser criterion was applied (**Supplementary Figure 3**). Based on the scree plot and Kaiser criterion, an eigenvalue of the factor above 1 indicated four to be the optimal number of factors. Thus, EFA was conducted using four factors. Further, to provide an intuitive interpretation of the analysis and the best possible separation among the four factors, a varimax rotation was applied.

The EFA results (**Supplementary Table 3**) show that our items can be meaningfully grouped following the fundamental theory of CPNs in schema-oriented psychotherapy. These factors are named "efficacy," "pleasure," "relationship," and "self-esteem." Our empirical analysis thus supports the underlying structures of CPNs theorized above. In contrast to expectations, the items BV04_10, BV05_04, BV05_05, BV05_08, and BV05_10 did not follow the structure of previously theorized scales. To analyze the validity of the categorization of these items, different rotation and extraction methods were applied. Three (BV05_04, BV05_08, and BV05_10) of the items were unable to meet both theoretically and statistically meaningful groupings to justify their inclusion and were, therefore, dropped. Regarding the variance explained by the factors, each factor explains approximately the same amount, indicating a similar level of importance.

EFA of CBSs

On a five-point Likert scale (1 = never; 5 = always), participants rated how they dealt with the challenges of the present pandemic. The items used in this analysis are listed in **Supplementary Table 4**. With respect to coping based on behavioral style, Bartlett's test yielded $p < 0.001$, indicating high significance. The KMO value was 0.85, ensuring the suitability of the data for conducting an EFA.

To elicit the optimal number of factors, a scree plot was drawn, and the Kaiser criterion was applied (**Supplementary Figure 4**). Based on the scree plot and Kaiser criterion, an eigenvalue of the factor above 1 indicated four to be the optimal number of factors. Thus, EFA was also conducted using four factors. To provide an intuitive interpretation of the analysis and the best possible separation among the four factors, a varimax rotation was applied.

As shown by the results (**Supplementary Table 4**), the items can be meaningfully grouped and the factors established can be identified with the terms "self-soothing," "confrontation," "surrender," and "divert attention." However, two items (BV06_07 reflecting "escape" and BV07_09 reflecting "confrontation") were theoretically unsuitable to justify their inclusion in the group "self-soothing" and were thus dropped.

EFA of Concerns

In this analysis, the participants' concerns for health issues, crime and social insecurity, setback at school or work, and financial or economic problems rated on a five-point Likert scale (1 = not at all; 5 = very much) were evaluated. Bartlett's test yielded $p < 0.001$, indicating high significance. The KMO value was 0.705, ensuring the suitability of the data for conducting an EFA. The scree plot analysis (**Supplementary Figure 5**) showed the unidimensionality of concern items, thus suitable to be combined to one scale. The unidimensional factor is termed "existential concerns."

RESULTS

Overview of the Scales

As shown in **Table 1**, descriptive parameters, such as means, standard deviations, skewness, and kurtosis of the scales, do not exhibit any irregularities. Generally, Cronbach values of approximately 0.65 are considered moderate but acceptable, mainly where small item-numbers are involved in exploratory research (Hinton et al., 2004; Hair et al., 2014). With values ranging from 0.65 to 0.83, the Cronbach's alphas of our scales, therefore, indicate acceptable to very good reliability. The corresponding Omega values are presented in the table. The table also shows that all significant intercorrelations have positive intercorrelations, as theoretically expected. Thus, good criterion validity is assumed.

Multiple Linear Regression Suitability Analysis

Multiple linear regression is a statistical method to estimate the relationship between several explanatory (independent) variables and one observed (dependent) variable. To provide valid results, the linear multiple regression is based on several statistical assumptions, such as linearity of the associations (multivariate), normality (data is symmetrically distributed with

TABLE 1 | Intercorrelations of scales based on exploratory factor analysis.

		Descriptive parameters. Reliabilities and intercorrelations of scales																	
S. No.	**Scale**	***M***	***SE***	***SD***	**Skewness**	**Kurtosis**	**Ω**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
1.	Compliance	3.76	0.03	0.81	−0.52	−0.21	0.83	(0.83)											
2.	CPN-relationship	3.43	0.03	0.81	−0.15	−0.33	0.75	0.275***	(0.74)										
3.	CPN-self-esteem	3.14	0.03	0.89	−0.06	−0.52	0.67	0.124***	0.223***	(0.66)									
4.	CPN-efficacy	3.65	0.03	0.76	−0.33	−0.05	0.73	0.242***	0.423***	0.498***	(0.73)								
5.	CPN-pleasure	3.61	0.03	0.76	−0.28	−0.05	0.78	0.326***	0.459***	0.353***	0.563***	(0.78)							
6.	CBS-self-soothing	2.32	0.03	0.91	0.62	−0.08	0.73	0.093*	0.244***	0.339***	0.089*	0.091*	(0.73)						
7.	CBS-confrontation	3.00	0.03	0.87	0.20	−0.21	0.68	−0.036	0.032	0.493***	0.364***	0.249***	0.371***	(0.68)					
8.	CBS-surrender	2.93	0.03	0.82	0.18	−0.06	0.67	0.314***	0.189***	0.298***	0.194***	0.208***	0.422***	0.317***	(0.65)				
9.	CBS-divert attention	3.31	0.03	0.92	−0.26	−0.07	–	0.237***	0.317***	0.423***	0.384***	0.469***	0.353***	0.358***	0.375***	(0.69)			
10.	Existential concerns	3.22	0.04	1.06	−0.10	−0.90	0.79	0.004	0.157***	0.405***	0.248***	0.185***	0.274***	0.333***	0.211***	0.210	(0.77)		

$^{*}p \leq 0.05$ and $^{***}p \leq 0.001$. $N = 740$; Diagonal: Cronbach's alpha; CPN, core psychological need; and CBS, coping behavior style, existential concerns. Omega (Ω) using macros by Hayes on SPSS. Omega for "divert attention" not calculable due to unavailability of minimum number of items.

no skew), no multicollinearity, and homogeneity of variance (homoscedasticity of residuals).

Linearity of the association was double-checked by partial added plots not indicating any better association than the (applied) linear one. The assumption of normally distributed residuals was visualized by a P–P plot indicating no violation of the assumption. Possible multicollinearity problems were double-checked by calculating the variance inflation factor (VIF). With VIF values of <2.81, no multicollinearity problems were identified. Minor heteroscedasticity issue was detected with the scatterplot between fitted and actual values. Accordingly, heteroscedasticity consistent standard error (Hayes and Cai, 2007) was applied to improve the model and to ensure the results' validity. Consequent to these preliminary analyses, the model's result can be presumed to be valid. Finally, covariates, such as age, gender, education, savings, and country, were included to control for socio-demographic variables.

Test of Hypotheses: Effect of CPNs, CBSs, and Concerns on Compliance

As shown in **Table 2**, the overall regression model achieved an R^2 of 0.232, with a significant value of $p < 0.001$, indicating the relevant effects measured within the model.

With a significant value of p of 0.047 and a regression coefficient of 0.116, a positive effect of psychological need for "efficacy" was confirmed. Thus, the more essential that the basic psychological need is to handle (self-efficacy), the higher compliance can be expected.

With a significant value of $p < 0.001$ and a regression coefficient of 0.193, the positive effect of psychological need for "pleasure" was verified. Thus, the more essential the fulfillment of the CPN for "pleasure" is during the pandemic, the higher the expected compliance with policies.

With a significant value of $p < 0.001$ and a regression coefficient of −0.165, the negative effect of "confrontation" was verified. Thus, the higher the coping behavior style of confrontation during the pandemic, the lower the expected compliance with policies.

With a significant value of $p < 0.001$ and a regression coefficient of 0.310, a positive effect of "surrender" was confirmed. Thus, the higher be coping behavior style of surrendering in dealing with the pandemic, the higher compliance can be expected.

With respect to the standardized coefficient, the effect size of "CBS-surrender" on "compliance" (0.309) was greater than that of "CPN-pleasure" on "compliance" (0.180), followed by "CBS-confrontation" (−0.177) and "CPN-efficacy" (0.107). In the case of other effects, such as "relationship," "self-esteem," "self-soothing," "divert attention," or "existential concerns," no significant effect on compliance was confirmed.

DISCUSSION

Core Psychological Needs

This study aims to contribute to understanding behavior during the pandemic in the light of theories of schema-based therapy.

Grawe's tradition teaches that topmost motivational factor of human behavior lies in the gratification of the basic needs, as demonstrated in plan analysis (Caspar, 2009, 2018). Accordingly, the individual's motivation to comply with measures during the pandemic would depend on their topmost "plan," and the topmost level of a person's plan structure consists of the psychological needs essential to them at the given time. These needs can be categorized into the core needs of (a) "relationship," (b) "self-esteem/dignity/recognition/self-determination," (c) "efficacy/handling/actionability," and (d) "pleasure/easiness/gaudium" (Grawe, 2004; Offurum, 2019).

We therefore assessed the importance of the core psychological needs during the pandemic and tested the hypotheses that with the topmost motivation being the gratification of the CPN for "relationship" or "self-esteem," individuals would not comply with the anti-pandemic policies, but with the topmost motivation being "efficacy" or "pleasure," individuals would indeed comply with the anti-pandemic policies.

These assumptions were based on the premises that, due to the nature of the pandemic (contagion through contact), the measures restrict contact, which is a core aspect of relationship and that, due to the nature of sanctioning, individuals whose topmost plan during the pandemic was self-esteem (dignity) were highly challenged. However, for those whose topmost plan toward the pandemic lies in the category of efficacy (actionability), the measures provide an opportunity to act; and individuals whose topmost plan during pandemic was to experience pleasure and avoid pain would comply in order to avoid the pain of the viral infection.

Our results show that the four-factor categorization of basic needs according to the conceptualization of Grawe's tradition of schema-based therapy is adoptable. Further, our results show that the higher the importance of fulfillment of the CPN for *efficacy*, the higher compliance can be expected. This seems to demonstrate the driving factor of efficacy (actionability, control, or achievement of solution) amidst the threats of the pandemic. Perhaps, those whose topmost plan toward the pandemic lies in efficacy cannot endure being passive toward the threats.

Our results also show the higher the importance of fulfillment of the CPN for *pleasure*, the higher compliance can be expected. This seems to suggest that restrictions on festivities must not have prevented individuals from having pleasure, or that avoiding pain, which is a core aspect of the CPN for pleasure, must be a driving force for compliance. However, we found no statistically significant relationship between the CPNs of relationship and self-esteem with compliance. Concerning relationship, this may be because the restrictions of human contact to curtail the pandemic may have particularly jeopardized the fulfillment of needs for relationship, but that relationship *via* digital technology must have partially compensated the deficit, however not enough for statistically significant positive effect on compliance. Concerning self-esteem, this may be because for these people, maintaining elevated self-esteem was indeed essential at the time, but unlike the factor "relationship," self-esteem may not have been very much challenged by these restrictions, particularly not by those on human contact. However, the self-esteem of people must have still not been considered enough by authorities to provide for a statistically significant positive effect on compliance.

Behavior Styles

Young's tradition of schema-based therapy differentiates between the maladaptive *coping styles and responses* of "surrender," "avoidance," and "confrontation," whereby avoidance is viewed in an active ("flight"/"divert attention") or passive ("pacifying"/"self-soothing") way. We therefore accessed the coping styles of participants during the pandemic and tested the hypotheses that participants exhibiting the behavior styles of "confrontation" and "diversion of attention" would significantly express low compliance, while participants exhibiting the styles of "surrender" and "self-soothing" would significantly express high compliance.

Our results indicate that the four factors established could be meaningfully termed "surrender," "self-soothing," "divert attention," and "confrontation," and that the four-factor categorization of coping styles is adoptable for schema-based therapy. Although here the term "divert attention" best reflects the factor established by the present items, it still corresponds

TABLE 2 | Regression analysis of the effect of CPNs, CBSs, and concerns on compliance.

Dependent variable: Scale compliance			$R^2 = 0.232$	$F_{(16;684)} = 12.640$	$p > \|F\| = 0.000$***
Items	***Coeff.***	***SE* (*HC*)**	***Coeff* (*Std.*)**	***t***	***p* > |*t*|**
(Constant)	1.923	0.248		7.741	0.000***
Scale CPN-relationship	0.053	0.046	0.053	1.158	0.247
Scale CPN-self-esteem	0.032	0.045	0.034	0.704	0.482
Scale CPN-efficacy	0.116	0.058	0.107	1.988	0.047*
Scale CPN-pleasure	0.193	0.051	0.18	3.824	0.000***
Scale CBS-soother	0.024	0.042	0.027	0.562	0.574
Scale CBS-confrontation	−0.165	0.047	−0.177	−3.531	0.000***
Scale CBS-surrender	0.31	0.042	0.309	7.393	0.000***
Scale CBS-divert attention	0.037	0.037	0.042	1.006	0.315
Scale CBS-existential concerns	−0.047	0.034	−0.061	−1.377	0.169

*$p \leq 0.05$ and ***$p \leq 0.001$.

HC, Heteroscedasticity consistent standard errors; Covariates: Age, gender, educational level, country, and savings; CPN, Core psychological need; and CBS, Coping behavior style.

with the concept of "active avoidance" or "escape" used in Young's theory; as such, this grouping is principally in line with the fundamental theory of the coping styles in schema-oriented psychotherapy. Nevertheless, this observation may be useful for improvement of items in future research, as it may indicate a more complex underlying structure and may provide a step forward to resolve the ambiguity in conceptualization (*cf.* "freezing" by Atkinson, 2012; Faßbinder et al., 2016 versus Roediger and Zarbock, 2015) as mentioned above.

Further, our results show that the higher the coping style of "confrontation," the less compliance can be expected, presenting a negative significant effect of "confrontation" on "compliance." Our interpretation is that the coping style of "fighting against" in response to a threat is explained in psychology of motivation with the concept of "reactance" as the immediate response to restriction of freedom, particularly where the restrictions are not perceived as legitimate or justified and the restriction is not irrelevant (Graupmann et al., 2016). Furthermore, we did not find that either "self-soothing" or "divert attention" had a significant effect of on compliance. We consider that these passive and active forms of avoidance have no significant effect on compliance because they do not express proximity, which may be decisive for positive or negative compliance. While Karmakar et al. (2021) found self-soothing as a coping style during the present pandemic, Orgilés et al. (2021) found that avoidance-oriented styles were related to better psychological adaptation during the present pandemic. Further, our results show that the coping style of "surrender" correlates significantly with compliance, expressing a positive significant effect of "surrender" on "compliance." This is not surprising, as the behavior style of succumbing-to or giving-in would imply abiding with sanctions. These findings seem in line with Blais et al. (2021), who found that "rule-followers" (*cf.* "CBS-surrender") and "deliberate planners" (*cf.* CPN-efficacy) exhibit greater compliance in social distancing than those who are callous and antagonistic in personality.

Concerns

Both traditions of schema-based therapy dwell in the context of personal distress and impairment of wellbeing, and within this study, they are conceptualized as worry or concerns in a non-clinical context. We therefore accessed participants' concerns during the pandemic in our model and additionally tested the hypothesis that the stronger participants' other existential concerns are, for example, with health issues, crime and social insecurity, setback at school or work, and financial or economic problems, the less compliant they are. This hypothesis could not be verified, showing that these existential issues do not show any statistically significant effect on whether individuals comply with anti-pandemic recommendations or not. Imbriano et al. (2021) likewise found no significant association of worry with compliance with health behaviors.

Contribution to the Literature

Our research holds practical value to the literature input. First, to the best of our knowledge, this is the first study to investigate compliance behavior during a pandemic in light of the fundamentals of schema-based psychotherapy. Second, we believe that our findings can be beneficial for citizens, policymakers, risk managers, researchers, and experts in human behavior and health as our research contributes to the understanding of the psychological aspect of behavior during a pandemic. Microbiological and epidemiological data, although valuable, cannot exclusively inform pandemic policy; holistic approaches require a more in-depth knowledge of human behavior. Finally, our work presents a preliminary step toward reconciling the two independently developed traditions in schema-oriented psychotherapy.

Limitations

It may be easy to endorse the finding that people tend to comply to anti-pandemic measures when they possess the coping style of submission. However, we venture to claim that compliance with pandemic measures does not necessarily signify subservience to authorities. Our findings do not demonstrate all motivations for compliance and non-compliance. There must be others: For instance, Dinić and Bodroža (2021) found that selfishness had negative effects on compliance with protective measures, and prosocial tendencies in general positively correlate with protective behaviors. Individuals may be non-compliant to demonstrate their disagreement with the authorities, or as an exhibition of power. It may even be an infantile act of defiance or influenced by peer pressure. Major barriers to compliance may include the complexity of the problem, the demands made by authorities and the steps to be taken, as well as misunderstanding the benefits of compliance. People could also fear side effects, be skeptical of costs, or feel suspicion backed by true experiences. Compliance may also be rooted in infantile servility, mental thralldom, or renunciation of responsibility. Further research is definitely needed.

There are some particular limitations we ought to note: Our study relied on self-reported responses, which are influenced by respondents' imperfect memory or social desirability. Although data on personal needs and coping styles can primarily be self-reported, limitations inherent to self-report measures may affect results.

Further, it was convenient for participation to be online. However, persons with Internet access might not represent the general population. Thus, our findings are to be interpreted with respect to context and limitations, and generalized with care. Above, we illustrated the socio-demographic characteristics of participants and presented the descriptive statistics of the age of participants, not based on an idealized symmetric distribution (biological age grouping in 10 or 20 years) but grouped in the social-generational groups. Social generations are viewed as cohorts, whereby a cohort is seen as people within a delineated population who experienced significant range of same life event within a given historical time (Pilcher, 1994). Beyond the sociological dimension, the concept of a social generation provides a psychological dimension in the sense of belonging and shared identity to understand a socio-demographic (Biggs, 2007). Sandeen (2008), with reference to Strauss and Howe, views it as a "peer

personality" and suggests that social-generational groups act as very meaningful segmentation in research. With 74% of participants belonging to Generation Z and Y, generalization to other social age groups has to be with care.

Though the scales of "self-esteem," "confrontation," "surrender," and "diverted attention" are acceptable, slightly increasing the number of items would lead to a much better values for Cronbach's alpha. If one would aim at standardizing the items for pandemic questionnaire based on schema therapy, it would be advantageous for items to be improved in later research. Our conclusions should therefore be taken as incentives for further exploration. Finally, our study was limited to a certain stage of the pandemic. Different results could be expected in a longitudinal study.

Outlook

An extensive future study of the fundamental theories of schema-based psychotherapy during a pandemic may involve investigating whether clients' problems during pandemic are schema-driven (e.g., "Vulnerability to Harm/Illness schema" or "Negativity/Pessimism schema") or whether a schema that has been dormant in people can be activated by a pandemic (*cf.* Schema Therapy Bulletin 2020).

On investigating the theory of schema-oriented therapy during a pandemic, we focused on general, cross-cultural, and cross-gender trends although controlling for the effect of country, gender, education, and savings. Future studies may look at similar phenomena independently for different groups, such as gender, marital status, nationality, ethnicity, and education.

We believe science advances through benevolent criticism, counter-opinion, and suggestions for improvement. One would not generalize that all human behavior in all pandemics is exactly alike. Compliant behavior may also depend on other factors, for example, the kind or the novelty of the virus or its mutations, the policy details, and the duration of the pandemic. Similarly, compliance may depend on the individuals' fears, sources of and level of critical analysis of information, and trust in authorities. Therefore, we contend that these additional aspects call for consideration.

Furthermore, developing a standardized questionnaire, particularly on the fulfillment of core psychological needs within the framework of schema-oriented psychotherapy, would be highly valuable for practitioners. We invite other researchers to this endeavor and believe that we have herewith provided a strong foundation.

PRACTICAL IMPLICATIONS AND CONCLUSION

A year has passed, and the world is still in the midst of the COVID-19 pandemic, which has led us to revisit one of psychology's fundamental questions, *what determines human behavior*, and to examine it in the light of a contemporary and influential theory: schema-based psychotherapy.

Our findings present key insights that may (a) help effectively promote individual psychological consistency, (b) assist government's regard of that, and (c) therefore, foster collective health-responsible behaviors.

First, these results teach that when drafting and communicating sanctions during a pandemic, the authorities should consider the driving force of behavior, i.e., the fulfillment of the CPNs. Authorities cannot limit their responsibility to promulgating restrictions that may impinge on fundamental human needs; to effectively control contagion during a pandemic, they must see the relevance of human need fulfillment. They should clearly highlight admissible and feasible actions that allow for the fulfillment of basic needs despite the context of a pandemic. Individuals are more prepared to comply when their topmost goals are taken into account and less prepared to comply when topmost goals are infringed.

Accordingly, the authorities should emphasize the superordinate goal of citizens' efficacy and performance, and put power into citizen's hands. Likewise, they should emphasize the superordinate goal of increasing pleasure and reducing pain.

Since restrictions can impair the fulfillment of the need for relationships amidst a pandemic, authorities should, for example, help build psychological supports for the population and provide and highlight alternative ways facilitate people finding their idiosyncratic *strategies* to meet, be acquainted with, relate to, and communicate, as well as develop and nourish relationships with others, in line with the anti-pandemic measures. For instance, to facilitate compliance among those who hold the CPN for *relationship* as a primary necessity during the pandemic, authorities need to emphasize that individuals may still socialize while sanitizing and limiting physical contact and that the pandemic restrictions ultimately aim at reinforcing possibilities for relationships in the long run and at reducing the chances of losing beloved ones.

Since restrictions also challenge self-determination, with regards to self-esteem, authorities should address individuals' needs for honor, dignity, and autonomy, and make recommendations with due respect and without signs of defamation. Thus, in order to facilitate compliance among those who hold the CPN for *self-esteem* (dignity/autonomy), authorities must communicate with humility and respect, and authentically present themselves as being concerned about serving the people, without arrogance or demonstration of paternalism. They should also show gratitude for the valued contribution of compliance which the citizens eventually take autonomously.

Further, individuals have different ways of coping with challenges. While those with the coping style of surrender may easily comply with sanctions, particular attention should be given to individuals with the style of confrontation; their cooperation is not to be taken for granted; and reactance or the rejection of coerced blessings is to be expected. With due understanding of the concept of the behavior style of overcompensation/confrontation in schema therapy, there is need to make sure that reactance is not provoked, and when provoked that it is competently dealt with to the interest of the subject.

The key contribution of the current study is the importance of emphasizing individual's superordinate goals (their basic needs) and behavior styles to support the imperative fulfillment of psychological needs, with respect to and for the CPNs that

individuals are focused on at the particular time, rather than increasing compliance.

The key message is that supporting people from the perspective of the psychological needs which they are focused on fulfilling in the given moment and in respect of their behavior styles may be more affective for facilitating compliance than forcing or exhorting people to change/behave. Therefore, the effectiveness of anti-pandemic measures depends on the extent to which individual's resources can be activated within their peculiarities.

A practical application of motivation *via* core psychological needs is illustrated in the concept called the "motive-oriented psychotherapeutic relationship" (Grawe, 2004; Caspar et al., 2005) in the tradition of Grawe. Accordingly, a decisive factor for effective therapy is the extent to which specific measures address the abilities within patient's existing characteristics and subsequently activate their willingness to take action (Grawe and Grawe-Gerber, 1999). Dealing with reactance in therapy is illustrated in the concept of "empathic confrontation" in the tradition of Young and may be enrichened with concept of defense mechanisms in psychoanalysis. Defining precise mechanisms for political or medical authorities to achieve this during a pandemic is outside the purview of this article; for now, we allow them to grasp the importance of the concept.

We hope this research can assist in fostering understanding and cooperation between compliant and non-compliant people for the common goal of survival in any future pandemics. It must also be noted that we do not assert that compliance or adherence to authority is an ethical or moral value *per se* (*cf.* Milgram Experiment).[1] Nevertheless, given the ongoing pandemic, and since compliance cannot be presumed, we believe that research that elucidates compliant behavior during a pandemic will aid in improving people's lives during these trying times.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

[1]Das Milgram Experiment (Video; 2021, April 12). YouTube. https://www.youtube.com/watch?v=0MzkVP2N9rw

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Commission of the Institut für Verhaltenstherapie (Institute for Cognitive Behavior Psychotherapy Training and Research), AVM, Salzburg, Austria. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CO conceptualized the study, designed the questionnaire, performed the primary data analysis, prepared the original draft of the manuscript, and contributed to the acquisition of funding. CO, ML, and BJ contributed to the improvement of theoretical and statistical model, analysis, and interpretation. All authors contributed to the manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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REVIEW
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Healthcare Workers and COVID-19-Related Moral Injury: An Interpersonally-Focused Approach Informed by PTSD

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The COVID-19 pandemic has resulted in a still-unfolding series of novel, potentially traumatic moral and ethical challenges that place many healthcare workers at risk of developing moral injury. Moral injury is a type of psychological response that may arise when one transgresses or witnesses another transgress deeply held moral values, or when one feels that an individual or institution that has a duty to provide care has failed to do so. Despite knowledge of this widespread exposure, to date, empirical data are scarce as to how to prevent and, where necessary, treat COVID-19-related moral injury in healthcare workers. Given the relation between moral injury and post-traumatic stress disorder (PTSD), we point here to social and interpersonal factors as critical moderators of PTSD symptomology and consider how this knowledge may translate to interventions for COVID-19-related moral injury. Specifically, we first review alterations in social cognitive functioning observed among individuals with PTSD that may give rise to interpersonal difficulties. Drawing on Nietlisbach and Maercker's 2009 work on interpersonal factors relevant to survivors of trauma with PTSD, we then review the role of perceived social support, social acknowledgment and social exclusion in relation to potential areas of targeted intervention for COVID-19-related moral injury in healthcare workers. Finally, building on existing literature (e.g., Phoenix Australia—Centre for Posttraumatic Mental Health and the Canadian Centre of Excellence—PTSD, 2020) we conclude with individual and organizational considerations to bolster against the development of moral injury in healthcare workers during the pandemic.

Keywords: moral injury, post-traumatic stress disorder, healthcare workers, COVID-19, interpersonal factors, social cognition

INTRODUCTION

Healthcare workers around the globe are facing a series of novel, potentially traumatic moral and ethical challenges during the COVID-19 pandemic. In interviews with Canadian healthcare workers that our research group has been conducting throughout 2021, for example, healthcare workers have recounted repeatedly struggling with how *wrong* it feels to helplessly witness the deterioration of human life when caring for critically ill COVID-positive patients (see **Figure 1** for a sample vignette of healthcare workers' experiences with moral injury). Exposure to such events has the potential to place healthcare workers at an elevated risk for moral injury. Moral injury is a form of psychological response that may arise when one transgresses, or witnesses another transgress, deeply held moral values, or when one feels that an individual or institution that has a duty to provide care has failed to do so (1, 2). Moral injury is associated with negative mental health outcomes, such as incapacitating feelings of guilt and shame (3) and elevated symptoms of anxiety (4, 5), depression (6–8), post-traumatic stress disorder (PTSD) (4, 5, 9–12) and suicidality (12–14). Despite widespread exposure during the COVID-19 pandemic, limited empirical data renders it unclear at present how best to prevent and, where necessary, treat moral injury in healthcare workers during the pandemic, particularly among those who go on to develop full-blown mental illness as a result of this exposure.

A growing body of literature points to a relation between moral injury and PTSD (reviewed below), suggesting that knowledge in the field of PTSD may translate well to prevention of and intervention for moral injury. Here, an understanding of alterations in social cognitive functioning (e.g., empathy, moral reasoning, theory of mind) associated with PTSD (15) may assist in better elucidating the role of interpersonal factors (e.g., social support, acknowledgment and exclusion) in moderating PTSD symptomology (16). These disruptions are of particular concern where an overwhelming body of evidence points to social support as a consistently strong predictor of who develops PTSD following trauma exposure (17–22), such as the exposures associated with the current pandemic.

Given evidence pointing toward the role of interpersonal factors in moderating symptoms of PTSD, along with the relation between PTSD and moral injury, we suggest here that an interpersonally-focused approach may serve as a useful starting point for prevention, early intervention, and treatment strategies for COVID-19-related moral injury in healthcare workers. Accordingly, the purpose of the present narrative review is to illustrate the potential utility of an interpersonally-focused approach focusing on the role of perceived social support, social acknowledgment and social exclusion as key targets in understanding and mitigating COVID-19-related moral injury in healthcare workers. In this synthesis of the relevant literature, we first review social cognitive impairments previously observed in PTSD that may be associated with interpersonal difficulties. We next consider Nietlisbach and Maercker's (16) landmark review of the role of social support, social acknowledgment and social exclusion in the development and maintenance of PTSD symptoms and consider these factors in relation to moral injury among healthcare workers during the COVID-19 pandemic. Finally, we summarize individual and organizational considerations for bolstering against the development of moral injury among healthcare workers during and after the pandemic.

Moral Injury in Healthcare Workers

Moral Injury and Moral Distress

The potentially traumatic moral and ethical challenges that healthcare workers face in their occupation were first addressed in the moral distress literature. Moral distress has been conceptualized as the psychological distress that arises when a healthcare worker is prevented, by personal or institutional constraints, from doing what they believe to be right (e.g., witnessing the deterioration of patient care due to institutional factors or a lack of communication) (23, 24). Moral distress is associated with poor self-esteem, low job satisfaction, burnout and intention to leave one's position or profession (23–25). Relatedly, moral injury, as reviewed above, has been defined as a type of psychological response to trauma that may arise from exposure to a single or several potentially morally injurious events (PMIEs): rarely occurring, abnormally stressing, high-stakes situations with limited time for decision making (3, 26). Although a concrete definition has yet to be established, Litz et al. (10) contend that PMIEs can take several forms, including acting in ways that contravene moral values (i.e., acts of commission), failing to prevent events that transgress moral values (i.e., acts of omission), or witnessing someone else fail to act in line with moral values (10). Following this definition, PMIEs may be discussed as perpetration- and/or betrayal-based, where an individual holds perceived responsibility for a PMIE (e.g., by acting or failing to act), or has witnessed/been affected by the actions or inactions of others, respectively (11). Morally injurious outcomes will vary on an individual basis according to the codes of moral conduct in one's culture and one's personal values, yet the sequelae of moral injury, as reported in a recent integrative review, often include widespread effects in psychological/behavioral, social, religious/spiritual and biological domains (11). Following Litz and Kerig's heuristic continuum of moral injury (2), moral distress and moral injury may differ in frequency and event magnitude, where moral distress, although harmful, is believed to be less severe in degree of psychological impact when compared to moral injury (2). Due to its origin in the military literature, empirical research on healthcare workers' experiences with moral injury is limited in comparison to research on moral distress among this population. Indeed, in a recent scoping review, Cartolovni et al. (27) identified just seven articles examining moral injury among healthcare workers. Given the unique moral and ethical challenges present in the healthcare arena, exacerbated further by the COVID-19 pandemic, research in this area appears to be accelerating, with some researchers using moral injury and moral distress as interchangeable terms in healthcare during the COVID-19 pandemic (28).

COVID-19-Related Moral Injury in Healthcare Workers

Healthcare workers may be at an elevated risk for moral injury during the COVID-19 pandemic as they are more likely to be exposed to PMIEs at this time than, for example, civilians. Possible PMIEs discussed within the healthcare context

Imagine being a healthcare worker on the frontlines of the COVID-19 pandemic. You have never seen anything like this. You have been a registered respiratory therapist for twenty-two years now, exposed to countless stressful situations of human suffering and death, yet no amount of training or years of experience could have prepared you for the circumstances you now find yourself in. The number of COVID-positive patients increases daily. The patient you are on your way to see now remains paralyzed, sedated and isolated in critical care, separated from their family who are banned from entering the hospital to see their loved one. You and your colleagues have used all expertise and technology at your disposal, yet your efforts feel in vain as you continue to watch this patient deteriorate alone in a room. The patient's family demands that you do everything you can to save their loved one and you do so despite feeling that these measures are futile, only prolonging suffering that will inevitably result in you having to hold up an iPad for the family to say goodbye in their loved one's final moments. When that time comes, you hold the patient's hand in an attempt to provide them with some sort of comfort as they pass. On the video call, the patient's family apologizes to their loved one through painful sobs and you try to choke back tears of your own. When the call ends and the patient has passed, every part of you wants to break down. You can't stop thinking about how wrong it is that a human being just died while their family watched through a screen. Suddenly, you are being paged for a code and must hurry to change your PPE and get to your next patient, hoping the outcome is different than what just occurred. You have never seen anything like this.

FIGURE 1 | In an ongoing study in our research group, healthcare workers from across Canada have described various events which may be experienced as morally injurious. This vignette provides a summary of the types of events we have heard about from Canadian respiratory therapists early in the Spring of 2021. Participants recounted instances of having to perform care that was perceived to be futile, feeling helpless when caring for critically-ill COVID-positive patients and being at the beside of dying COVID-positive patients in place of their family members, who were prohibited from entering the hospital due to COVID restrictions. Additional stressors compacting upon these potentially morally injurious events included having no time to process events, rushing to change PPE and a high patient caseload.

during COVID-19 include having to take potentially life-saving resources from one patient in an attempt to save another patient's life, exposing individuals to the coronavirus because of failure in the screening process, witnessing healthcare managers poorly ration life-saving resources, or witnessing people living life unbothered outside of the hospital (26, 29). Indeed, preliminary findings from ongoing research in our group have revealed that Canadian respiratory therapists experienced intubating and proning patients over 90 years of age and "holding an infant while he passed away because COVID rules would not allow his mother in the room" as PMIEs. Critically, as the pandemic persists, moral injury and other mental health concerns are expected to remain, if not increase. Hines et al. (30) reported that healthcare workers in the United States showed stable symptoms of moral injury across the first 3 months of the pandemic (i.e., March to July 2020), occurring at levels similar to reports from military veterans upon return from deployment (31). Similarly to military populations, moral injury in healthcare workers during the pandemic has been associated with anxiety, depression, PTSD and suicidal ideation (32). Some caution is warranted in the interpretation of these findings, however, as moral injury is a relatively recent concept in the healthcare context and, to date, the clinical and research communities have not identified a highly-reliable, psychometrically-validated measurement tool for common use in this population.

Notably, as moral injury has been related to psychological/behavioral, social, religious/spiritual and biological harm (11), outcomes of moral injury among healthcare workers performing their duties during the COVID-19 pandemic may also vary across these domains. For example, in the case of a respiratory therapist comforting a dying infant in place of his mother, the respiratory therapist may experience impairing moral emotions of guilt, shame, anger or betrayal. The distress associated with this experience may, in turn, lead the respiratory therapist to withdraw from others, question prior beliefs of the world as a just place or experience a spiritual/existential crisis (11). Exposure to this event may be associated with physical manifestations such as decreased sensitivity to pain or stress-related illnesses, such as arthritis and PTSD, as found in prior research on outcomes of exposure to PMIEs (33, 34). Furthermore, exposure to these types of events may be associated with a sense of being "dirty" or shameful, thus contributing to a sense of being undeserving. Relatedly, such feelings of being "undeserving" have been recounted by healthcare workers in our research group's ongoing interviews during the COVID-19 pandemic where healthcare workers have shared that these feelings have limited their efforts to seek appropriate physical or mental healthcare and/or take breaks and rest periods from the healthcare environment.

Moral Injury and PTSD

Moral injury and PTSD are currently thought to be associated yet distinct concepts based on symptomology and etiology (9, 11). Both moral injury and PTSD are stressor-linked problems where the outcome is identified after evidence of a prolonged emotional response from exposure to a potentially traumatic or morally injurious event (2). To date, whereas PTSD is considered a mental disorder, moral injury is not (5, 35). There is some evidence to suggest, however, that moral injury and PTSD are associated by symptomology. Based on research with military service members, Litz et al. (10) developed a conceptual model of moral injury that accounts for intersecting symptoms of PTSD and moral injury. In this model, individuals who experience distress over a moral transgression and hold global, internal and stable (i.e., not context dependent, specific to the individual and enduring) attributions about the event

are posited to experience enduring shame, guilt and anxiety, which may influence the individual to socially withdraw. With social withdrawal comes failure to encounter experiences with important members of one's community that may otherwise have provided alternative attributions that cultivate self-forgiveness. Here, Litz et al. (10) contend that the path following internal moral conflict, withdrawal and self-condemnation resembles PTSD symptomology. Indeed, chronic intrusions of the morally transgressive event, avoidance behaviors, numbing, self-harming or self-handicapping and demoralization are expected here and, critically, are also classic experiences indicative of PTSD (10, 36).

Conversely, Bryan et al. (12) found evidence of distinct symptom profiles between moral injury and PTSD in a sample of American military personnel. In this study, the PTSD symptom profile included an exaggerated startle reflex, memory loss, flashbacks, nightmares and insomnia, whereas the moral injury symptom profile included guilt, shame, anger, anhedonia and social alienation (12). A distinction between moral injury and PTSD is further supported by etiology, where PTSD has been defined as a response after exposure to direct or indirect life threat or sexual violence (9), but such criteria is not necessary for PMIEs, which are characterized by moral transgressions or betrayal from leadership (10). Furthermore, Currier et al. (33) highlighted how the function of symptoms consistent between PTSD and moral injury may be related to different motivations in some cases. For example, whereas some individuals with PTSD may engage in avoidance behaviors related to fear and safety concerns, some individuals with moral injury may engage in avoidance behaviors motivated by shame and a perception that they may morally contaminate others (33). Although further research on the relationship between moral injury and PTSD is needed, they are currently thought of as associated yet distinct traumatic responses (9, 11).

Given the relation between moral injury and PTSD, it has been suggested that some evidenced-based psychotherapies for PTSD may prove useful in treating moral injury (9, 37). Here, the majority of research and clinical work centred on the treatment of moral injury focuses primarily on military populations (38–41). For example, prolonged exposure therapy and cognitive processing therapy for PTSD have been proposed for treating moral injury in military samples (35, 38, 42). Murray and Ehlers (35), however, recently discussed the use of cognitive therapy for PTSD (CT-PTSD) for moral injury-related PTSD (i.e., PTSD related to traumatic events including a PMIE), providing a case outline and example of the use of CT-PTSD in a healthcare population. As treatment for moral injury continues to be explored, it will be essential that PTSD treatments be strategically adapted to target symptoms specific to moral injury [e.g., dissonance that arises from the discrepancy between moral beliefs and perpetrations/witnessed events, impairing guilt and shame; (10, 12)].

Social Cognition and PTSD

Alterations in social cognitive functioning have been documented among survivors of trauma who went on to develop a diagnosis of PTSD (15–17, 43–45). Nietlisbach and Maercker (16) previously reviewed evidence for a relation between PTSD and impairments in social cognition and associated interpersonal factors (e.g., social support, acknowledgment and exclusion). Social cognition has been defined as "the ability to use, encode and store information about others that we gain from social interactions" (40). Specifically, social cognition is the coordination of several modes of cognition (e.g., attention, perception, interpretation and processing) in a social context that allows one to perceive and interpret social cues to direct their behavior (41, 46). There are four classic domains of social cognition, namely, theory of mind (ToM), social perception, affective empathy and social behavior (15). ToM refers to the ability to draw on knowledge of how the mind works and of social rules to understand the mental states and beliefs of others (15). ToM can be subdivided into a cognitive component (i.e., what others are thinking) and an affective component (i.e., what others are feeling) (15). Social perception is a domain of social cognition concerned with the ability to recognize and perceive emotional stimuli such as facial expressions, body language or prosody, whereas affective empathy refers to one's emotional response to social situations (15). Finally, social behavior refers to the ways in which an individual conducts themselves in a social context. Alterations in any one of ToM, social perception or affective empathy may lead to deficits in social behavior where an individual displays aggression or socially withdraws (15).

A recently published systematic review of social cognition in PTSD found that social cognition is altered in individuals with PTSD as they display significant impairments in predicting the internal states of others, alterations in perceiving basic emotions and disturbances in empathy (15). In a study investigating emotion recognition and ToM among military police officers exposed to trauma, Mazza et al. (17) found that those with PTSD, in comparison to their counterparts without PTSD, showed deficits in ToM on a task where they were instructed to identify the emotions of a protagonist in a short story. Poljac et al. (44) examined emotion recognition in PTSD patients and controls when viewing video clips of an individual displaying basic emotions. The PTSD group displayed reduced accuracy and sensitivity to facial expressions of fear and sadness in comparison to controls (44). Relatedly, Parlar et al. (47) examined empathic responding among women with PTSD related to childhood trauma. Results of this investigation revealed altered empathic responding in this population, such that women with PTSD showed impairments in identifying the perspective of others when compared to healthy controls (47). Interestingly, however, women with PTSD in this study reported greater levels of personal distress than controls when learning about the negative experiences of others (47). Nazarov et al. (43) examined moral reasoning among women with PTSD related to chronic abuse in childhood and found evidence of altered moral reasoning among these women in comparison to healthy, matched controls. Participants in this study were presented with complex moral situations and were asked to provide a response and justification for their decisions to these dilemmas. The results of this investigation revealed that women with PTSD related to chronic childhood abuse were less likely than controls to approve of utilitarian decisions if the decision involved personally inflicting direct physical harm driven by concern over feelings of guilt and

shame associated with these actions (43). Finally, Sherman et al. (45) examined veteran's perceptions of the impact that PTSD had on their parenting, on their children and on the parent-child relationship. More than half of the sample scored above the cut-off on the reactivity subscale of the Parenting Scale, suggestive of alterations in social behavior related to PTSD (45). Cumulatively, the evidence on deficits in key domains of social cognition (i.e., ToM, social perception, affective empathy and social behavior) among individuals with PTSD are related to outcomes of poor quality of life (15). This evidence warrants, in part, the necessity of interpersonally-focused interventions for survivors of trauma with PTSD.

Here, we explore the utility of a social cognitive approach to understanding, mitigating and treating moral injury in healthcare workers during the COVID-19 pandemic. While not intended to be a stand-alone approach to treatment of moral injury in the healthcare population, this perspective may prove useful to the development and implementation of prevention, early intervention and targeted intervention strategies surrounding moral injury in this vital workforce. In a study investigating the relation between moral injury and PTSD among a sample of U.S. National Guard personnel, Bryan et al. (12) noted that a social-cognitive perspective may be a useful approach to understanding moral injury. Social cognitive theory accounts for different types of emotions: natural and manufactured (12, 42). Natural emotions include fear, anxiety and sadness as they are natural responses to direct trauma exposure. By contrast, manufactured emotions are those that arise from an individual's processing and interpretation of events as opposed to the event itself and include feelings of guilt and shame (12, 42). Targeting healthcare workers' interpretation and processing of events during the pandemic, thus, may be one mechanism through which to buffer against the deleterious impacts of guilt and shame related to moral injury. As interpersonal factors such as social support, acknowledgment and inclusion are mediators of PTSD symptom development and maintenance (16), we argue further that an interpersonally-focused approach to moral injury may prove a useful starting point to address COVID-19-related moral injury among healthcare workers.

Importantly, evidence-based treatments for PTSD should always be provided where necessary. The International Society for Traumatic Stress Studies offers guidelines for the prevention and treatment of PTSD, including the use of cognitive behavioral therapy and eye movement desensitization and reprocessing (48). Beyond evidence-based treatments for PTSD that may be adapted for moral injury, a social cognitive approach may be promising, while in need of future study. Notably, this approach relies heavily on a top-down, cognitively oriented approach to the treatment of moral injury. We wish to be clear here that we believe such approaches may, in some cases, require augmentation with more bottom-up therapies that target raw emotion and alterations in somatosensory processes that are also characteristic of PTSD [please see Harricharan et al. (39) for a recent review] (49). An additional caveat to the discussion that follows is that the targeted treatment approach described does not distinguish between dissociative and non-dissociative presentations of PTSD (50–52). Such work, focusing on neuroscientifically-guided approaches to restoration of lower-brain based alterations in emotional processing and somatosensory integration [e.g., deep-brain re-orienting; (53, 54)] as potential augmentative treatments for moral injury are on-going in our research group, as are efforts to develop therapeutic approaches for the treatment of moral injury that distinguish between the dissociative and non-dissociative presentations of PTSD. Lloyd et al. (83) recently demonstrated alterations in top-down control of emotional affect among military and paramilitary personnel with PTSD. Specifically, participants with PTSD described a "nauseating and painful, like an internal gnawing sensation (p. 601)" when recalling morally injurious events, which was thought to be linked to increased activation of the posterior insula and its connections to the viscera. The authors postulated that unpleasant visceral sensations aroused when recalling morally injurious events may, in turn, lead to increased activation of modulating brain areas such as the dorsolateral prefrontal cortex, or the central executive network, in an effort to control excessive bottom-up activity evoked from recalling morally injurious events (83). Critically, over-modulation of excessive bottom-up affect is a pattern of neural activation consistent with dissociation (82, 83). Social support, for example, may then be an important factor in processing morally injurious events as treatments focused on bottom-up affective processes and bodily sensation may encourage pro-social, attachment-based, interpersonal relationships and in turn alleviate interfering symptoms, including heightened arousal and dissociation. Further evidence is required, however, to verify the veracity of this claim and at present, it is imperative that healthcare workers receive access to evidence-based approaches to treat PTSD that, where necessary, may be augmented by evidence-informed approaches for residual symptoms in treatment-refractory cases.

An Interpersonally-Focused Approach to Moral Injury

With limited empirical data on moral injury in healthcare workers in general and during COVID-19 specifically, we look here to interpersonal factors known to influence the development and maintenance of PTSD symptoms (e.g., social support, acknowledgment and exclusion) as a starting point for potential prevention and treatment strategies. Notably, this interpersonally-focused approach to moral injury is in keeping with evidence from healthcare workers' experiences during the SARS crisis (55). Here, social support and social rejection/isolation were reported to be associated with the psychological impact that the crisis had on healthcare workers (55). Marjanovic et al. (56) found that poor organizational support was associated with avoidance and anger among nurses, a finding similar to that of Tam et al. (57) who reported that poor "team spirit" and administrators not hearing healthcare workers' feedback were associated with poor mental health (55). Similarly, Chen et al. (58) found that nurses who reported greater family support were at a lower risk of mental health problems (55). Koh et al. (59) reported increased work stress

and workload among healthcare workers on the frontlines of the SARS crisis in Singapore, with many experiencing social stigmatization and ostracism from family members due to their occupation (55). Drawing on this pre-pandemic evidence in combination with Nietlisbach and Maercker's (16) work on interpersonal factors relevant to survivors of trauma with PTSD, we now provide a review of the role of perceived social support, social acknowledgment and social exclusion in relation to potential areas of targeted intervention for COVID-19-related moral injury in healthcare workers.

Perceived Social Support

Social Support and PTSD

Social support is a psychological construct referring to the emotional and instrumental care provided by those close in one's social circle, such as family or close friends (16). Whereas, seeking social support to deal with traumatic stress is a protective factor against PTSD (18), a perceived lack of social support is strongly associated with increased PTSD symptoms (60). The role of social support in mediating PTSD has been reported among many populations, including war veterans (19), survivors of childhood sexual abuse (20), survivors of violent crime (61) and nurses (21). Cieslak (19) investigated the role of perceived social support and self-efficacy in veterans' adaptations to distress. The results of this investigation revealed that greater received and perceived social support predicted high coping self-efficacy, which in turn predicted lower post-traumatic stress and depression symptom severity (19). Kerasiotis and Motta (21) investigated PTSD symptoms among nurses and found that nurses reported high levels of anxiety but did not reach clinically significant levels of PTSD, depression and dissociation. Here, social support was inferred to help nurses cope with work-related stressors (21). Finally, in a study investigating the specific types of perceived social support that mediated PTSD development in female survivors of childhood sexual abuse, self-esteem support was defined as "others' communications indicating that the abused individual is valued" (20) and was the type of social support that specifically mediated PTSD development in the sample. It is critical to acknowledge that while social support is a strong moderator of PTSD symptom development and maintenance, PTSD characteristically undermines relationships and support networks (62) as discussed above, making social relationships a key target for PTSD intervention. Moreover, PTSD is highly associated with disruptions in childhood attachment (47, 63, 64), rendering it potentially more difficult to form and sustain interpersonal relationships into adulthood.

Social support is thought to influence the cognitive appraisals of traumatic events in survivors of trauma. Specifically, social support may influence how one attributes their role in the traumatic event and their beliefs about the world (65). Cohen and Wills' (66) well-cited stress-buffering model posits that social support is a protective factor against the deleterious effects of trauma exposure as it increases one's perceived ability to cope with trauma and reduces negative appraisals of the traumatic event (22). In a study investigating social constraints, post-traumatic cognitions and PTSD among recent survivors of trauma, those who reported more social constraints (i.e., feeling unsupported, misunderstood or alienated when seeking support) reported more negative post-traumatic cognitions (67). Further, both social constraints and negative post-traumatic cognitions were related to a greater number of PTSD symptoms in this sample (67). These findings are in keeping with decades of research on the role of social support following exposure to trauma where a lack of social support continues to be a strong risk factor for developing PTSD (18, 22, 68). Further, individuals with strong social support are likely to recover faster than those who lack support (68). Indeed, in a recent meta-analytic review, Zalta et al. (22) examined the magnitude of the relation between social support and PTSD symptom severity, reporting a medium effect size across 148 cross-sectional studies and 38 longitudinal studies. The results supported the notion that greater levels of social support and lower levels of negative social reactions are related to lower levels of PTSD symptom severity (22).

Though not fully understood, the relation between social support and resilience documented in neurobiological literature may represent, in part, the mechanism through which social support moderates PTSD symptoms. The noradrenergic and hypothalamic-pituitary-adrenocortical (HPA) systems are implicated in both stress and resilience. Individuals with PTSD display dysregulated noradrenergic systems that fail to terminate the stress response after exposure to stressful stimuli (62). Individuals who report low social support display physiological and neuroendocrine responses, such as increased heart rate and blood pressure, that are indicative of a heightened reactivity to stress (69). Conversely, stress resilience is associated with the ability to keep the HPA and noradrenergic systems stable during exposure to stressful stimuli and terminated when the stimuli are no longer present (69). Social support is thought to influence both biological and environmental susceptibility to stress by acting on the HPA and noradrenergic systems, encouraging resilience (69, 70). As such, on a neurobiological level, social support may be a key factor in mediating the stress response as it promotes resilience.

Relatedly, the neurohormone oxytocin also plays a key role in stress regulation where social contact impacts the HPA axis to release oxytocin and in turn reduce stress (71–77). Indeed, studies using animal models have demonstrated that social contact is associated with oxytocin release (75–77). Furthermore, oxytocin release during or just after exposure to stressful events has been shown to regulate the HPA axis through the corticotropin-releasing factor (72, 78). Oxytocin's affinity for reducing PTSD symptoms may be related, in part, to its critical role in social bonding as oxytocin is known as the neurohormonal substrate of human affiliations, including parental, romantic and filial social bonds (79). For example, oxytocin release is implicated in maternal-infant social bonds such that oxytocin levels early in pregnancy and postpartum were related to maternal bonding behaviors such as positive affect, attachment-related thoughts and frequency of attending to the infant (80). Indeed, in a study investigating the therapeutic potential of intranasal oxytocin administration as a preventative measure for PTSD symptoms, Frijling et al. (81) found that repeated oxytocin administration reduced the development of PTSD symptoms among individuals who were recently trauma exposed.

Furthermore, oxytocin has been shown to cause long-term depression of the amygdala, regulating the amygdala's sensitivity to aversive social stimuli (74). As such, the relation between social support and PTSD symptom severity may be explained, in part, due to the release of oxytocin, which is critical for social bonding and regulates the HPA axis along with subcortical structures critical to the stress response [see Lanius et al. (82) for a detailed review of the neurobiology of PTSD, including its dissociative subtype].

Healthcare Workers and Social Support During COVID-19

Research on healthcare workers' perceived social support during the pandemic is limited yet provides evidence that social support is critical for mental health and well-being. Indeed, in a systematic review of quantitative studies investigating psychological resilience, coping behaviors and social support in nurses during the pandemic (84), only seven studies explored the relation between social support and mental health outcomes, where greater perceived social support yielded a reduction in burnout (84, 85) and explained variance in psychological distress (84, 86). Using qualitative interviews, Brophy et al. (87) explored Canadian healthcare workers' experiences during the initial months of the pandemic, reporting that a perceived lack of support from employers affected healthcare workers' sense of well-being (e.g., a co-worker being sent to care for a suspected COVID-19 patient without PPE). Similarly, Xiao et al. (88) explored the impact of social support on sleep quality and functioning in a sample of Chinese healthcare workers providing medical care during the pandemic. Social support not only decreased anxiety and stress, but also increased self-efficacy in this sample (88). Finally, Labrague and De los Santos (89) examined the role of resilience, social support and organizational support on COVID-19-related anxiety among nurses working on the frontlines in the Philippines. Here, whereas social support was defined as assistance and protection offered by colleagues, managers, friends and family, organizational support was defined as the degree to which resources, reinforcement, communication and encouragement were offered to an individual by their organization (89). Both social and organizational support significantly predicted COVID-19-related anxiety among this sample, such that greater degrees of these supports were associated with lower degrees of anxiety (89).

In recent surveys of healthcare workers' needs during the pandemic, healthcare workers have highlighted their desire for social support. For example, Shanafelt et al. (90) asked healthcare workers about their main concerns during the pandemic, their needs from leaders and their perspectives on tangible supports. Healthcare workers' requests were summarized as follows: hear me, protect me, prepare me, support me and care for me. Healthcare workers desire clear assurance from their leaders that they, along with their families, will be supported emotionally, physically and socially while working on the frontlines on the pandemic (90). Specifically, healthcare workers shared a desire for their expert perspectives to be included in decision making, for their risk of infection to be mitigated, for appropriate training to treat critically ill patients, for support in dealing with extreme work hours and distress and for practical support such as food and childcare aid should they be infected (90). This call for support was echoed in a recent review by Heber et al. (91) who reported that public safety personnel (PSP) who, like healthcare workers, face novel stressors while working during the pandemic (e.g., greater risk of infection compared to civilians), may benefit from consistent support offered in the form of specialized mental health and preparedness training, frequent and transparent communication, strong leadership and team building, assistance in navigating quarantine and focus on self-care.

Altogether, social support mediates PTSD symptoms in a range of populations, perhaps through influencing cognitive appraisals of events by survivors of trauma (i.e., buffering patterns of common emotional response to trauma, enhancing feelings of connectedness) and likely enhancing resiliency on a neurobiological level [i.e., increasing the availability of neurohormones associated with stress reduction, in turn, regulating the HPA axis and critical subcortical structures associated with trauma and stress; (63–65, 67, 69, 70, 84). Given the relation between moral injury and PTSD symptoms and emerging mental health data suggesting that social support is important for decreasing healthcare workers' anxiety and stress during pandemic situations, targeting perceived social support is one means by which organizations and individuals may mediate the morally injurious outcomes for healthcare workers exposed to PMIEs during the COVID-19 pandemic. This may be accomplished by creating Communities of Practice where healthcare workers may gather in person and/or virtually to discuss shared concerns and coping mechanisms, or by ensuring that healthcare workers have regular breaks to spend with family members or creating "buddy systems." Similarly, the need for efforts to retain a healthcare workforce that is increasingly considering leaving the profession given experiences throughout the pandemic (92, 93) combined with our own preliminary qualitative findings that healthcare workers demonstrate more concern for team members and family members than themselves, we suggest that efforts to retain healthcare staff and to promote workplace wellness focus, to an extent, on teams and team well-being. Strengthening these connections by highlighting social cohesion with team members may facilitate retention and promote post-traumatic growth. These efforts may also focus on the identity of the healthcare worker as a helping professional and serve as a reminder of why the healthcare worker entered the field in the first place.

Perceived Social Acknowledgment

Social Acknowledgment and PTSD

Social acknowledgment involves receiving appreciation and positive reactions from the wider social environment in recognition of the difficult situation experienced by individuals exposed to trauma (16). The social environment may include colleagues, neighbors, authorities, clergy and the media (94). Social acknowledgment differs from social support as the former measures the degree to which one feels recognized and understood as a survivor of trauma and the latter emphasizes emotional or instrumental care (95).

Poor social acknowledgment (i.e., receiving disapproval and a lack of recognition as a survivor of trauma) is associated with greater severity of PTSD (95). For example, in a study examining PTSD symptom trajectories for Red Cross volunteers in Indonesia who responded to a large earthquake, those in the chronic PTSD trajectory reported lower perceived social acknowledgment compared to those in the resilient trajectory (96). Furthermore, a lack of social acknowledgment predicted increased PTSD symptomology in a longitudinal study on predictors of PTSD recovery in survivors of crime (97). In a study investigating trauma and PTSD symptomatology in German developmental aid workers, some participants reported that experiencing general disapproval from others was associated with more severe intrusive thoughts about the traumatic event and increased hyperarousal (94). Finally, a study on PTSD symptom severity, disclosure attitudes and social acknowledgment among Chinese and German survivors of crime found that, although PTSD symptom severity differed cross-culturally, disclosure attitudes and social acknowledgment predicted PTSD severity in both groups where a reluctance to disclose and a perceived lack of social acknowledgment predicted greater PTSD severity (97).

One mechanism through which social acknowledgment may mediate PTSD symptom development and maintenance is similar to that of social support, namely, post-traumatic cognitions. Post-traumatic cognitions are recognized as strong predictors of PTSD (97). Whereas, a strong sense of social acknowledgment may help survivors of trauma affirm positive cognitions that a traumatic experience has damaged, poor social acknowledgment may foster negative self- and other-focused cognitions (95). Indeed, Mueller et al. (97) found that perceived social acknowledgment was negatively associated with post-traumatic cognitions in a sample of 86 survivors of crime.

Here, it is critical to note evidence of altered patterns of response to emotions among individuals with PTSD that may pose as a barrier to the reception of social acknowledgment. For example, Nazarov et al. (98) found evidence for altered comprehension of affective prosody among women with PTSD related to chronic child abuse. Women in this study were asked to recognize angry, fearful, sad and happy emotions on a computer-based task and also asked to identify if the emotions portrayed in consecutive excerpts were the same or different. Nazarov et al. (98) found that women with PTSD took longer to identify all emotions except for those portraying anger in comparison to healthy controls. Interestingly, women with PTSD who experienced dissociative symptoms were more likely to be less accurate in discriminating between consecutive emotional presentations (98). Further, greater severity of childhood trauma was related to poorer accuracy in discrimination as well as slower recognition of emotions (98). Consistent with the altered patterns of emotional response demonstrated by Nazarov et al. (98), alterations in ToM, emotional recognition, empathic reasoning, moral reasoning and social behavior have been demonstrated among individuals with PTSD, as described above (15, 17, 43–45). As such, altered patterns of emotional response in PTSD must be considered when evaluating interventions targeting social acknowledgment.

Healthcare Workers and Social Acknowledgment During COVID-19

Research on healthcare workers' perceived social acknowledgment during the pandemic is limited, with the majority of work instead focused heavily on social support from familiar others, such as co-workers. A small number of studies, however, have explored healthcare workers perceptions surrounding a lack of recognition for their efforts during the COVID-19 pandemic. For example, some healthcare workers have described feeling abandoned by political leaders and have attributed inadequate staffing and PPE during the pandemic to political leaders' poor response to their needs during the crisis (26, 99). Relatedly, in a recent systematic review and meta-synthesis on frontline healthcare workers' experiences during pandemics and epidemics (e.g., COVID-19, SARS, MERS, Ebola), Billings et al. (100) reported that workers felt abandoned and betrayed by organizations when they did not received promised financial renumeration for their service and sacrifice on the frontlines. Kröger (26) stated further that healthcare workers may perceive an inconsistent world outside of the hospital when witnessing people carelessly ignoring safety measures. Despite window decorations in homes and businesses thanking healthcare workers for their service, healthcare workers may perceive the non-chalance of people in their communities as a lack of recognition for their sacrifice on the frontlines. Finally, Cai et al. (99) investigated the psychological impact and coping strategies of healthcare workers in China and found that recognition from management and the government was associated with psychological benefit. Preliminary findings from our research groups' ongoing interviews with healthcare workers throughout 2021 corroborate the perceived lack of recognition discussed in the literature where nurses discussed feeling underappreciated at the beginning of the pandemic when financial renumeration for their service was smaller in proportion to that offered to some first responders. Unsurprisingly, we also heard from some healthcare workers that they felt abandoned and described a lack of recognition from the community when protests against masks and vaccines were held outside the hospital.

As social acknowledgment plays a role in the development and maintenance of PTSD symptoms in various trauma-exposed groups, it is imperative that healthcare workers perceive that they are recognized and understood as survivors of trauma during the COVID-19 pandemic. This perception may influence positive post-traumatic cognitions that may ameliorate moral injury as a response to COVID-19-related-PMIEs. Indeed, in outlining how healthcare workers desire strong leadership to support them during the pandemic, Shanafelt et al. (90) note the critical role of leadership asking healthcare workers about their concerns and acknowledging their requests. Despite potentially being constrained from providing answers, leadership must demonstrate that healthcare workers' service is acknowledged and appreciated (90). This call for strong leadership was echoed by Jetly et al. (1) who discussed key qualities of effective leadership in the military that may prove useful for leaders attending to COVID-19-related moral injury in healthcare

workers. Jetly et al. (1) propose that effective leadership listens to the concerns of subordinates, are positive yet not overly optimistic, respect their subordinates' values, recognize that the risk of COVID-19 infection is not evenly distributed as frontline workers are the most vulnerable at this time, care about those whom they lead and accept the blame for team failures while attributing success to their team members.

Perceived Social Exclusion

Social Exclusion and PTSD

Social exclusion is an act of ostracism related to stigmatization where one is rejected and isolated from a group (16). Humans have an inherent need for relationships with others that is disturbed in situations of social exclusion (101). Social exclusion may lead to feelings of isolation as if one were no longer viewed as a part of society (16). When ostracized, survivors of trauma may perceive themselves as less-human and believe that they are perceived to be less-human by the perpetrator of their ostracism (101). Social exclusion or ostracism can lead to physiological changes, such as cardiovascular issues or increased cortisol levels and psychological issues, including negative emotions of anger, sadness and shame (102, 103).

Individuals suffering from PTSD and other mental illnesses are often victims of social exclusion in the form of stereotyping and stigmatization (104). For example, among East-African conflict survivors, stigmatization was associated with an increased likelihood of PTSD after exposure to trauma (105). Wesselmann et al. (103) investigated the relation between perceived ostracism (i.e., "being ignored and excluded") and post-traumatic stress among military veterans and found that perceived ostracism was related to post-traumatic stress symptoms, anxiety and psychological distress. Further, perceived ostracism explained variance in post-traumatic stress symptoms apart from theoretically relevant variables (i.e., deployment stress and social support) (103). In a study investigating the effects of social exclusion between individuals with PTSD and control participants, those with PTSD reported greater perceived social exclusion than control participants in an experimental manipulation of inclusion and exclusion (106), perhaps underscoring evidence of impaired social cognition among individuals with PTSD. Finally, among female adolescents exposed to war-related trauma, those who experienced sexual violence reported increased stigmatization (i.e., feeling treated worse than others, being insulted, rejected and excluded from family or community) (107). Further, stigmatization explained symptoms of depression and post-traumatic stress more so than did the direct impact of sexual violence in this sample (107).

Healthcare Workers and Social Exclusion During COVID-19

Healthcare workers may perceive themselves to be socially excluded during the pandemic. In acknowledgment of the stigmatization that healthcare workers may experience by their communities during disease outbreaks, Taylor et al. (108) conducted a North American study evaluating non-healthcare workers' attitudes toward healthcare workers serving during COVID-19 and found that more than one quarter of respondents believed that healthcare workers should be subject to severe restrictions, including isolation from communities and families. Further, one-third of the respondents reported avoiding healthcare workers due to fear of infection (108). Indeed, Kröger (26) highlighted how healthcare workers have been prohibited from certain public spaces including bringing their children to school and Shimizu and Lin (109) recounted instances of defamation against healthcare workers in Japan during the pandemic. Individuals affected by COVID-19 in Japan have experienced societal rejection, discrimination and stigmatization and since healthcare workers are at a high risk of infection due to contact with COVID-19 patients, they are more likely to suffer from social exclusion (110). Reports indicate that Japanese healthcare workers have been victims of discrimination and abuse outside of work as the public treats them as "germs" (109). Healthcare workers in Japan have also been denied access to public transportation and their families have fallen victim to discrimination as well (109). In Canada, a national news organization reported on two nurses' experiences of facing criticism for crossing the border to provide care at a hospital in Detroit. The nurses described being blamed for bringing COVID cases into their city as they worked to be a part of the solution by caring for COVID-19 patients (111). Furthermore, Dye et al. (112) conducted a survey of healthcare workers' experiences of COVID-19-related bullying and stigma with participants from across 173 countries, reporting that healthcare workers were experiencing social exclusion during the pandemic, especially in communities affected by the intersection of racism, violence and police involvement (112).

In sum, social exclusion violates the inherent human need for relationships, consequently generating physiological and psychological disturbances. The effects of social exclusion in the form of stigmatization have been documented among various populations such as war veterans (103), survivors of sexual violence (107) and survivors of conflict (105). Our research group is currently preparing a scoping review on healthcare workers' and public safety personnel's exposure to PMIEs and distressing experiences during the pandemic. Here, we identified a need for further investigation of the verbal and physical abuse that healthcare workers have experienced in order to understand the context and severity of such exposures globally. As social exclusion is implicated in the development and maintenance of PTSD symptoms, targeting healthcare workers' perceptions of social exclusion may be an effective strategy to prevent and treat COVID-19-related moral injury.

DISCUSSION

In Litz et al.'s (10) conceptual model of moral injury, it is clear that an individual's social world is expected to mediate their response to PMIEs. Indeed, this model postulates that the degree of dissonance an individual initially experiences post-PMIE will be moderated by others' reactions. In addition, stable, internal and global attributions may be countered when an individual has others in their environment to offer interpretations of events that lead to self-forgiveness rather than self-condemnation

(10). Targeting perceived social support, acknowledgment and inclusion may be an opportunity for PMIE-exposed healthcare workers to reconcile dissonant cognitions of their beliefs about the world and their experiences. Here, this targeted approach may aid the individual in processing intense moral emotions and deter them from social withdrawal, which may otherwise manifest into symptoms of moral injury such as self-condemnation, overwhelming shame, guilt, anger, anhedonia and/or PTSD symptoms. For example, social exclusion may play a critical role in how healthcare workers evaluate themselves after experiencing perpetration-based PMIEs during the COVID-19 pandemic. In interviews our research group has conducted with healthcare workers throughout 2021, healthcare workers have described excessive guilt when not able to attend to patients quickly enough due to changing out of and into PPE. If an individual in this situation is subsequently ostracized from colleagues or receives condemning information from close individuals in their life regarding their actions, these reactions may strengthen beliefs such as "I am a bad person" and "I am responsible for the patient's death", contributing to the sequalae of moral injury postulated by Litz et al. (10).

Relatedly, social support and acknowledgment may not only be factors that mediate morally injurious outcomes among those who are exposed to PMIEs, but may also inherently constitute PMIEs for some healthcare workers during the pandemic. For example, in a recent review of frontline healthcare workers' perspectives on working during pandemics and epidemics (e.g., COVID-19, SARS, Ebola), Billings et al. (100) discussed how healthcare workers valued support from their organizations and perceived the organization to have "an institutional duty to provide staff with sufficient protection to work safely" (pg. 10). Healthcare workers may feel betrayed by their organization when they are sent to care for COVID-19 patients without appropriate PPE (87) or when they feel unheard by leaders (91) who establish procedures and policy with which workers do not agree. Finally, actions or inactions that communicate to healthcare workers that their efforts on the frontlines are not recognized or appreciated [e.g., lack of inclusion in financial compensation; (100)] may constitute betrayal-based PMIEs for some healthcare workers. Thus, healthcare organizations must carefully consider the ways in which their operations may betray their employees in addition to recognizing that, as a trusted authority to their healthcare workers, they have the ability and responsibility to support workers and mitigate the effects of moral injury through means of social support and acknowledgment.

An important consideration in translating research on interpersonal factors in PTSD to moral injury, however, is that moral injury by definition may involve witnessing morally transgressive acts and/or an individual enacting the moral harm themselves. Thus, the utility of addressing social support, acknowledgment and exclusion in moral injury may need to be strategically implemented to accommodate for both personally transgressed and witnessed PMIEs, which has not been explored in the PTSD literature. This tailored approach will mimic research that has adapted traditional PTSD treatments to better suit the experience of those with moral injury (11, 35). With this consideration, it is necessary for future studies to continue to investigate the boundaries between moral injury and PTSD as well as the ways in which a social cognitive model can inform treatment interventions.

An interpersonally-focused approach to understanding and mitigating moral injury in healthcare workers during COVID-19 is consistent with a recent call for moral injury treatments to move beyond psychotherapy and include an affirmative community effort (11). This approach must include both individual and organization considerations that take into account the unqiue indiviudal in their specific social environement. Indeed, Billings et al. (100) highlighted the importance of the social environment when reviewing the experiences of frontline healthcare workers affected by stigma and discrimination in their communities. Here, healthcare workers reported feeling supported by their orgnizations at times (e.g., when communication was clear, when buddy systems were established between expereinced and new staff) and unsupported at other times (e.g., when staff safety was not a clear priority, when they felt coerced to caring for infected paitents). Below, we synthesize and disucss ciritical considerations for bolstering against the deliterious imapcts of moral injury in healthcare workers at both the indiviudal and organizaiton level.

Individual Considerations

In line with the recommendations made in the recent Moral Injury Guide prepared by the Centre of Excellence on PTSD (113), we offer the following individual level considerations to buffer against the deleterious impacts of moral injury for healthcare workers during the COVID-19 pandemic.

At the individual level, it is important to consider risk and resilience factors that may affect one's likelihood of developing moral injury after exposure to a PMIE. Williamson et al. (114) highlighted risk factors for moral injury in the military, which may be pertinent to healthcare workers during the pandemic, including loss of life to a vulnerable person (e.g., elderly, children), perception of leaders not taking responsibility for events or being unsupportive, staff feeling unprepared for the emotional or psychological impacts of decisions, concurrent exposure to other traumatic events and a lack of social support after exposure to a PMIE. Furthermore, our research group has shown that emotional abuse during childhood (115, 116) and emotional regulation (116) are critical factors related to moral injury. Battaglia et al. (115) examined the relation between childhood abuse and moral injury among members of the Canadian Armed Forces (CAF) and found that emotional abuse in childhood may increase the likelihood of moral injury among adults in the CAF (115). Further, Roth and colleagues (116) demonstrated that exposure to adverse childhood experiences was associated with both moral injury and trauma-related symptoms among PSP, but emotion regulation skills buffered moral injury (116). Thus, whereas healthcare workers who are survivors of childhood trauma may be at an elevated risk for moral injury, those with strong emotion regulation skills may have the necessary resilience to buffer against the development of moral injury.

Healthcare workers who identify with a minority group (e.g., gender, sexual orientation, or racial/ethnic group) may also be

at an elevated risk for moral injury during the pandemic due to the compacting nature of minority stress (i.e., stress associated with discrimination or marginalization) with COVID-19-related stressors. The Centre of Excellence on PTSD's moral injury guide (113) highlighted that racialized individuals are at a higher risk of COVID-19 exposure, infection and severe outcomes due to racial disparities in income and poverty. Further, racialized healthcare workers may deal with stressors related to systemic racism in addition to the stressors associated with providing care during COVID-19. For example, racialized healthcare workers may experience racism from patients and colleagues, may witness colleagues make racist comments about patients, may feel compelled to protect racialized patients from racism, may face skepticism about their training and competence, may experience belittlement of their speech, appearance, religion or cultural practices and may be called upon to educate others about systemic racism (113). As a result, racialized healthcare workers may be at an increased risk of experiencing distress and moral injury during the pandemic in comparison to their non-racialized counterparts. It is vital to acknowledge the unique stressors that healthcare workers who identify with minority groups may face in relation to discrimination and marginalization and consider these impacts when developing interventions for COVID-19-related moral injury.

Based on Heber at al.'s (91) recommendations for PSP to support themselves during COVID-19, healthcare workers may benefit from taking time to practice self-care in the form of healthy coping and seeking connections and help. For example, frontline workers should prioritize sleep, nutrition, hydration and exercise, stress management, relaxation, maintaining/establishing routines, connecting with friends, family and co-workers and seeking informal and formal supports as needed (91). These individual recommendations were echoed in the Centre of Excellence on PTSD's guide to moral injury (113), which additionally recommends that healthcare workers gain education about moral stressors, moral injury, relaxation therapy and mindfulness or meditation to reduce stress.

Organizational Considerations

Cohen and Wills' (66) stress-buffering model contends that a specific match between trauma and the subsequent social support is necessary for social support to reduce the harmful psychological responses associated with trauma exposure. Thus, in the context of COVID-19, healthcare organizations must play a critical role in supporting healthcare workers to buffer against moral injury as their workers look to leadership for guidance in these unprecedent times. In line with the recommendations made in the recent Moral Injury Guide prepared by the Centre of Excellence on PTSD (113), we offer the following organizational level considerations for leaders to consider in an effort to buffer against the deleterious impacts of PMIE exposure and moral injury as an outcome for healthcare workers during the COVID-19 pandemic. Recommendations for organizations to support healthcare workers include: offering clear, positive yet realistic information; establishing peer support networks among healthcare workers where team cohesion is emphasized; time and space to rest and discuss experiences; encouraging self-forgiveness and re-integration of moral transgressions into one's moral code; honest discussions about the moral requirements of working during a pandemic; leaders taking responsibility to ensure that staff are prepared for the emotional consequences of their work and are aware of vicarious traumatization and relevant coping strategies; peer support teams to provide psychological first aid; encouraging staff to utilize employee assistance programs, chaplaincy, or other levels of support; intentionally expressing gratitude to frontline workers; offering accessible professional resources; rotating staff between high and low stress roles; optimizing the work environment for appropriate breaks; educating healthcare workers on PMIEs and the possible morally injurious outcomes that may be experienced after exposure (e.g., overwhelming moral emotions of anger, guilt, shame betrayal; self-condemnation, anhedonia, social withdrawal), encouraging self-assessments for risks of moral injury and formal screening for PTSD, as well as receiving evidenced-based treatment, if required (113, 117–121). Critically, some healthcare workers may show signs of distress, yet deny or lack insight into these difficulties and refuse help (122). Healthcare workers involved in previous pandemics and epidemics did not fully voice their needs or seek supports until after the peak of the crisis (100). As such, it is essential that orgnaizations continiously offer and encourage staff to prioritize their mental health during and beyond the COVID-19 pandemic, even in the absence of explicit requests for this support.

Limitations

While a thorough search of the literature was conducted in preparing this review, it must be acknowledged that the present review is limited by its narrative structure, which inherently is unsystematic and is consequently associated with bias. The purpose of this review was to synthesize literature on different topics (e.g., social cognition, PTSD, moral injury) to present the notion of an interpersonally-focused approach to COVID-19-related moral injury in healthcare workers. Though it has limitations, a narrative review was the most appropriate type of review for this work (123). The present review is additionally limited by the paucity of empirical research surrounding moral injury in healthcare workers and a lack of consensus on moral injury as a clinical phenomenon. As moral injury has historically been situated in the military context, there remains a need for research on the types of events that may be experienced by healthcare workers as PMIEs, as well as the outcomes associated with these exposures, to better characterize healthcare workers' experiences and arrive at a definition for moral injury in this population. Future research should consider a systematic review of the literature on moral injury in healthcare workers as data becomes available to reduce bias and synthesize knowledge on moral injury in this population.

CONCLUSION

In summary, many healthcare workers have faced morally and ethically challenging situations throughout the COVID-19

pandemic that place them at an elevated risk for moral injury. The relation between moral injury and PTSD, although not fully understood, suggests that the two are related yet distinct responses to trauma. Alterations in social cognitive functioning that may contribute to interpersonal difficulties in PTSD render interpersonal factors such as social support, acknowledgment and exclusion important in moderating PTSD symptomology. Existing research on the interpersonal factors that moderate PTSD symptom development and maintenance, then, may prove to be a useful starting point for preventing and, where necessary, treating moral injury in healthcare workers during the COVID-19 pandemic. We urge researchers and clinicians to consider carefully a social cognitive and interpersonal lens in relation to ongoing research on moral injury in healthcare workers during the COVID-19 pandemic and beyond. Healthcare organizations should follow the available recommendations to support healthcare workers at this time to bolster against moral injury.

AUTHOR CONTRIBUTIONS

AD'A: conceptualization, writing (original draft), review, and editing. KR and RM: conceptualization and review and editing. RL, AH, PS, AM, HS, CO'C, FH, and SR: review and editing. MM and RL: conceptualization, writing, review and editing, and funding acquisition. All authors contributed to the article and approved the submitted version.

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Face Processing in Early Development: A Systematic Review of Behavioral Studies and Considerations in Times of COVID-19 Pandemic

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Human faces are one of the most prominent stimuli in the visual environment of young infants and convey critical information for the development of social cognition. During the COVID-19 pandemic, mask wearing has become a common practice outside the home environment. With masks covering nose and mouth regions, the facial cues available to the infant are impoverished. The impact of these changes on development is unknown but is critical to debates around mask mandates in early childhood settings. As infants grow, they increasingly interact with a broader range of familiar and unfamiliar people outside the home; in these settings, mask wearing could possibly influence social development. In order to generate hypotheses about the effects of mask wearing on infant social development, in the present work, we systematically review $N = 129$ studies selected based on the most recent PRISMA guidelines providing a state-of-the-art framework of behavioral studies investigating face processing in early infancy. We focused on identifying sensitive periods during which being exposed to specific facial features or to the entire face configuration has been found to be important for the development of perceptive and socio-communicative skills. For perceptive skills, infants gradually learn to analyze the eyes or the gaze direction within the context of the entire face configuration. This contributes to identity recognition as well as emotional expression discrimination. For socio-communicative skills, direct gaze and emotional facial expressions are crucial for attention engagement while eye-gaze cuing is important for joint attention. Moreover, attention to the mouth is particularly relevant for speech learning. We discuss possible implications of the exposure to masked faces for developmental needs and functions. Providing groundwork for further research, we encourage the investigation of the consequences of mask wearing for infants' perceptive and socio-communicative development, suggesting new directions within the research field.

Keywords: face processing, development, infancy, social cognition, mask wearing, COVID-19

INTRODUCTION

Faces are our primary source of information about other people. We rely on social cues conveyed by human faces to interpret socio-communicative interactions, using information from the face to decode others' intentions, emotions, and interests. Since the early stages of the COVID-19 pandemic, the World Health Organization (WHO) recommended wearing face masks in social contexts to limit viral diffusion (WHO, 2020). This brings an important change in the facial information available for encoding, leaving eyes uncovered while masking the mouth. Face coverings remove information about facial configuration and potentially affect social cognition by altering face perception and detection of communicative meanings in social contexts in adults (Carragher and Hancock, 2020; Noyes et al., 2021) and school-aged children (Stajduhar et al., 2021). Considering the effects of face coverings on social cognition is important in evaluating the risk–benefit balance of mask mandates in particular settings.

The roots of social cognition begin at birth and critically rely on processing information from faces. Newborns preferentially orient toward faces (Morton and Johnson, 1991; Gamé et al., 2003; Macchi Cassia et al., 2004), an effect driven by the configural location of the eyes and mouth (Morton and Johnson, 1991; Farroni et al., 2005). The most frequent stimulus infants encounter in their environment is the human face (Fausey et al., 2016). Being exposed to a variety of facial features (eyes, eye gaze, and mouth) and emotional expressions within sensitive periods is crucial for the specialization of social brain networks (Johnson, 2005). Thus, given that masks disrupt visual access to facial features, it is important to consider the possible cascading effects of exposure to masked faces on perceptive and socio-communicative development. Since a large corpus of published literature has examined how early exposure to faces contributes to social brain development, we can leverage existing work to ask which aspects of face processing may be altered by exposure to masked faces and whether this has different implications depending on one' s developmental stage.

In the present paper, we summarize the wide corpus of studies on the development of face processing to understand possible effects of mask wearing as a function of infants' developmental needs. To generate hypotheses, we consider the changes in facial cues resulting from mask wearing (mouth covered and eyes uncovered and breaking face configuration) and present a guided systematic review of behavioral studies investigating face processing during the first years of life (0–36 months). Mask wearing is discussed in terms of both altering face perception and hindering social communication by removing information about face configuration. Crucially, the aim of this review is to inform future research exploring the developmental effects of mask wearing, which is a key preventive measure to limit COVID-19 diffusion.

MATERIALS AND METHODS

Two literature searches were conducted on Elsevier's Scopus® (Ballew, 2009) and OVID databases before February 20th, 2021 to select papers on the topic of face processing in infancy. The search string was {[(face and (face processing or eye or eyes or mouth or gaze or emotion or motion or race) and infan*) not ("autism spectrum disorders" or asd or asc or autis* or ndd or "neurodevelopmental disorde*")].ti,ab,kw.} yielded 8,828 manuscripts in total. Manuscripts were selected from subject areas of Psychology, Neuroscience and Social Sciences as published or in press articles written in English; then, duplicates were removed resulting in 5155 papers to be screened. We focused on behavioral studies with typically developing infants to get a sense of possible observed effects of mask mandates in community contexts for children in preschool age.

An additional automatic filter was applied before manual abstract screening, such that the retrieved manuscripts' title, abstract, or keywords had (1) to include or (2) not to include words as indicated in **Table 1**. This strategy was adopted to limit the search to content which was pertinent to our research questions. Two independent researchers (LC and AG) screened the remaining abstracts ($N = 615$) and read all the selected papers ($N = 110$). By reading abstracts, papers were excluded if non-relevant in terms of topic, age, non-behavioral methodology (EEG, NIRS, fMRI, and pupillary reflex), publication type being a review, or meta-analysis, publication date before 2000. Each of the selected papers was assigned to one or more from the following topics: "eyes," "gaze cueing," "mouth," "motion," "local/global," "emotion," "race," and "face looking." To limit the focus of this review to the effect of facial features

TABLE 1 | Criteria used for manuscript search.

String	Keywords	
	Limited to	Excluded
{[(face and (face processing or eye or eyes or mouth or gaze or emotion or motion or race) and infan*) not ("autism spectrum disorders" or asd or asc or autis* or ndd or "neurodevelopmental disorde*")].ti,ab,kw.}	Newborn, Infant, Child, Preschool Child, Child, Preschool, Face, Facial Expression, Emotion, Mouth, Attention, Child Development, Emotions, Child Behavior, Infancy, Psychology, Information Processing, Visual Perception, Gaze, Perception, Pattern Recognition, Visual, Eye Movement, Nose, Facial Recognition, Recognition, Social Behavior, Fixation, Ocular, Eye Fixation, Eye-Tracking, Eye, Face Processing, Infant Behavior, Social Interaction	Adolescent, School Child, Middle Aged, Major Clinical Study, Temperament, Pregnancy, Animal, Prematurity, Autistic Disorder Autism Spectrum Disorder, Clinical Feature, Sex Difference, Comparative Study, Animals, Aging, Photostimulation, Neuroimaging, Electroencephalography, Evoked Response, Nuclear Magnetic Resonance Imaging, Pathophysiology, Magnetic Resonance Imaging, Electroencephalogram, Hemispheric Dominance, Evoked Potentials

and information that could be altered or hidden by masks, papers focusing on the effect of race on face perception were excluded at this stage.

Selection bias could possibly happen based on automation tool selection; however, we attempted to overcome this by carefully selecting relevant references during full-text reading. An additional $N = 28$ papers were manually included at this stage. Nine papers were excluded after full-text reading as considered out of topic. The final sample was $N = 129$ papers. The literature selection process is illustrated in the PRISMA flow diagram (**Figure 1**).

RESULTS

Papers included in the present review covered five main topics: face exposure (i), featural and configural face scanning (ii), eye and eye gaze (iii), mouth (iv), and emotion expression (v). These topics were selected to allow us to extrapolate the possible impact of mask wearing linked to: being exposed to a smaller variety of uncovered faces and possibly to familiar faces more often than before the COVID-19 pandemic (i), being exposed to partly covered faces rather than full faces (ii), having the eyes region uncovered and available to extract information (iii), obtaining limited information from the mouth and mouth movements (iv), and having limited experience with simultaneous changes in face features due to emotional expressions (v). Importantly, perceptual and communicative aspects are examined in each paragraph. In **Table 2**, we provide a summary of the main information for each included study.

Environmental Exposure to Faces

Early in life, infants often spend most of their time inside the household. As they grow, their living contexts extend and they encounter more people outside the family (i.e., peers and teachers). To get a sense of the likelihood of being exposed to masked faces in daily routines, we summarize naturalistic and screen-based studies on the extent to which faces are present and looked at in everyday visual environments during the first 3 years of life.

Studies conducted using head mounted cameras showed that within the first year, the amount of face exposure is higher for younger infants; infants see fewer faces as they grow older during the first 2 years of life (Jayaraman et al., 2015, 2017). Indeed, 3-month-old infants are exposed to faces for 21% of their daily time, and this is most frequently the face of the primary caregiver. However, frequency of exposure and consistency of faces vary across contexts, with caregiver's faces being present in a wide range of contexts but for shorter durations compared to other relatives or strangers (Sugden and Moulson, 2019). Similarly, in a survey study, Rennels and Davis (2008) found that over the first year of life, most adult-infant interactions happen with the primary caregiver and with people of the same age, gender, and race. Furthermore,

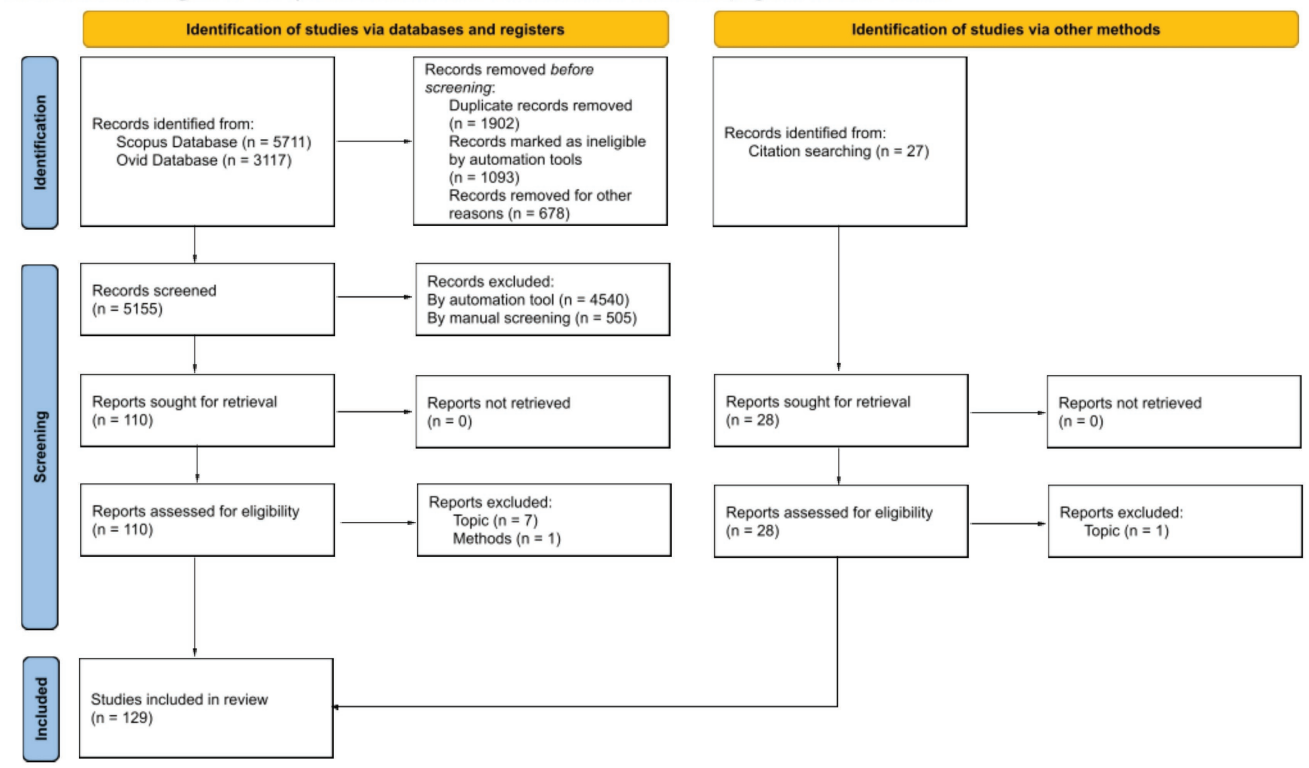

FIGURE 1 | PRISMA flow diagram.

TABLE 2 | Summary of studies included in the review.

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Aktar et al., 2018	Emotion	14	Free-viewing task	Yes	*n* = 57 (23F)
Amano et al., 2004	Motion	3–4	Live interaction	No	Exp 1: *n* = 24 (10F), Exp 2: *n* = 22 (13F)
Atagi and Johnson, 2020	Mouth	15–25	Free-viewing task	Yes	*n* = 77 of which *n* = 34 (11F; monolinguals) *n* = 43 (15F; bilinguals)
Bahrick and Newell, 2008	Motion	5.5	Familiarization	No	Exp 1: *n* = 24 (13F), Exp 2: *n* = 24 (10F)
Bahrick et al., 2013	Mouth	2 and 3	Habituation	No	Exp 1: *n* = 48 (15F, 2 months) Exp 2: *n* = 32 (17F, 3 months)
Bhatt et al., 2005	Featural/configural	3, 5	Habituation	No	Exp 1: *n* = 28 3 m (13F) Exp 2: *n* = 32 of which *n* = 16 3 m (8F) *n* = 16 5 m (7F) Exp 3: *n* = 16 3 m (8F) Exp 4: *n* = 32 5 m (18F)
Brenna et al., 2013	Emotion	3	Familiarization	No	*n* = 64 (26F)
Brooks and Meltzoff, 2002	Eyes	12, 14, and 18	Live interaction	No	Exp 1: *n* = 96 Exp 2: *n* = 96
Cashon et al., 2013	Featural/configural, Face exposure	22–25 weeks 27–32 weeks	Habituation	No	*n* = 111 (42F)
Cecchini et al., 2011	Motion, Featural/configural, Face exposure	Newborns	Familiarization	No	*n* = 16
Chen et al., 2020	Gaze cuing	12–37	Free play	Yes	*n* = 21 12–37 m
Chien et al., 2010	Featural/configural	2–4.5	Forced-choice novelty preference	No	*n* = 24
Cohen and Cashon, 2001	Featural/configural	7	Habituation	No	*n* = 32 (16F)
Coulon et al., 2011	Mouth, motion	Birth	Familiarization	No	Exp 1: 16 (7F) Exp 2: 16 (9F)
Courage et al., 2006	Face exposure	3,5–13	Free-viewing task	No	*n* = 100 (50F)
de Haan et al., 2004	Emotion	7	Video coding looking time	No	*n* = 40 (11F)
de Heering et al., 2008	Face exposure	Birth	Habituation	No	*n* = 28
de Heering et al., 2015	Featural/configural	3	Preferential looking	No	*n* = 40 (23F)
Della Longa et al., 2019	Eyes	4	Habituation	No	*n* = 48 (21F)
Denicola et al., 2013	Face exposure	4, 8	Preferential looking	No	*n* = 64
Di Giorgio et al., 2012	Face exposure	3, 6	Visual search	Yes	*n* = 31 (17F) of which: *n* = 12 6 m (7F) *n* = 19 3 m (10F)
Doi et al., 2010	Eyes, Emotion	10	Disengagement task	Yes	*n* = 24 (13F)
Farroni et al., 2000	Gaze cueing, motion	4, 5	Eye-gaze cueing paradigm	No	Exp 1: 13 (7F) Exp 2: 16 (7F) Exp 3: 30
Farroni et al., 2002	Eyes	Birth, 4	Preferential looking	No	*n* = 17 (10F)
Farroni et al., 2005	Eyes	Birth	Preferential looking	No	*n* = 105 of which Exp 1:a: *n* = 33 Exp 1:b: *n* = 17 Exp 1:c: *n* = 12 Exp2a: *n* = 31 Exp2b: *n* = 12

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Farroni et al., 2006	Eyes	Birth	Preferential looking	No	Exp 1: *n* = 15 (4F) Exp 2: *n* = 18 (8F) Exp 3: *n* = 29 (13F)
Farroni et al., 2007	Eyes	4, 5	Habituation	Yes	*n* = 24 (11F)
Fecher and Johnson, 2019	Mouth, motion	9	Switch habituation task	No	*n* = 48 (24F)
Flom and Bahrick, 2007	Emotion	3, 4, 5, 7	Habituation	No	Exp 1 (bimodal): *n* = 18 (9F) 3 m, *n* = 18 (10F) 4 m, *n* = 18 (7F) 5 m, *n* = 18 (9F) 7 m; Exp2 (auditory): *n* = 18 (11F) 4 m, *n* = 18 (9F) 5 m, *n* = 18 (8F) 7 m; Exp3 (visual): *n* = 18 (8F) 4 m, *n* = 18 (8F) 5 m, *n* = 18 (10F) 7 m; Exp 4 (asynchronous): *n* = 18 (9F) 4 m, *n* = 18 (10F) 5 m; Exp 4 (unimodal sequential): *n* = 18 (7F) 4 m.
Flom et al., 2018	Emotion	3 and 5	Habituation	No	*n* = 20 3 m *n* = 20 5 m (18F in total)
Franchak et al., 2018	Face exposure	12	Free play	Yes	*n* = 17
Fu et al., 2020	Emotion	4–24	Orienting eye-tracking task	Yes	*n* = 151 (65F)
Galati et al., 2016	Featural/configural	3, 5	Familiarization	No	Exp 1: *n* = 20 (7F) Exp2: *n* = 20 (5F) Exp3: *n* = 18 (5F) Exp4: *n* = 36 (15F)
Gamé et al., 2003	Featural/configural	2–6	Familiarization	No	*n* = 43 (22F) of which *n* = 8 (5F) 2 m *n* = 9 (6F) 3 m *n* = 9 (4F) 4 m *n* = 9 (3F) 5 m *n* = 8 (4F) 6 m
Geangu et al., 2016	Emotions	7	Familiarization	Yes	*n* = 77 UK, *n* = 76 Japan
Gliga et al., 2009	Face exposure	6	Visual search	Yes	Exp 1 *n* = 16 (8F) Exp 2 *n* = 12 (7F) Exp 3 *n* = 16 (6F)
Gluckman and Johnson, 2013	Face exposure	6	Visual search	Yes	*n* = 32 (16F)
Gredebäck et al., 2008	Gaze cuing	5–6- 9- 12-	Gaze (and head) following video with eye-tracking	Yes	*n* = 16 5 m, *n* = 16 6 m, *n* = 16 9 m, *n* = 16 12 m
Gross and Schwarzer, 2010	Emotion	7 and 9	Habituation	No	*n* = 33 (18F) 7 m, *n* = 38 (16F) 9 m
Haensel et al., 2020	Eyes, Mouth	10, 16	Free-viewing task	Yes	*n* = 48 10 m (21F) *n* = 41 16 m (16F)
Hayden et al., 2007	Featural/configural	5, 7	Movement-enhanced discrimination procedure	No	Exp 1: *n* = 24 7 m (11F) Exp 2: *n* = 32 5 m (19F)

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Heck et al., 2016	Emotion	3.5 and 5	Looking time following a peripheral checkboard is presented	Yes	*n* = 24 (15F) 3.5 m, *n* = 24 (12F) 5 m
Hernik and Broesch, 2019	Gaze cuing	5–7	Gaze (and head) following videos with eye-tracking	Yes	*n* = 22 (10F)
Hillairet de Boisferon et al., 2017	Mouth	4, 6, 8, 10, 12	Free-viewing task	Yes	Exp. 1 *n* = 93 (39F) Exp. 2 *n* = 81 (39F)
Hillairet de Boisferon et al., 2018	Mouth	14 and 18	Free-viewing task	Yes	*n* = 91 (29F)
Houston-Price et al., 2006	Gaze cuing	15	Paired comparison preceded by gaze cue and auditory stimulus (online video coding)	No	Exp 1: *n* = 27 (14F), Exp 2: *n* = 30 (14F), Exp 3: *n* = 30 (18F), Exp 4: *n* = 32 (20F)
Humphreys and Johnson, 2007	Featural/configural	4, 7	Habituation	No	*n* = 32 of which *n* = 16 4 m (8F) *n* = 16 7 m (7F)
Hunnius and Geuze, 2004	Motion	6–26	Live scenes	Yes	*n* = 10 (5F) 6 to 26 months
Ichikawa et al., 2014	Motion, emotion	4–5 and 6–7	Exp 1: preferential looking static images. Exp 2: familiarization and visual preference with static images. Exp 3: habituation to static images and short videos with online video coding	No	Exp 1: 24 (9F) 4/5 m, 24 (5F) 6/7 m, Exp 2: 18 (10F) 4/5 m, 18 (12F) 6/7 m, Exp 3: 18 (5) 4/5 m, 18 (12F) 6/7 m
Ichikawa and Yamaguchi, 2014	Emotion	6–7	Habituation	No	*n* = 32 (13F)
Ichikawa et al., 2011	Motion	7–8	Preferential looking task	No	Exp 1: *n* = 29 (10F) 5/6 m, *n* = 29 (13F) 7/8 m, Exp 2: *n* = 16 (8F) 5/6 m, *n* = 16 (6F) 7/8 m
Jayaraman et al., 2015	Face exposure	1–11	Head mounted cameras, videorecording infants' natural visual ecology	No	*n* = 22 (11F)
Jayaraman et al., 2017	Face exposure	1–24	Head mounted cameras, videorecording infants' natural visual ecology	No	*n* = 120 (53F) of which Exp 1: *n* = 84 (34F) Exp 2: n = 36 (19F)
Kato and Konishi, 2013	Featural/configural	6–13	Visual scanning	Yes	*n* = 40 (20F) of which *n* = 10 (5F) 6 m *n* = 10 (5F) 8.5 m *n* = 10 (5F) 11 m *n* = 10 (5F) 13.5 m
Kim and Johnson, 2013	Emotion	6	Preferential looking	Yes	Exp 1: *n* = 22 (12F), Exp 2: *n* = 22 (11F)
Kim and Johnson, 2014	Motion	3, 5	Preferential looking task (eye-tracking)	Yes	*n* = 33 (16F) 3 m, *n* = 42 (21F) 5 m
Kubicek et al., 2013	Mouth, Motion	12-	Familiarization	Yes	*n* = 40 (19F)
Layton and Rochat, 2007	Motion	4–8-	Habituation/dishabituation task	No	*n* = 62

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Lee et al., 2015	Emotion	6–9–12-	Habituation	No	Exp 1: *n* = 23 (9F) 6 m, *n* = 41 (21F) 9 m, *n* = 43 (21F) 12 m, Exp2: *n* = 16 (10F), *n* = 38 (18F)
Leo and Simion, 2009	Featural/configural	Newborns	Preferential looking	No	Exp 1: *n* = 14 (7F) Exp 2: *n* = 12 (4F)
Leo et al., 2018	Motion, Emotion	Newborns	Habituation (online video coding)	No	Exp 1: *n* = 28 (14F), Exp 2: *n* = 28 (14F), Exp 3: *n* = 14 (5F)
Leppanen et al., 2010	Emotions	7	Gap-Overlap	No	*n* = 42 (20F)
Lewkowicz and Hansen-Tift, 2012	Mouth	4, 6, 8, 10, 12	Free-viewing task	Yes	*n* = 179 of which Exp 1: 4 months *n* = 19 6 months *n* = 16 8 months *n* = 17 10 months *n* = 17 12 months *n* = 20 Exp 2: 4 months *n* = 19 6 months *n* = 15 8 months *n* = 17 10 months *n* = 20 12 months *n* = 19
Macchi Cassia et al., 2004	Face exposure	Newborns	Preferential looking	No	*n* = 60
Mercure et al., 2019	Mouth	4–8	Mcgurk task	Yes	*n* = 73 (34F)
Nagy, 2008	Motion	Birth	Still-face paradigm	No	*n* = 90 (42F)
Nakato et al., 2009	Gaze cuing	6, 8	Familiarization	No	*n* = 16 (6F) 6 m, *n* = 16 (7F) 7 m, *n* = 16 (7F) 8 m
Niedźwiecka and Tomalski, 2015	Eyes, gaze cuing	9, 12	Gaze cuing by different facial expressions	Yes	Pilot: *n* = 13 (5F) 9 m, Exp: *n* = 27 (13F) 9/12 m
Oakes and Ellis, 2013	Featural/configural	4.5, 6.5, 8, 12.5	Visual scanning	Yes	*n* = 24 (8F) 4.5 m, *n* = 27 (12F) 6.5 m, *n* = 21 (9F) 8 m, *n* = 20 (5F) 12.5 m
Otsuka et al., 2009	Motion	3–4	Familiarization	No	Exp 1: *n* = 24 (10F), Exp 2: *n* = 12 (5F), Exp 3: *n* = 12 (8F), Exp 4: *n* = 12 (7F)
Otsuka et al., 2016	Gaze cuing	4–5, 7–8	Wollaston's task	No	*n* = 20 (9F) 4/5 m, *n* = 20 (7F) 7/8 m
Peltola et al., 2008	Emotions	7	Gap-Overlap	No	*n* = 17 (9F)
Peltola et al., 2009b	Emotion	7	Overlap eye-tracking task	Yes	*n* = 15
Peltola et al., 2009a	Emotions	5, 7	Visual paired comparison task	No	*n* = 23 5 m *n* = 26 7 m
Peltola et al., 2011	Emotion	7	Overlap task	No	*n* = 24

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Peltola et al., 2013	Emotion	5, 7, 9, 11	Overlap task	Yes	*n* = 25 5 m, *n* = 26 7 m, *n* = 28 9 m, *n* = 25 11 m
Peltola et al., 2015	Emotions	7	Gap-Overlap	Yes	*n* = 62 (24F)
Pérez-Edgar et al., 2017	Emotion	4–24	Baby dot-probe task	Yes	*n* = 145 (63F)
Pickron et al., 2017	Eyes, Gaze cuing	5, 10	Gaze cuing + paired object comparison	Yes	*n* = 32 (21F) 5 m, *n* = 30 (18F) 10 m
Pons et al., 2015	Mouth	4, 8, 12	Free-viewing task	Yes	*n* = 60 (26F) of which *n* = 20 4 months (10F) *n* = 20 8 months (8F) *n* = 20 12 months (8F)
Pons et al., 2019	Eyes	12	Free-viewing task	Yes	*n* = 34 (20F)
Quadrelli et al., 2020	Emotion	7–8	Habituation	No	*n* = 36 (16F)
Quinn and Tanaka, 2009	Featural/configural	3–4, 6–7	Familiarization	No	*n* = 64 of which *n* = 32 3- to 4 m (15F) *n* = 32 6- to 7 m (20F)
Quinn et al., 2013	Featural/configural	3–7	Familiarization	No	*n* = 64 (36F) of which *n* = 32 (16F) 3- to 4-months *n* = 32 (20F) 6- to 7-months
Rennels and Davis, 2008	Face exposure	2, 5, 8, 11	Parent-report during two-weeks observation	No	*n* = 42 (18F)
Rhodes et al., 2002	Featural/configural	5–8	Preferential looking	No	*n* = 27 (9F)
Rigato et al., 2011a	Eyes	Birth	Habituation (1a, 1b) Preferential looking (2a, 2b)	No	Exp 1a: *n* = 16 Exp 1b: *n* = 18 Exp 2a: *n* = 8 Exp 2b: *n* = 6
Rigato et al., 2011b	Eyes, emotions	Birth	Preferential looking	No	Exp 1: *n* = 14 Exp 2: *n* = 13 Exp 3: *n* = 13 Exp 4: *n* = 16
Rigato et al., 2013	Gaze cuing	4	Modified Posner' spatial cuing with eye gaze as cue	Yes	*n* = 14 (5F)
Rose et al., 2002	Featural/configural	7, 12	Familiarization	No	Exp 1: *n* = 72 of which *n* = 36 7 m (22F) *n* = 36 12 m (15F) Exp 2: *n* = 48 of which *n* = 24 7 m (10F) *n* = 24 12 m (14F)
Safar and Moulson, 2017	Emotion	6.5	Habituation (exp 1), preferential looking (exp 2)	No	Exp 1: *n* = 32 (23F), Exp 2: *n* = 34 (18F)
Sai, 2005	Face exposure	Birth	Preferential looking	No	Exp 1: *n* = 14 (7F) Exp 2: *n* = 14 (8F) Exp 3: *n* = 10 (5F) Exp 4: *n* = 15 (7F)

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Sakuta et al., 2014	Featural/configural	3–5, 6–8	Familiarization	No	*n* = 48 of which *n* = 24 3 to 5 months (14F) *n* = 24 6 to 8 months (15F)
Schure et al., 2016	Mouth	8	Training + Habituation	Yes	*n* = 93 (44F)
Schwarzer and Jovanovic, 2010	Emotion	8	Habituation	No	Exp 1: *n* = 64 (M/F ratio missing) Exp 2: *n* = 21 (9F)
Schwarzer and Zauner, 2003	Featural/configural	8	Habituation	No	*n* = 97 (46F)
Schwarzer et al., 2007	Featural/configural	4, 6, 10	Habituation	No	Exp 1: *n* = 264 of which *n* = 88 4 m (36F) *n* = 88 6 m (39F) *n* = 88 10 m (44F) Exp 2: *n* = 75 4 m (30F)
Sebastián-Gallés et al., 2012	Mouth	8	Habituation	No	*n* = 48
Segal and Moulson, 2020b	Featural/configural, emotion	7	Preferential looking	Yes	*n* = 62 (31F)
Segal and Moulson, 2020a	Emotion	7	Free-viewing	Yes	*n* = 63 (33F)
Senju et al., 2008	Gaze cuing	9	Familiarization	No	Exp 1: *n* = 14 (6F), Exp 2: *n* = 12 (7F), Exp 3: *n* = 12 (7F), Exp 4: *n* = 12 (8F)
Senju et al., 2008	Gaze cueing	6.5	Gaze (and head) following	Yes	Exp 1: 20 (10F), Exp 2: 20 (10F)
Senju et al., 2015	Gaze cueing	6–10, 12–16	Gaze (and head) following	Yes	*n* = 14 (7F)
Simpson et al., 2014	Featural/configural	4–6, 9–12	Familiarization	No	*n* = 77 (34 F) 4 to 6 m *n* = 66 (27 F) 9 to 12 m
Simpson et al., 2020	Face exposure	2, 4, 6	Visual search	Yes	*n* = 65
Souter et al., 2020	Mouth	18–30	Free-viewing	Yes	*n* = 58
Spencer et al., 2006	Motion	3–8	Familiarization	No	*n* = 55 (26F)
Streri et al., 2013	Mouth, Motion	Birth	Familiarization	No	not specified
Streri et al., 2016	Mouth	3–9	Familiarization	No	*n* = 72 of which *n* = 24 3 m (11F) *n* = 24 6 m (12F) *n* = 24 9 m (9F)
Striano et al., 2007	Gaze cuing	1.5, 3	Live interaction	No	Exp 1: *n* = 12 (9F) 6-wo, *n* = 14 (8F) 3 m, Exp 2: *n* = 22 (10F) 6-wo
Sugden and Moulson, 2019	Face exposure	3-	Head mounted cameras, videorecording infants' natural visual ecology	No	*n* = 40 infants (13F) 169 h, 58 min, and 8 s of video recorded
Szufnarowska et al., 2014	Gaze cueing	6	Gaze (and head) following	Yes	*n* = 20 (14F)
Tenenbaum et al., 2013	Mouth	6, 9, 12	Free-viewing task	Yes	*n* = 97 at 6 months (44F) *n* = 65 at 9 months (29F) *n* = 62 at 12 months (29F)
Thompson et al., 2001	Featural/configural	7	Preferential looking	No	Exp 1: *n* = 39 (22F) Exp 2: *n* = 18 (9F)

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TABLE 2 | Continued

Authors	Topic(s)	Age (months)	Method	Eye tracker	Sample size
Tomalski et al., 2013	Mouth	6, 9	Free-viewing task	Yes	*n* = 32 (22F)
Tsurumi et al., 2019	Face exposure	5–8	Preferential looking	No	*n* = 20 (7F)
Turati and Simion, 2002	Featural/configural, face exposure	Newborns	Exp. 1: habituation	No	Exp. 1: *n* = 58 (28F)
			exp. 2: habituation		Exp. 2: *n* = 59 (31F)
			exp. 3: familiarization		Exp. 3: *n* = 25 (14F)
			exp. 4: habituation		Exp. 4: *n* = 26 (12F)
Turati et al., 2004	Featural/configural	4	Habituation	No	Exp 1: *n* = 14 (7F)
					Exp 2: *n* = 33 (14F)
Turati et al., 2005	Face exposure	Birth, 3	Preferential looking	Yes	Exp 1: *n* = 16 (8F)
					Exp 2 *n* = 34
					Exp 3 *n* = 10
Turati et al., 2008	Featural/configural	Newborns	Habituation	No	Exp. 1: *n* = 18
					Exp. 2: *n* = 18
					Exp. 3: *n* = 18
					Exp. 4: *n* = 17
Turati et al., 2011	Emotion	3	Familiarization	No	Exp 1: *n* = 73 (39F),
					Exp 2: *n* = 22 (11F)
Valenza et al., 2015	Motion	Birth and 4	Gap-Overlap	Yes	Exp 1a: *n* = 20 (6F) 4 m,
					Exp 1b: *n* = 14 newborns,
					Exp 2a: *n* = 18 (9F) 4 m,
					Exp 2b: 14 newborns
Von Hofsten et al., 2005	Gaze cuing	12	Video of gaze (and head) following and pointing	Yes	*n* = 20 (8F)
Wagner et al., 2013	Eyes, Mouth	6, 9, 12	Preferential looking	Yes	*n* = 36 6 m (15F)
					n = 42 9 m (18F)
					n = 39 12 m (24F)
Walle and Campos, 2014	Emotion	16, 19	Video coding infant behavior	No	*n* = 35 (20F) 16 m, *n* = 30 (14F) 19 m; *n* = 38 (20F) 16 m, *n* = 41 (24F) 19 m
Xiao and Emberson, 2019	Emotion	9	Preferential looking between two images following auditory presentation (eye-tracking)	Yes	*n* = 18 (9F)
Xiao et al., 2015	Motion	3, 6, 9	Familiarization	Yes	*n* = 41 (17F) 3 m,
					n = 32 (16F) 6 m,
					n = 26 (12F) 9 m
Yamashita et al., 2012	Eyes	6, 8	Familiarization	No	*n* = 24 (12F)
Yong and Ruffman, 2016	Emotion	7	Matching to sample task (face image and auditory stimulus expressing emotion)	No	*n* = 24 (10F)

female faces appear more frequently in infants' visual environment; infants have 2.5 times more experience of the mother's compared to the father's face (Rennels and Davis, 2008). In terms of duration, mean exposure time to unfamiliar individuals shortens with age, possibly because infants move around the environment and shift attention away from faces more frequently as they grow (Rennels and Davis, 2008). At 12 months of age, when infants' motor abilities are rapidly developing and performing actions might require some effort, face looking and mutual gaze are decreased when parents are standing and face looking has higher motor costs (vs. a low motor cost condition), as shown by eye-tracking data collected during free play. Indeed, parents are keen on spending time on the floor, perhaps to facilitate face looking in their children (Franchak et al., 2018).

Differently from naturalistic studies, screed-based studies show that with age, infants look more at faces when exposed to complex and dynamic social contexts. Within complex arrays, faces attract and hold infants' attention as in adults at 6 but not 3 months of age (Di Giorgio et al., 2012) and are looked at for longer than objects (Gluckman and Johnson, 2013) or toys at both 4 and 8 months (DeNicola et al., 2013). Orienting to faces is facilitated by direct gaze before 6 months (Simpson et al., 2020), in line with literature supporting the role of direct gaze in engaging attention from the earliest developmental stages (Farroni et al., 2002). After 6 months of age, infants

pay increasing attention to moving faces, compared with static images of patterns (Courage et al., 2006). At this age, both upright and inverted faces elicit attention orienting in complex visual displays, but only upright faces hold infants' attention (Gliga et al., 2009).

Taken together, this evidence suggests that a significant amount of time is spent looking at faces from early in life. While an increase in face looking with age is found when presenting infants with complex arrays in laboratory settings, naturalistic studies highlight that infants look less at faces as they grow. The motor skills required to direct attention to faces in real life situations, as well as the increasing importance of the adults' hands and objects in social contexts could perhaps explain some of these contrasting results. In lab settings, when face exposure does not depend on postural motor skills, infants increasingly find images of faces more engaging than objects, especially if presented upright and with direct gaze. Thus, they gradually show a preference for the stimuli they are largely exposed to that will scaffold their face perception and social communication skills.

The Development of Face Perception

Faces are a predominant stimulus in an infant's environment and constitute an important source of learning from soon after birth. Wearing a face mask changes low-level perceptual properties of faces that include contrasts (involving borders and features) as well as the features that are visible. Knowledge of the mechanisms that underpin face perception from birth is necessary to understand whether and when face coverings could impact face perception.

Newborns are predisposed to orient toward face-like configurations (Morton and Johnson, 1991; Gamé et al., 2003; Macchi Cassia et al., 2004) and multiple studies have been conducted over the years aiming to explain mechanisms beneath face preference at birth.

One proposed mechanism is that stimuli with more elements on the upper part—two eyes vs. one mouth in faces—are preferred due to the presence of more receptors, and consequently higher sensitivity, in the part of the retina that perceives the upper visual field (top-heavy hypothesis; Simion et al., 2002). Supporting this hypothesis, Macchi Cassia et al. (2004) found that newborns preferred stimuli with more elements in the upper part regardless of them being a face and concluded that a non-face-specific perceptual bias could account for face preference at birth. At 3 months, when infants' looking behavior start to be less influenced by automatic processes and they can discriminate top- vs. bottom-heavy stimuli (Chien et al., 2010), Turati et al. (2005) and Chien (2011) found no consistent bias for top-heavy patterns.

Another proposed mechanism for face bias could be linked to low-level visual constraints, as newborns' looking behavior is strongly affected by low-level stimulus properties, such as image contrast, and their vision is tuned to low frequencies (black and white changes). Relatedly, a primitive subcortical mechanism (CONSPEC, **Table 3**) could support face detection processes at birth, being later complemented by a domain-relevant mechanism (CONLERN) that gradually enables the system to recognize the face *per se* instead of a general face-like configuration (Morton and Johnson, 1991; Johnson, 2005; Johnson et al., 2015). Supporting this account, de Heering et al. (2008) manipulated the spatial frequencies of faces to which newborns were habituated and found that face recognition is facilitated by the lowest spatial frequency within the visible range. Further studies manipulating phase contrast of the stimuli revealed that face-characteristic contrast polarity (one or more dark areas surrounded by lighter surface) is required for the upright face preference in newborns (Farroni et al., 2005). The importance of contrasting internal features of faces for face preference was also found in older infants. By 3 months, infants looked longer at face than car images when faces were manipulated using a horizontal filter that altered external borders and the nose feature but preserved the face configuration composed by eyes and mouth. No face preference was shown when images were manipulated with a vertical filter, preserving the face shape but altering the top-heavy face pattern, and with inverted faces (de Heering et al., 2015).

Hypotheses on the implications of mask wearing on face preference in early life might differ according to the aforementioned theories. Referring to the top-heavy theory, newborns' exposure to masked faces in the first weeks of life (for example, in case of prolonged hospitalization after birth) should not inhibit face bias as the presence of more elements in the upper part of the stimulus is maintained. However, since this theory is based on the interdependence between the stimulus borders and the internal features (Turati and Simion, 2002), one question remains on whether masked faces are perceived as oval shapes or whether the upper border of the mask is perceived as a face bound. In the latter case, the stimulus composed by forehead and eyes (face region above the mask) would not show the top-down asymmetry and face bias could possibly be inhibited. In the CONSPEC-CONLERN framework, preferential orienting to masked faces at birth supported by subcortical neural pathways (CONSPEC) is expected to be maintained, as contrasts are preserved in the eyes region. One could wonder whether, if infants are exclusively exposed to masked faces in the first 2 months of life, the CONLERN system might theoretically be disadvantaged as it would receive atypical input regarding the face configuration. However, a recent update of the two-process theory of face processing highlights the central role of eye contact in subcortical rapid face detection (Farroni et al., 2002; Johnson et al., 2015). Since eyes are not impacted by face covering, this may compensate for the missed exposure to the entire face configuration for the development of cortical pathways underlying CONLERN. Interestingly, Sai (2005) found that head turns toward the mothers' face occur only in the presence of mothers' voice, suggesting that auditory stimuli also contribute to the origins of face processing and might support face preference when the stimulus is partially occluded by the mask; however, this hypothesis has not been tested yet. Besides, some of this will depend on whether there is a critical period, and how long that extends for, given that newborns would presumably be more exposed to masked faces when in the hospital while once at home they would probably see unmasked faces.

TABLE 3 | Glossary.

Configural processing	Holistic way of processing whereby features are integrated into a Gestalt to extract meanings (Kimchi, 1992). Expertise in face processing is based on the ability to encode configural information, useful to extract communicative meanings conveyed by emotional expressions, gaze cueing and identities. As all faces share the same general configuration (e.g., eyes are above the nose, called first-order relations), to distinguish a face from another we need to rely on more subtle changes of spatial relation among features (e.g., the distance between the eyes, named second-order relations) (Carey and Diamond, 1977)
CONSPEC	A primitive subcortical mechanism that could support face detection processes at birth, later complemented by a domain-relevant mechanism (CONLERN) that gradually enables the system to recognize the face *per se* instead of a general face-like configuration (Morton and Johnson, 1991; Johnson, 2005; Johnson et al., 2015).
Fearful attentional bias	Enhanced attention to fearful faces compared to other emotional or neutral faces
Featural processing	Detailed-oriented style where features are processed independently from their context (Kimchi, 1992)
Intersensory redundancy	Used referring to information coming from the mouth, implies the presence of synchronous visual and auditory cues (Lewkowicz and Hansen-Tift, 2012)
Inversion effect	Integrating single facial features into a configuration is easier when the facial stimulus is upright than when the face is inverted (Yin, 1969)
McGurk effect	Based on the McGurk effect, the task consists in the presentation of faces articulating syllables with congruent, incongruent and silent auditory tracks.
Wollaston illusion	This illusion postulates that eyes orientation is evicted based on the direction of the face too

Featural and Configural Face Processing

When looking at a face, two different perceptual strategies can be adopted to encode information: featural and configural (**Table 3**). Expertise in face processing is based on the ability to encode configural information, useful to extract communicative meanings conveyed by emotional expressions, gaze cueing, and identities. Disruptions in the presentation of the typical face configuration have been shown to affect configural processing (i.e., Inversion Effect, **Table 3**). This is also the case of face masks, as shown in adults (Freud et al., 2020). Whether and to what extent face masks have similar effects in developmental populations is currently unreported. To generate hypotheses on the potential effects of mask wearing on featural and configural face processing from early in life, in this paragraph, we summarize evidence on the emergence and development of these scanning strategies in infancy.

Developmental changes in the strategies employed to encode facial information have been investigated to explore the pathways leading to specialized face processing. Configural face processing appears to gradually develop during the first year of life (Thompson et al., 2001; Bhatt et al., 2005). At birth, newborns' ability to discriminate face-like patterns relies on their inner features (Turati and Simion, 2002), although there is evidence that they do not need to rely on fine details and spatial relation between features to recognize face-like patterns (Leo and Simion, 2009). A perceptual shift from featural to configural processing is suggested to happen between 4 and 10 months (Schwarzer et al., 2007), with configural face sensitivity to fine spatial resolution specializing sometime between 3 and 5 months of age (Bhatt et al., 2005). For example, Quinn and Tanaka (2009) found 3-month-olds to be more sensitive to configural changes (distance variations between features) than local changes (variations in features' size) around both the upper (eyes) and lower (mouth) face areas. Between 3 and 7 months, they appear to specialize in detecting local changes happening in the upper vs. lower face region (Quinn and Tanaka, 2009). However, the same effect has been found with objects, suggesting that processing of featural and configural variations might not be face-specific (Quinn and Tanaka, 2009; Quinn et al., 2013). Differently, despite sensitivity to featural and first-order changes being present as early as 3 months, sensitivity to variations in spatial distance among features could only be observed in 5-month-olds (Bhatt et al., 2005). During the second half of the first year of life, infants scan upright faces more efficiently (Kato and Konishi, 2013; Simpson et al., 2014) and, like adults, at 7–8 months they are faster in identifying upright than inverted faces (Tsurumi et al., 2019). While scanning patterns of the different face regions (high, middle, and low) are comparable for upright and inverted faces before 8 months, infants gradually start to scan upright faces more broadly and do so significantly more than inverted faces by 1 year of life (Oakes and Ellis, 2013). Thus, the inversion effect strengthens during the first year, possibly due to infants' experience with the entire face configuration. The end of the first year seems to be a crucial period for integrating features within the typical upright face configuration, and sufficient exposure to the entire face could be important.

Infants' face processing ability varies according to different factors beyond age, such as face orientation and pose. The ability to recognize (i.e., show novelty preference following habituation) unfamiliar full faces presented on a ¾ pose is recorded as early as 1–3 days of life (Turati et al., 2008). At 4 months, infants' performance in face recognition takes advantage of the face being upright if they had been familiarized with different poses of the same face, indicating that this manipulation requires more cognitive resources for face recognition (Turati et al., 2004). At the same age, but not at birth, infants are faster to orient from a central face toward a peripheral face when this is upright than inverted, although motion of the central face stimulus (displaying blinking, mouth opening, or

nodding) reduces the speed of orienting toward upright and inverted faces (Valenza et al., 2015). While some studies indicate sensitivity to face orientation at birth (Leo and Simion, 2009), others indicate that from 4 months infants' face processing ability is sensitive to factors like orientation, pose, and motion that modify the entire face configuration. As argued by Turati et al. (2004), differential sensitivity to inversion indicates a progressive tuning to the characteristics and configuration of a face. Since face masks affect the visible face configuration, it is possible that speed of detection and recognition of masked faces could be altered from 4 months of age.

The number of full unfamiliar faces a child is exposed to can be a factor that affects face expertise, since exposure to multiple different faces provides more opportunities to explore second-order relations. While between 3 and 4 months of age infants do not spontaneously detect changes in spacing among facial features, they can be trained to do so by being repeatedly exposed to faces varying in spatial proportions (Galati et al., 2016), in line with the idea that this is a critical period for developing configural face processing skills. On the contrary, 5- to 8-month-old infants spontaneously use configural face processing as they demonstrate sensitivity to variations in spatial relations among face features that are within the normal range of human variability (Hayden et al., 2007). When presented with pairs of faces where location of spatial features was manipulated, 5- to 8-month-old infants demonstrate sensitivity to symmetry and averageness, reflected by increased looking toward less average/symmetric faces (Rhodes et al., 2002). Accordingly, 7-month-olds look less at shortened and elongated faces, where distance between features are atypical, than faces with an average eye-to-mouth distance (Thompson et al., 2001). Furthermore, Humphreys and Johnson (2007) habituated 4- and 7-months-old infants to morphed faces and found that face regions used for identity recognition narrow with age, allowing more refined recognition and less errors with increased experience of faces (Humphreys and Johnson, 2007). The variety of faces infants are exposed to is important to develop and refine face processing skills. If mask wearing is mandatory outside the home environment and infants only see caregivers without masks, it is possible that identity recognition skills are affected.

Supporting the importance of experience with faces in everyday contexts is the research by Cashon et al. (2013). They found that sitting abilities correlate with configural face processing in 6-month-olds, suggesting that the development of more mature face processing systems based on configural instead of featural strategies also depends on changing in viewpoint and context linked with motor skills. Further, 7-month-old infants can confidently use configural information to discriminate upright but not inverted faces (which are likely never seen in the normal environment; Cohen and Cashon, 2001). Moreover, Schwarzer and Zauner (2003) showed that configural processing is used by 8 month olds to encode facial information coming from real human faces, while featural processing takes place when presented with face-like configurations (handmade drawings). Configural strategies are increasingly employed from 6 to 12 months, but older infants also use featural information for face processing (Rose et al., 2002). Moreover, Sakuta et al. (2014) showed that from 6 months onward infants can discriminate faces according to eye size, while 3 to 5 month olds could not. This suggests that building expertise on eyes alone could compensate for the diminished expertise on full face configuration in face recognition tasks in case of preponderant exposure to masked faces.

Taken together, these studies describe a gradual transition from featural to configural processing with infants using different strategies according to their developmental stage as well as experience with face configurations. Specifically, at birth, newborns rely on internal features to discriminate between faces or face-like patterns. The literature overall supports a transition to using configural strategies for face recognition between 3 and 5 months of age. Configural face processing abilities are clearly manifested from 7 to 8 months and are increasingly used for face recognition toward the end of the first year for upright faces. The development of configural processing is likely driven by experience, possibly with a range of faces. Thus, if infants are just seeing a very small number of people unmasked, it is possible that these skills will develop differently. Featural strategies are used when the configuration is broken, as it happens in the case of inverted faces. They might therefore be used for recognition of masked faces too. Furthermore, we know that infants pay different attention to eyes and mouth according to their developmental needs (i.e., attentional shift to the mouth for language learning; see paragraph 3.2.2). While masks drastically change visibility of facial features, it is possible that they impact infant's perception of the face configuration differently at different ages. Although their presence could break the CONSPEC (Acerra et al., 2002), this might not affect the communicative valence of the face at birth and throughout the first few months of life, when eyes are more salient than the mouth, while this could happen when attentional shifts to the mouth occur. However, it is also possible that being exposed to a more limited number of faces in a variety of situations (i.e., different distance, lighting, orientation, and expression) could be enough to support the development of configural strategies. Whether masked faces disrupt facial information processing and whether this effect is age-specific remain open questions for future research.

Perceiving Facial Features and Their Communicative Meanings

The development of face processing abilities partly relies on infants' attention being focused on different facial features during sensitive periods for the development of functions and skills. Crucially, faces are one of the most prominent sources of social communication. Perceptual information from the face contributes to shape trajectories of individual socio-communicative skills. For instance, eye contact engages infants (Farroni et al., 2007) and gaze shifts support their attention allocation in the environment to learn from relevant stimuli (see, for example, Cetincelik et al., 2021), while information coming from others' mouth supports language development (Lewkowicz and Hansen-Tift, 2012). Face masks change what

features can be perceived, covering nose and mouth while leaving the eye region and forehead uncovered. To discuss whether and when face masks could interfere with infants' socio-cognitive development, we examine published studies on infants' focus on each facial feature and on how social and communicative skills are learnt from others' faces.

The Value of Interactive Faces

Soon after birth, newborns appear to preferentially orient to stimuli that carry a socio-communicative meaning, which are preferred over non-communicative cues. Differently to when they are habituated to still faces, newborns do not show novelty preference after being habituated to a live interaction scene where they saw a face producing communicative cues (Cecchini et al., 2011). In classic habituation studies, novelty preference is interpreted as evidence that children can discriminate between the stimulus they have been habituated to and the one they see for the first time. Thus, these results could be interpreted as in favor of the motionless vs. interactive face. On the contrary, the authors argue this proves that newborns' interest is enhanced and more durable for interactive faces, and therefore, they are equally attracted to both post-habituation faces, regardless of previous exposure. In line with this view, newborns show a significant decrease in the looking time to faces that are not responsive during social interaction versus interactive faces (Nagy, 2008). Moreover, Coulon et al. (2011) and Streri et al. (2013) found that newborns look longer at faces when they have previously been familiarized to a video of the same face with a direct gaze, interacting or talking to them. They also seem to be facilitated in identity recognition when familiarized with dynamic (but not static) emotional faces, as shown by Leo et al. (2018). From these results, it is evident that newborns are wired for interactions; within those, they detect and prefer elements that build up the basis for social communication.

Interactive faces seem to be more powerful than static, non-interactive faces in attracting attentional resources and facilitating the acquisition of face processing skills across the first year of life. Kim and Johnson (2014) found that both 3- and 5-month-old infants look longer at faces directed toward them and in the presence of infant-directed speech. Moreover, faces displaying changes in facial expression facilitate face recognition in 3- to 4-month-olds (Otsuka et al., 2009) and around 5 months, infants can recognize actors based on their actions if exposed for enough time (min 320 s) to the naturalistic scene (Bahrick et al., 2002; Bahrick and Newell, 2008). Similarly, Spencer et al. (2006) showed that infants aged between 3 and 8 months can discriminate between people based on differences in their facial motion. Layton and Rochat (2007) tested whether motion or visual contrast helped infants discriminate their mother from a stranger to which they had been habituated. They found that facial motion improved recognition in 8- but not 4-month-old infants, indicating that dynamic changes are not only encoded but also used for identity recognition by 8 months of age. Of note, when using animated face patterns instead of real faces, infants preferred to look at biologically plausible vertical movements of the internal features (simulating eyes and mouth closure) compared to horizontally moving patterns only at 7–8 months of age and not at 5–6 months (Ichikawa et al., 2011). By obscuring mouth dynamics, masks partly reduce the availability of communicative cues in a face while they leave eye information only available. This could possibly influence face preference or depth of processing. We examine below what information infants receive from the different features to understand whether and when their role is essential for socio-cognitive development.

Eyes

Perception

Perceiving eyes scaffolds the development of face processing from birth. Farroni et al. (2005) conducted a series of experiments manipulating contrast within face-like patterns and real face stimuli. Results showed that newborns' basic visual capacity is sufficient to perceive eyes within a face, and the authors suggest that this might be a reason for face preference to be manifested soon after birth. Perceiving differences in eyes direction is important not only for face detection, as discussed earlier, but also for identity recognition. Newborns can recognize a previously seen face and this process is facilitated by direct gaze (Rigato et al., 2011a). Averted gaze prevents newborns to display a preference for happy facial expression, that is, conversely observed in the presence of direct gaze (Rigato et al., 2011b). Similarly, Farroni et al. (2007) showed that 4-month-old infants manifested a novelty preference when the face they were previously habituated to had direct but not averted gaze. In older infants, eye contact has been shown to facilitate facial discrimination as well, possibly affecting three-dimensional face recognition. In fact, 8-month-old infants were able to recognize a face they were previously familiarized with even if this was rotated, but only if the familiarized face had a direct gaze (Yamashita et al., 2012).

Perceiving gaze shifts is also a crucial feature that contributes to the emergence of processing skills, as infants learn to extrapolate information about the context from the direction of eye gaze. At 4 months, infants can already orient in the direction cued by the gaze and perform shorter saccades to a peripheral object appearing in the direction of the eye gaze of a central face image (Farroni et al., 2000). Of note, this eye-gaze effect is canceled out if faces display emotional expressions, as these seem to hold their attention and reduce speed to orient toward the referent object (Rigato et al., 2013).

The ability to discriminate eye-gaze direction is at the base of another face processing skill that emerges very early in life, that is, the ability to integrate information about the head and eyes orientation when interpreting directional cues. Otsuka et al. (2016) used artificially created realistic face images in a paradigm inspired by the Wollaston's effect (**Table 3**). They found that infants could infer the direction of the gaze based on the head orientation from 4 to 5 months of age. Nakato et al. (2009) investigated the same effect familiarizing infants to the original Wollaston's drawings and saw that 8-, but not 6- and 7-month-olds, looked longer at illusory direct gaze, providing evidence that they were sensitive to the Wollaston's effect. Inverted faces disrupt configural processing and inhibit the interpretation of gaze direction in the context of head

orientation in the younger infants (Nakato et al., 2009). Thus, while at 4 months of age infants use eye-gaze direction to choose where to direct their attention, the ability to integrate information about eye gaze and head orientation especially in realistic situations develops more gradually until 8 months.

As perceiving the eyes plays a specific role in face processing from birth and the facilitatory role of eye contact and gaze shifts is preserved in more complex tasks as infants grow older, it is reassuring that the eyes region is not covered as a precaution against COVID-19 diffusion. Relatedly, examining studies investigating the role of eyes for developing socio-communicative skills is crucial for the scope of this review.

Communication

Within the face, eyes are a central component for communication. It is not just the quantity of faces infants are exposed to that affects the development of social brain networks—whether faces include eyes looking toward or away from the observer is crucial. Gaze direction can provide two types of social information: eye contact establishes a communicative context between humans, gaze shifts can also be interpreted as initiating "joint attention."

Eye contact is involved in face detection processes soon after birth. Newborns not only manifest a preference for faces and face-like configurations, as discussed, but among faces they prefer those with direct eye gaze. Farroni et al. (2002) presented 2- to 5-day-old newborns with pairs of faces manipulating the direction of the gaze while keeping the face identity constant and found more frequent orientations and longer looking times toward faces with direct rather than averted gaze. In a subsequent study, they crucially found that the effect is present with upright and straight-ahead faces only (Farroni et al., 2006), that is, in the typical presentation of a face during interaction. Direct gaze also facilitates face recognition in 4-month-old infants (Farroni et al., 2007). Supporting the view that infants are tuned to detect communicative meaningful stimuli contributing to their social development, infants who looked more to their mothers' eyes at 6 months as well as those who paid greater attention to the talker's eyes (vs. mouth) at 12 months were found to manifest higher social and communication skills at later ages (Wagner et al., 2013; Pons et al., 2019). Attention to the eyes at these preliminary stages allows infants to engage with and learn from eyes, which support socio-cognitive development and could compensate the effects of mask wearing at later developmental stages.

The direction of the eyes constitutes an important modulator of face processing since early in life, which is integrated with multiple sources of social information. For example, eye gaze modulates infants' allocation of attention toward emotional expression. Doi et al. (2010) found that at 10 months, infants are faster to orient toward the peripheral target in case of a central happy face with direct gaze, while it takes them longer to disengage from the central facial stimulus when the face displays anger (both if direct and averted gaze). Nevertheless, recent evidence shows that when provided with alternative communicative sensory stimulation (i.e., affective touch) infants still engage with less or non-communicative faces, suggesting that different senses conveying communicative information might compensate for each other. For example, evidence shows that when habituated to faces with averted gaze while simultaneously caressed, 4-month-olds discriminate and recognize the familiar face despite gaze being averted (Della Longa et al., 2019). This is in line with the idea that multiple sensory channels support infants' face processing and learning. For the scope of this review, this is encouraging as it suggests that communicative meanings might enter the system through different sensory gateways and do not rely exclusively on the visual information available from a face when this is limited by mask wearing.

By the end of the first year of life, infants appear to understand the referential essence of gaze that allows to establish joint attention (Mundy, 2018). Many have studied when and how this mechanism develops. Striano et al. (2007) showed that infants start to gaze more in the direction cued by the adults' gaze from 6 weeks to 3 months of age. While the degree to which infants looked at the experimenter during live joint attention situations did not differ by age, 3 month olds looked more at the gazed-at object compared to younger infants (Striano et al., 2007). Gredebäck et al. (2008) found that when watching an adult gazing and turning the head toward one of two possible toys, infants aged 5 to 12 months looked significantly more at the attended toy, with no effect of age on overall looking time. The microstructure of the infant gaze revealed that 5-month-olds were equally likely to perform the first gaze shift toward the attended and the unattended toy. Differently, 6-, 9-, and 12-month-old infants oriented their gaze toward the toy immediately. These findings indicate that the ability to orient the gaze following a gaze cue is not fully developed at 5 months of age.

Other information usually provided in conjunction with gaze shifts facilitates infants in processing gaze cues in the first year of life, including head direction, familiarity with the person performing the eye-gaze shift, and ostensive communicative signals. For example, at 3 to 4 months of age, head turns in the adult encourage infants to look in the direction of the adult's moving hands and objects (Amano et al., 2004). At 5 and 10 months of age, infants seem to rely more on gaze cueing coming from highly familiar (i.e., of the race and sex infants were more exposed to) compared to non-familiar adult models (Pickron et al., 2017). Thus, it is possible that as early as 5 months of age, infants have already learnt the referential value of eye gaze coming from the caregivers. At 6 to 9 months of age, infants orient toward the cued toy first and more frequently in the presence of ostensive communicative cues, such as direct gaze and eyebrows lift or infant-directed speech preceding gaze following (Senju and Csibra, 2008; Senju et al., 2008). This is also observed in non-communicative attention-grabbing situations (e.g., if the model actor performed a shiver before the gaze shift) suggesting that attention, rather than communicative intent, plays a crucial role in eliciting gaze following (Szufnarowska et al., 2014). Perhaps in contrast with this account, a study with infants living in a rural society island in Vanuatu, where face-to-face interactions between infants and adults are less common than

in Western cultures, confirmed that orienting toward the other's gaze direction is not dependent on cultural aspects, but rather on the communicative engagement with the infant before gaze cueing. Vanuatu infants between 5 and 7 months oriented toward the cued object more easily after being addressed with infant-directed speech, compared to adult-directed speech, just like Western infants (Hernik and Broesch, 2019). Thus, the roots of joint attention seem to rely on gaze cuing from 3 to 9 months of age and are boosted, in this age range, by additional information that are not impacted by mask wearing, such as the head direction, familiarity, direct gaze, speech, and head movements.

Toward the end of the first year of age, infants start to integrate gaze direction with other communicative cues, such as facial emotional expression, pointing, and gestures, although eyes remain the most salient source of information until 2 years of age. Using a gaze-cueing task whereby faces manifested emotional expressions (happy, fearful, and angry), Niedźwiecka and Tomalski (2015) found that infants aged between 9 and 12 months were faster in orienting toward a peripheral stimulus in trials where the central stimulus was a happy face with gaze directed toward the same side of the screen. Of note, this gaze cueing effect was present only with happy facial expressions, confirming infants' tendency to rely more on gaze information provided by positive-valanced faces. By 1 year of age, eye gaze or a combination of eye gaze and pointing, but not pointing alone, toward an object facilitates infants' gaze shift toward the cued object, showing that gaze is still the preferred cue for learning about the surrounding environment (Von Hofsten et al., 2005). Further, during the second year of life (14 and 18 months), infants are more inclined to look in the direction cued by the adults' eyes rather than head alone, as observed during a live gaze following task (Brooks and Meltzoff, 2002). However, typically developing children start to direct their attention more toward the adults' hands for learning and communication from the second year of life. Chen et al. (2020) analyzed joint attention episodes during free play between parent and children using head mounted eye-trackers in children with hearing loss and children with normal hearing matched for chronological (24 to 37 months) and hearing age (12–25 months). They found that from the second year of life, hearing children tend to attend more to the parents' hand actions, while children with hearing loss rely still more on the parents' eye-gaze cuing (Chen et al., 2020). Eyes seem to be such a powerful communicative cue that they probably partly compensate for the absence of language information in toddlers with hearing loss.

Eye-gaze cueing is even supporting the development of language skills in the second year of life. For example, when watching a short video of a woman directing her gaze and head toward one of the two objects, 15-month-old infants looked longer at the image corresponding to the word sound played in the test phase (Houston-Price et al., 2006). This indicates that eye-gaze cueing facilitates learning of new words and is promising regarding the possibility that eyes support language acquisition even more importantly when the visual information of the mouth is less available due to mask wearing of the speaking adult. Masked faces probably convey lots of social communicative information through the eyes, so communication is likely to be less affected by masks. Effects might be observed in developmental processes that require mouth input.

Mouth

Perception

Redundant audiovisual information (see glossary on **Table 3**) is important for speech learning especially during the second half of the first year of life, when infants start to shift their attention from the eyes toward the mouth region, while it creates competition between attentional resources before 3 months (Bahrick et al., 2013). At 3 and 6 months, visual scanning between moving and static faces does not differ, while at 9 months infants shift their fixation more frequently between inner facial and look more at the mouth (vs. eye) region only when familiarized with dynamic faces (Xiao et al., 2015). These results are in line with findings by Oakes and Ellis (2013) with static upright face, which indicated that 4.5- and 6.5-month-old infants look more at eyes and 12-month-olds look more at the mouth. A similar pattern was found by Hunnius and Geuze (2004) who followed up 10 infants longitudinally from 6 to 26 weeks when looking at the mothers' face. These results could be explained by the increasing importance of mouth looking for speech learning. In fact, from 8 to 10 months, infants' attention to non-speaking faces is distributed across eye and nose regions (Liu et al., 2011; Wheeler et al., 2011; Geangu et al., 2016) while if the faces are accompanied by speech the moving mouth becomes more salient than the eyes (Lewkowicz and Hansen-Tift, 2012; Haensel et al., 2020). Consistently, a longitudinal study by Tenenbaum et al. (2013) showed that infants shifted their attention to the mouth in the presence of spoken language, but not in the presence of a smile with no language. This effect was observed from 6 to 12 months, with a significant increase between 6 and 9 months of age, concomitantly to the canonical babbling stage. Crucial for the aim of this review to evaluate effects of masks covering the mouth regions, the authors noticed high variability between subjects, suggesting that individual experience interacts with developmental needs to influence how infants deploy their attention over talking faces (Tenenbaum et al., 2013).

It is possible that mouth looking has a key role in the initial phases of speech learning. Lewkowicz and Hansen-Tift (2012) found that while looking at speaking faces (either using infants' native and non-native language) infants focus more on the mouth from 8 months but they shift their attention to the eye region at 12 months in the native language condition only. At this age, infants have gained experience in their native language and audiovisual information is no longer useful, while they continue to attend to speakers' mouths in the non-native language condition. The authors suggested that to gain expertise with their native language, infants need to rely on redundant audiovisual information, as they learn how to articulate speech-like syllables by imitating the talkers' mouth (Lewkowicz and Hansen-Tift, 2012). Similarly, Schure et al. (2016) noted that despite the growing expertise in their native language, at

8 months, infants are interested in information coming from the mouth when it includes non-native speech sounds that contrast with native vowel categories they already know. At 9 months, increased looking to the mouth is observed when infants are presented with incongruent audiovisual information (e.g., seeing a mouth articulating a sound while listening to another; Tomalski et al., 2013), while at 12 months, infants focus on the mouth if they hear non-native language (Kubicek et al., 2013). Also supporting experience dependency of face processing, Fecher and Johnson (2019) found that after habituation with a face paired with a voice, 9-month-olds bilinguals subsequently looked longer to faces paired with a different versus the same voice. Thus, it seems that mouth looking plays a significant role in language learning at multiple development stages, both when speech is novel to infants and when they are in the process of learning it. Indeed, Hillairet de Boisferon et al. (2018) suggested that a second attentional shift toward the mouth region might occur when entering the word acquisition phase of language development, regardless of the spoken language being the child's mother tongue or not. They showed that 14- and 18-month-olds monolingual English infants looked longer to the mouth of faces speaking in English or Spanish during infant-directed speech (but during adult-directed speech at 18 months only).

In sum, attention to the mouth supports language acquisition especially during sensitive periods spanning over the second half of the first year of life, with differences based on infants' linguistic experience and ability to integrate auditory and visual information. Once infants are skilled enough in their native language they no longer focus more on the mouth unless visual and auditory information are not congruent, or the face speaks a foreign language. Given the relevance of mouth looking for language processing and learning, multiple questions should be raised about implication of face coverings during these sensitive periods. In particular, one could ask whether masks could affect acquisition of less familiar words or different accents, which would be even more relevant for bilingual populations.

Communication

When interacting with people wearing a mask, we realize that speech comprehension might be difficult, especially if we are speaking a language that is not our mother tongue. What about infants that are learning to decode the communicative meaning of speech without seeing lip and mouth movements? Will this impact their language development? To address these questions, we summarize the literature exploring the role of mouth processing for language development, in monolingual and multilingual environments.

The fact that the mouth region of a face is crucial for learning to communicate using verbal language is evident from studies of infants experiencing a multi-language environment. Comparing mono- and bilingual infants is useful to identify key aspects for the development of speech perception and comprehension skills, since only bilinguals need specific strategies to establish sounds, grammar, and social meaning of each of their languages (Werker and Byers-Heinlein, 2008). Differently from monolinguals, for bilinguals, equal attention toward eyes and mouth was found at 4 months and increased looking times toward the mouth were seen at 8 and 12 months, both while hearing their native and non-native language (Pons et al., 2015). Further, at 8 months, bilinguals can discriminate between two languages based on visual information only while this is not evident in monolinguals. Interestingly, this effect was found using languages infants had never been exposed to, suggesting the bilingual infants' advantage generalizes to support new language processing (Sebastián-Gallés et al., 2012). Thus, these studies indicate that looking at the mouth is a crucial strategy to language learning, used from 8 months of age by infants who are exposed to multi-language contexts.

Timing of speech sounds and mouth movements involved appears crucial when it comes to detecting and disambiguating speech signals. Hillairet de Boisferon et al. (2017) found that at 10 months (but not at 4, 6, 8, and 12 months) infants looked more to the eyes in case of desynchronized speech, while they looked more to the mouth when audiovisual information was synchronized, both for native and non-native languages (Hillairet de Boisferon et al., 2017). The authors suggested that 10 month olds rely on eye information to disambiguate confusing linguistic information, while mouth looking is used for language learning when it provides useful visual cues (Hillairet de Boisferon et al., 2017). Although these findings also partly suggest that in the absence of coordinated audiovisual inputs language processing might be impacted, they are also somewhat encouraging with respect to possible compensatory effects of the eyes when the talking adult's mouth is covered.

Exploring multisensory integration supporting speech learning, some authors investigated infants' ability to match static articulatory configuration with produced sounds and found that this changes with age. For example, Streri et al. (2016) familiarized infants of 3, 6, and 9 months of age with faces producing hearable vowels while occluding the mouth and tested looking preference to pairs of full static images including the familiarization face. Infants looked longer to the congruent face at 3 months and to the incongruent face at 9 months, while no preference was manifested at 6 months. This suggests that infants' ability to match audiovisual information for language learning consolidates close to 9 months of age (Streri et al., 2016). Of note, the type of sensory information available in the living context shapes how infants deploy attention to and integrate audiovisual cues. Mercure et al. (2019) compared visual scanning pathways of 4 to 8 month old during a McGurk task (see glossary on **Table 3**) and found that bimodal bilinguals (hearing infants of deaf mothers) do not shift their attention to the mouth as much as monolingual and unimodal bilingual infants do. From 6.5 months onward, bilinguals did not show a novelty preference when the auditory and visual information were not congruent, differently from monolinguals. The authors proposed that audiovisual speech experience is crucial for multi-modal speech processing (Mercure et al., 2019).

Notably, growing up infants and toddlers are more likely to find themselves in social interactive contexts whereby familiar and unfamiliar people interact with each other and not exclusively with them. Souter et al. (2020) found that 18 to 30 month

olds prefer to look at the eyes rather than the mouth both when seeing a single actor singing nursery rhymes or talking infant-directed speech, and when multiple actors interacting with each other. Regarding multi-language exposure and conversations, Atagi and Johnson (2020) tracked infants' gaze while seeing two women talking to each other and addressing the infant in a familiar or unfamiliar language. They found that bilinguals performed more anticipatory looks to talkers' face when the language was unfamiliar rather than familiar. Thus, during challenging communicative events, different scanning patterns could be observed according to prior language exposure (Atagi and Johnson, 2020), highlighting that even consistent exposure to masked faces could have different effects on children' language learning depending on their level of exposure to language.

In conclusion, beyond the first year of life, toddlers appear to focus on the mouth when entering the word acquisition phase of language development and then gradually shift again attention to eyes to complement language communicative meaning in function of their linguistic expertise. The differences in scanning strategies observed between monolingual and bilingual toddlers attending to conversations suggest that looking at the face is important when the spoken language is not familiar. Granting access to both visual and auditory speech information is crucial from 8 months of age, as infants make use of the synchronized sound and lip movement stimuli to learn a language. The analyzed literature suggests that face masks, which remove the visual mouth cue while probably muffling voice sounds, could have effects on language learning and understanding. Since children rely on facial cues to increase the amount of information that can help understanding the verbal content, we can expect conversations with masked faces to be more challenging for children who are less familiar with the spoken language.

Emotional Expressions

Perception

Facial expressions also have a central role in early learning; processing expressions require the use of configural information that is hindered by wearing face masks. To consider the potential impact of mask wearing on emotion processing, we describe studies examining its developmental underpinnings.

As discussed, newborns preferentially attend to faces, and especially dynamic faces. However, their ability to distinguish facial expressions is very limited. Newborns show novelty preferences when habituated to faces displaying dynamic changes in emotional expression regardless of the nature of the emotion (happiness and fear) (Leo et al., 2018). A facilitation effect of happy facial expressions is observed over the next months. At 3 months, happy facial expressions facilitate face recognition (Turati et al., 2011) when both eyes and mouth express happiness, but not in the case of happy eyes and an angry mouth or angry eyes and a happy mouth (Brenna et al., 2013). From this evidence, one could hypothesize that wearing a face mask would reduce or eliminate the facilitation effect of happy emotions for face recognition in early infancy because the mouth is not visible (*cf* Brenna et al. 2013). While these studies suggest that infants can discriminate between different emotional expressions from 3 months of age, others found that they need increased exposure to the emotional expressions (Flom et al., 2018) and the presence of multisensory cues (i.e., emotional voices; Flom and Bahrick, 2007) to show this ability before 5 months of age. Further research is needed to investigate whether the presence of auditory information might support face recognition despite the lack of information coming from the mouth, playing a compensatory role.

The emotional valence of faces has a key role in the development of face perception and learning abilities at later ages. At 6 months, happy emotional expressions increase infants' preference for a face (Kim and Johnson, 2013) and at 7–8 months, rule learning is facilitated by happy expressions and disrupted by angry faces (Gross and Schwarzer, 2010; Quadrelli et al., 2020). By 8 months, infants not only can recognize changes in emotional expression and facial identity, but also they use these two pieces of information in conjunction for face recognition in upright faces, as suggested by a novelty preference based on emotional expressions independent of the face's identity (Schwarzer and Jovanovic, 2010). Around this age, infants gradually learn to link auditory and visual emotional cues, and discrimination of the emotional valence of facial features becomes more refined. For instance, in 9-month-old infants, hearing emotional vocal sounds (laughing and grumbling) facilitates gaze shifts toward the face with a congruent facial expression paired with an incongruent face, providing evidence for a role of cross-modal top-down regulation on visual attention to facial expressions (Xiao and Emberson, 2019). The ability to integrate multisensory emotional cues seems to emerge only after the seventh month of age (Yong and Ruffman, 2016). It would be important to clarify whether emotion recognition is impoverished by mask wearing to understand whether it also affects a range of other domains.

The next developmental step includes the ability to discriminate between faces displaying different degrees of the same emotional expression. At 9 and 12 (but not 6) months, infants can discriminate faces along the happy-angry (but not happy-sad) continuum, while they are not able to discriminate variations within the same emotional category (Lee et al., 2015). These findings were interpreted as consistent with an infant inability to discriminate between faces within the same emotional category before the first year of life. This ability may develop in conjunction with emotion's relevance for the infant. In fact, 6- to 7-month-old infants recognize subtle anger expressions when presented in a static but not dynamic face, suggesting they are sensitive to anger but possibly find it difficult to recognize it within a more dynamic context due to scarce experience of this emotion in their daily environment (Ichikawa et al., 2014; Ichikawa and Yamaguchi, 2014). On the contrary, subtle happy expressions are easier to be recognized in the presence of facial movements at the same age (Ichikawa et al., 2014). Considering the limited availability of facial cues due mask wearing that covers an important source of facial movement, infants might show less refined emotion recognition abilities for subtle emotional changes, especially for emotions that are less experienced in caregiving interactions.

Scanning strategies of faces in 7-month-old infants vary as a function of emotional expression. Segal and Moulson (2020a) showed that infants in general look more at the eyes than the mouth of fearful and happy faces presented side-by-side (Segal and Moulson, 2020a). An examination of infants' looking time series revealed that they looked significantly longer to the eyes of angry and neutral faces, and to the mouth of happy faces in the first 3,000 ms, but scanning strategies were different for different emotional expressions (Segal and Moulson, 2020b). Interestingly, Geangu et al. (2016) showed that, while overall facial emotion recognition was found in both Western and East Asian 7-month-old infants, scanning strategies were different between the two groups, with Japanese infants looking more at the eyes and less at the mouth of happy and fearful faces compared to British infants. Importantly for the scope of the present review, these findings indicate that, while typical infants finally develop the ability to discriminate between emotional facial expressions, they might reach this milestone through different individual scanning strategies that are shaped by environmental exposure. In this view, we can expect infants who are predominantly presented with masked faces from 3 to 12 months of age to develop different strategies to process and interpret emotional expressions compared to infants who normally see the mouth as part of the emotional face configuration. However, given infants received normal full face exposure at home throughout the COVID-19 pandemic, it is also possible that they develop typical face scanning strategies when looking at non-masked faces.

Communication

Emotional expressions are used as communicative signals about the context. Fearful expressions might indicate the environment is threatening and are gradually prioritized by the infant's attention system. While 3-month-olds seem to be greatly engaged by happy faces, by 5 months, a fearful attentional bias (**Table 3**) is observed. For example, attention disengagement from a central face toward a peripheral stimulus is slower for fearful than from a happy or neutral face (Peltola et al., 2008, 2011; Heck et al., 2016). When fearful and happy faces are presented side-by-side, increased attentional bias for the fearful face compared to happy and neutral faces is shown at 7–11 months, while at 5 month olds prefer happy faces (Peltola et al., 2009a, 2013). Of note, face familiarity does not affect fearful bias, as infants look longer to a novel fearful face when habituated to happiness, regardless of faces in the habituation phase being familiar or not (Safar and Moulson, 2017). From this evidence, it appears that the fearful attentional bias emerges toward the 7th month of age, despite a sensitivity to fearful faces can already be observed at 5 months.

To examine whether exposure to masked faces influences infants' behavior and developmental processes elicited by the fearful bias, we need to know whether this is based on information derived from specific elements of the face or from the full facial configuration. Using artificially created faces, Peltola et al. (2009b) found longer latencies to disengage from fearful full faces but not fearful eyes alone at 7 months. The attentional bias to fearful faces at this age was associated with attachment security at 14 months of age, whereby infants who disengaged more easily from a fearful face in an overlap task showed more signs of attachment disorganization (Peltola et al., 2015). This finding corroborates the idea that early processing of emotional expression from the full face is involved in social development. This evidence appears particularly relevant when considering implications of mask wearing on emotion expression processing during development. According to Peltola et al. (2009b)'s results, eyes appear not to be sufficient for fearful bias to manifest at 7 months, possibly implicating that when wearing masks that leave only the eyes uncovered, fearful expressions might not elicit the same processes they would normally do, with potential cascading effects for later social development.

Importantly, preference for specific emotional expressions might vary depending on the individual infants' temperamental characteristics as well as their parents' emotional attitude (de Haan et al., 2004; Pérez-Edgar et al., 2017; Aktar et al., 2018; Fu et al., 2020). Highlighting the intertwin of individual temperament characteristics, caregiver affect dispositions, and the attentional bias toward certain facial expressions, this suggests that individual infants' and caregivers' temperament and affect dispositions may modulate the effect of mask wearing on the development of perceptual and communicative aspects of face processing.

Only in the second year, toddlers learn to distinguish between true and pretend emotional valence of the facial configuration. Walle and Campos (2014) examined 16- and 19-month-old behavioral responses to parental display of emotional expressions following a true or pretend distress situation. Parents were instructed to display pain and distress after perceptively hitting or missing their hand with a hammer. Both 16 and 19 month olds reacted with concerned facial expressions and prosocial responses more when they perceived the parents hit their hands (although only at 19 infants reacted with playful behavior and positive affect demonstrating they evaluated the context as playful; Walle and Campos, 2014). Further research will have to evaluate whether interacting with masked adults in times of COVID-19 has no effect on this the ability as emotional expression recognition skills have been acquired or whether mask wearing significantly limits toddlers' experience to link emotional face configurations to contexts.

DISCUSSION

In the present work, we aimed to leverage the wide corpus of existing literature on sensitive periods for the specialization of face processing skills in early development (summarized in **Figure 2**) to generate hypotheses on possible effects of adults' mask wearing adopted to limit COVID-19 diffusion. We asked which aspects of face processing might be altered by exposure to masked faces (**Figure 3**) and whether implications might differ as a function of infants' developmental stage (main questions for future research emerged from the present review are summarized in **Table 4**).

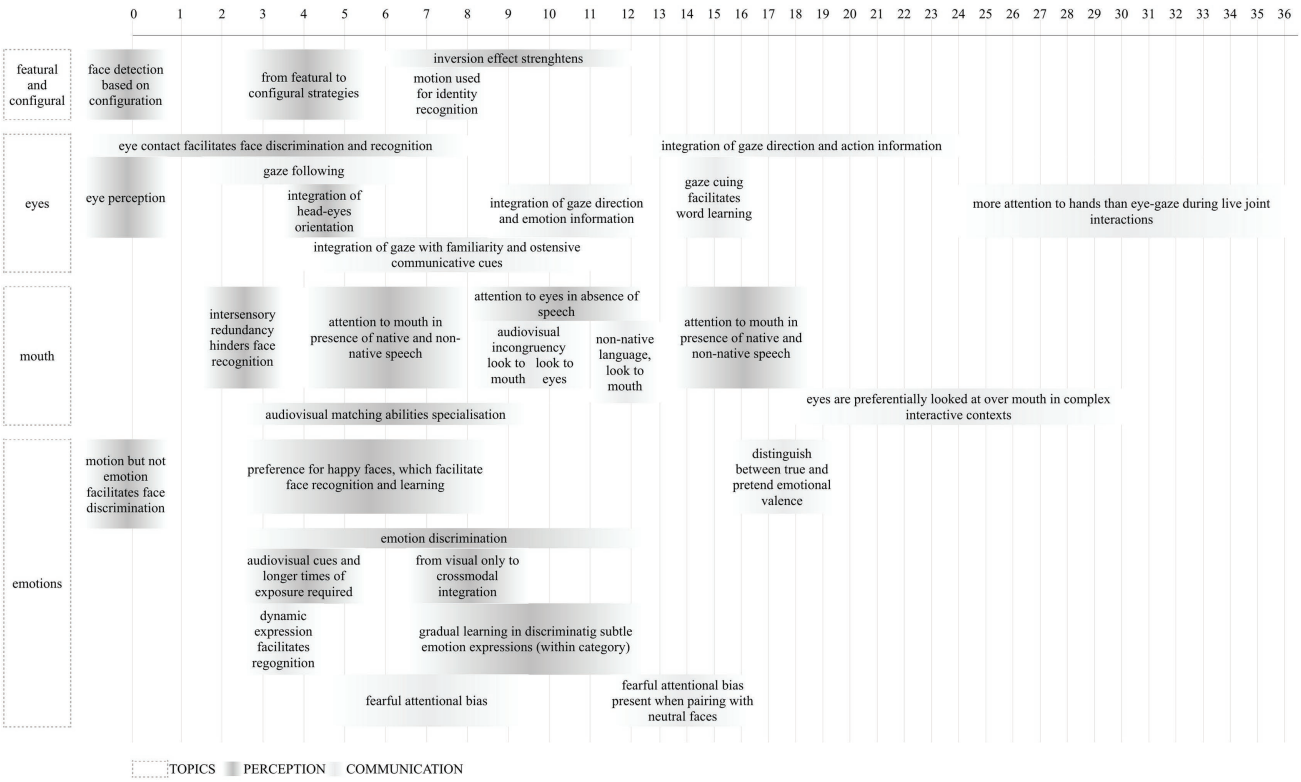

FIGURE 2 | Age periods studied in the literature for each of the addressed topics.

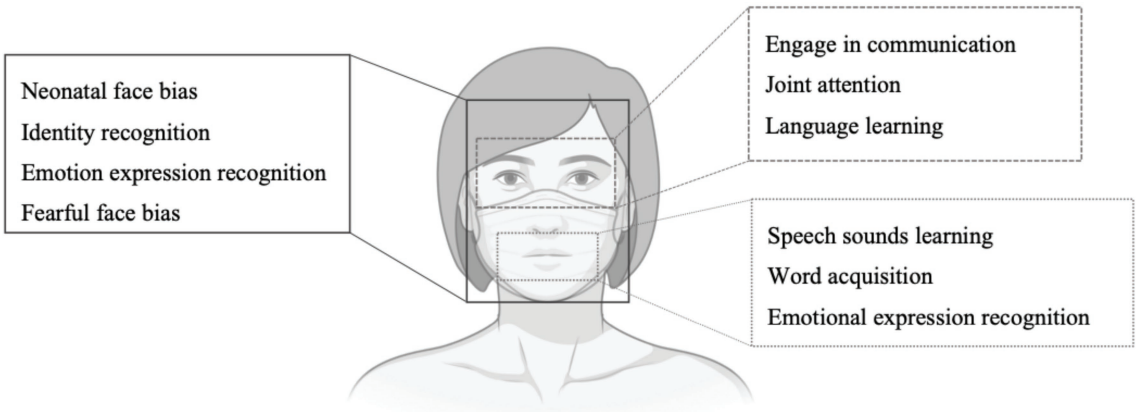

FIGURE 3 | Psychological processes linked to face processing. Created with BioRender.com.

When investigating the potential impact of mask wearing on face processing during the first years of life, we need to differentiate according to individuals' likelihood of being exposed to these stimuli. In fact, during the earliest stages of life, infants are more likely to spend most of the time within family contexts where they are not exposed to masked faces, while as they grow their daily environment includes people outside the household.

To discuss implications of mask wearing in infancy, it is crucial to describe how masks modify perceptual assets of faces. First, mask wearing disrupts configural face processing. When a mask is worn, no information can be obtained about the nose, cheeks, chin, mouth, and mouth movements. Second, processing of simultaneous changes in face features building up emotional expressions is limited due to the lower part of the face being covered. This limited exposure to facial

TABLE 4 | Outstanding questions.

Research topic	Discussed effect of face masks	Outstanding questions
FACE PROCESSING	Face masks hide the lower part of the face, possibly altering the infant's perception of the face configuration.	Does augmented exposure to masked faces disadvantage face preference and the CONSPEC system during the first few months of life? Do the eyes compensate for limited exposure to the full facial information that was considered to be crucial for identity and emotional expression recognition?
AMOUNT OF EXPOSURE TO FULL FACES	Infants living in times of the COVID-19 are exposed to full faces in the home environment and through technological devices (i.e., tablets, smartphones, and TV), while they are more likely to be exposed to covered faces outside the home environment, including in child-care settings (depending on the country regulations).	Do scanning strategies infants used for identity and emotional expressions vary as a function of the amount of experience they have with faces wearing masks? Is exposure to un-masked faces within the home environment enough for infants to compensate for possible effects of the limited availability of some facial cues on identify and emotion recognition?
SOCIAL COMMUNICATION	By obscuring mouth dynamics, masks partly reduce the availability of communicative cues in a face while they leave eye information only available.	Could this influence face preference with effects of social engagement and joint attention? If so, is this effect age-specific? Could eye gaze compensate in those occurrences when mouth movements are not visually available?
SPEECH LEARNING	When the mouth is covered, audiovisual redundancy and information about mouth and lip movements for speech production that typically support speech learning during sensitive periods are missing.	Does this impact the speech sound learning and word acquisition, especially in multi-lingual contexts?

configuration could possibly have implications in terms of both low-level perception and detection of communicative meanings. For this reason, developmental research in both areas has systematically been reviewed in the previous sections. Importantly, infants typically make use of multiple scanning strategies and pay differential attention to specific face regions and features to reach developmental milestones. Indeed, they gradually learn to analyze the eyes and gaze direction within the context of the entire face configuration—which contributes to the early face bias, identity recognition, as well as emotional expression discrimination—and they rely on audiovisual redundancy from others' mouth for language learning. Thus, there could potentially be developmental effects if exposure to full faces is limited by widespread mask wearing.

The Importance of the Full Face

Partially covering the face with a mask disrupts configural face processing, which largely constitutes the basis of facial discrimination and recognition abilities in adults. Developmental findings highlight that despite being sensitive to some configural variations as early as 3–5 months, infants clearly adopt configural scanning strategies around 7–8 months and master their use for upright face recognition toward the end of the first year. In recent studies with adults (Carragher and Hancock, 2020; Noyes et al., 2021) and children (Stajduhar et al., 2021), lower accuracy in identity and emotion recognition have been observed when processing masked faces. From this evidence along with that from developmental studies, we could hypothesize that similar effects could be found testing infants aged around 1 year of life. Moreover, because of the additional COVID-19 preventive measure of social distancing, unfamiliar faces might often be further away. Infants might then rely more on lower spatial frequency information of the face configuration because they cannot perceive details of featural characteristics. However, configural face processing is likely to be disrupted by the mask as well. Thus, social distancing may compound to mask wearing effects on identity and emotion recognition.

It should be noted that infants are not completely deprived of seeing full faces, which they normally encounter in the home environment. Further, since outside opportunities are reduced it is possible that infants living in COVID-19 times spend more time on technological devices where they are likely to be presented with a variety of full faces from streaming services and TV shows as well as videos, video calls on smartphones, and tablets, and other digital devices used by the older family members for socializing (Pandya and Lodha, 2021). In this respect, some suggestions might come from previous literature on monocular pattern deprivation during early development. For example, daily brief exposure to normal visual input greatly reduces the adverse effect of abnormal input due to monocular pattern deprivation during the sensitive period (Wensveen et al., 2006; Schwarzkopf et al., 2007). Given such findings, it is possible that the brief exposure to full faces infants are daily exposed at home throughout the COVID-19 pandemic may still be sufficient for the development of face recognition ability during infancy. However, the number of full faces infants are normally exposed to is reduced during the pandemic and, if the amount of faces they experience contributes to the development of perceptual and socio-communicative skills, some consequences might be observed in the next years. For such reasons, it is fundamental for future studies to explore developmental trajectories of face

processing skills in infants born during COVID-19 pandemic accounting for the exposure they had to masked rather than full faces. Since masked faces are often experienced outside the family context, one prospective question concerns whether face processing will specialize more narrowly based on very familiar faces that infants see without masks. It is also possible that those who are highly exposed to masks adopt face recognition processes based on featural strategies. As patterned visual stimuli presented in the first month of life are necessary to initiate functional development of the visual neural pathways (Maurer et al., 1999), it would be important to know whether there are critical periods for exposure to certain visual stimuli in terms of configural face processing. Infant research focusing on face processing in children born in times of the COVID-19 pandemic should collect information about exposure to masked and full faces at the time of testing and possibly in the earlier stages of their life to control or test for effects of individual variability in masked face exposure on their key cognitive phenotype.

Uncovered Eyes

Eye contact plays a crucial role in attention engagement, supporting face detection, and specialization of face processing skills from birth onward (Farroni et al., 2002, 2005; Johnson et al., 2015). While direct gaze facilitates face recognition and learning, gaze shifts coupled with head direction and other ostensive communicative signals scaffold the development of joint attention in the first semester of life. Toward the end of their first year, infants integrate gaze direction and emotion expression or hand actions to direct attention to the referred target, being able to rely on gaze cuing alone during the second year. Since the eye region is left uncovered by face masks, infants can access substantial socio-communicative information. Furthermore, masks could have the effect of driving attention to the eyes region. Relatedly, individuals who find focusing on the eye region or interpreting eye cues difficult [e.g., some autistic individuals (Senju and Johnson, 2009; Ashwin et al., 2015; Moriuchi et al., 2017; Pantelis and Kennedy, 2017)] could benefit from the exclusion of possibly competing visual information from the mouth region. Thus, attending the eyes region of the face might be easier in the presence of masked faces for these children from the first months of age, shaping developmental trajectories of social attention (Klin et al., 2015; Parsons et al., 2019). Alternatively, the mask could have a negative effect; for example, if they constitute an additional distractor. Further, masks may perhaps "force" attention to the eyes (the only visible feature), which may be associated with sensory over-stimulation for some people (Robertson and Baron-Cohen, 2017) and thus accelerate complete withdrawal from faces. Developmental longitudinal research is needed to test these hypotheses.

Mouth for Language Learning

Infants further rely on facial information to learn language, by means of intersensory redundancy (**Table 3**) coming from mouth movements. They pay particular attention to the mouth between 4 and 8 months of age and gradually shift it to the eye region as their language expertise increases. After the first year, when entering the word acquisition phase, infants again pay selective attention to the interacting adults' mouth to learn to articulate verbal sounds. If the speaking person has her mouth covered, infants cannot take advantage of audiovisual synchrony that is relevant for speech learning. A disadvantage linked to this could be particularly enhanced within multilingual environments, whereby infants rely on multisensory information to disentangle languages (Sebastián-Gallés et al., 2012; Pons et al., 2015). Sufficient experience with audiovisual information coupling during speech is required to exploit multi-modal speech processing in infancy (Mercure et al., 2019). Importantly, it should be noted that this experience might be acquired within the home environment with familiar adults and children. Further research is needed to elucidate whether partially transparent masks allow infants' learning in contexts where masks are compulsory, assuming that linguistic stimulation within familial contexts can also play a compensatory role. From the published literature, we learn that bilingual infants make use of visual information coming from the mouth region to disambiguate between languages from 8 months of age. These infants could struggle more, particularly if they are mainly hearing the second language in community contexts (nursery, play-groups, and shops) where masks are used, and not as much at home.

Further compensation for language learning could be derived by eye contact and gaze following, which might foster language learning by directing infants' attention to relevant cues in the environment (Çetinçelik et al., 2021). Thus, it appears important to investigate how much communicative content is vehiculated by facial features and cues beyond the mouth (i.e., eyes and head movements) and how to promote language learning more comprehensively. Crucially, the likelihood of exposure to masked faces, which intuitively increases with age as infants' social environment broadens, needs to be considered when addressing these questions. In some countries, for example, face masks are mandatory among all adults within childcare settings; thus, the effects of mask wearing on infant development might be more important if the child spends a lot of time in these settings. Moreover, rules and guidelines might change within the same country depending on governmental decisions to face the COVID-19 pandemic, such that mask wearing might only impact development for a relatively short period of time. Studies investigating effects of mask wearing on development should consider and report these factors when selecting a study sample.

Another factor that may influence the effects of masks on face processing is the type of mask people wear, especially in childcare services. Plain-colored masks covering the mouth could foster attention to the eye region important for identity and emotion recognition as well as joint attention development. However, it is possible that very colorful masks direct infants' attention away from the eyes, with the risk of limiting infants' exposure to relevant social information. Transparent masks may allow infants to perceive orofacial movements while speaking

and possibly enhance attention to the mouth region, reducing any risk of impacting language development. These factors should be considered by education and healthcare practitioners.

Effects on Emotion Reading

Configural strategies also allow us to perceive and process emotion expressions. While a study on mask wearing effects shows that anger and happiness are discriminable in adults despite the covered mouth (Calbi et al., 2021), other findings also highlight difficulties in emotion reading more broadly due to mask wearing (Carbon, 2020; Noyes et al., 2021). Some authors argue that with masks becoming a common practice in everyday life, people have learnt to rely on eye information to discriminate emotions from masked faces, reflecting an adaptation of face processing secondarily to available visual information (Barrick et al., 2020). However, the perception of negative emotions produced by frowning was enhanced in adults when presented with masked emotional faces (Nestor et al., 2020). In infants, this possible bias toward negative interpretations of others' expressions might have cascading effects on social communication. In this respect, it would be interesting to investigate emotional expression biases in infants exposed to masked faces during the COVID-19 pandemic and longitudinal effects of this on their own emotional development. During the second year of life, they rely on facial expressions in conjunction with their context (Walle and Campos, 2014). Whether not having access to configural information contribute to difficulties in emotion discrimination and understanding or whether, alternatively, the system specializes to allow processing based on alternative strategies is an interesting avenue for future research.

LIMITATIONS

This review has some limitations. First, as for selection criteria, seminal research that hugely contributed to the field has not been discussed due to being published before 2000. We believe the content of such findings was reflected in following research included in the present review. Second, a selection bias might have occurred due to automatic filtering, which we tried to overcome by manually adding relevant literature cited in the included papers. Third, studies on atypical development of face processing, that has been largely investigated, were not included to limit the content of this review to papers investigating typical development of face processing. Future work should compare evidence from typical and atypical development to systematically delineate effects of mask wearing in the context of neurodiversity. Fourth, an important limitation concerns participation bias within studies that have been considered with Western or Asian countries being predominantly involved and participants recruited on voluntary basis. Studies of infants who are typically exposed to covered female faces due to religious reasons have not been found in our systematic search, but a cross-cultural comparison would have provided additional proofs about the possibilities proposed in our review. Last, while our search focuses on the first 3 years of life, we found that most studies pertain to infancy, suggesting that face processing is less investigated beyond the first year of life.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

LC, AG, EJHJ, and TF contributed to the conception and design of the study. LC was primarily responsible for the literature search. LC and AG equally contributed to the article selection process, data extraction, and wrote the first draft of the manuscript. TF and EJHJ supervised the study. All authors contributed to manuscript revision and approved the submitted version.

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The Relationship Between Ego Depletion and Prosocial Behavior of College Students During the COVID-19 Pandemic: The Role of Social Self-Efficacy and Personal Belief in a Just World

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In the context of the COVID-19, we examined the relationship between college students' ego depletion and their prosocial behavior. We explored the mediating role of social self-efficacy between ego depletion and prosocial behavior, we also examined the moderating role of personal belief in a just world in this relationship. 1,122 college students completed the ego depletion questionnaire, prosocial behavior questionnaire, social self-efficacy questionnaire, and personal belief in a just world questionnaire. The current findings suggested that: (1) Social self-efficacy mediated the relationship between college students' ego depletion and their prosocial behaviors. The ego depletion of college students could be used to predict their prosocial behavior through social self-efficacy. (2) Personal belief in a just world moderated the relationship between social self-efficacy and prosocial behavior.

Keywords: ego depletion, prosocial behavior, social self-efficacy, personal belief in a just world, college students, the COVID-19 pandemic

INTRODUCTION

Ego depletion is a process in which individual self-control resources are consumed in large quantities. After a period of activities that require self-control resources, self-control ability will be exhausted, and this state is ego depletion (Hagger et al., 2010; Chen et al., 2011; Ding et al., 2020a). The individual's cognition, emotion, and behavioral issues are the aftereffects of ego depletion (Chen et al., 2011), such as the reduction of prosocial behavior (Fennis, 2011; Osgood and Muraven, 2015; Yi et al., 2021), the increase in online flaming, online cheating behavior and aggressive behavior, and future anxiety (Ding et al., 2020a,b; AlHarbi et al., 2021; Wang et al., 2021a).

The core idea behind ego depletion is that the self's acts of volition draw on some limited resource, and the effects of ego depletion are maladaptive and detrimental to performance (Baumeister et al., 1998, 2007; Muraven et al., 1998). The strength model of self-control suggests that engaging in initial self-control tasks depletes self-control resources, at least partially, leading to fewer resources being available to perform subsequent tasks (Hagger et al., 2010).

Self-control is related to behaviors that meet social expectations and the pursuit of personal achievement. Based on the strength model of self-control, individual's self-control resources are limited, when the individual is in a state of ego depletion, the depletion effect will occur (Wang et al., 2021b). Especially, according to the strength model, self-control is a finite resource that determines capacity for effortful control over dominant responses. What is worse, once the limited resource is expended, the individual's performance in self-control tasks will be seriously weakened (Hagger et al., 2010). Prosocial behavior is often a behavior under the superego standard, which requires people to overcome selfishness and the pursuit of self-interest, and do things that are morally encouraged. This behavior requires individuals to use cognitive control to maintain. The ego depletion will lead to individuals not having enough cognitive control ability to control and restrain their behavior, which will lead to the decline of the individual's preference for prosocial behavior.

Many studies have proved the relation between ego depletion and prosocial behavior. For example, Osgood and Muraven (2015) found that ego depletion can damage individual's prosocial behavior by reducing their ability or motivation to overcome self-desires. Furthermore, Fei et al. (2016) recruited 58 college students and adopted the dual-task paradigm of ego depletion to investigate the effect of ego depletion on the prosocial behaviors. The results showed that college students with a high degree of ego depletion showed fewer prosocial behaviors than college students with a low degree of ego depletion. Fennis (2011) also found that ego depletion can reduce college students' prosocial behavior of perspective taking (as a specific form of prosocial behavior). Ren et al. (2014) used the stroop task to generate ego depletion to manipulate the level of self-control of college students and observed whether the prosocial behaviors in the dictator game was affected by ego depletion. The experimental results showed that compared with the subjects in the non-ego depletion group, those in the ego depletion group showed fewer prosocial behaviors.

In addition, the negative emotions caused by the COVID-19 pandemic would further increase the level of people's ego depletion (Caldas et al., 2021; Robert and Vandenberghe, 2021). Robert and Vandenberghe conducted a study of 650 civil servants in the Quebec government during the first wave of the COVID-19 pandemic. They examined the effect of anxiety caused by the COVID-19 pandemic on ego depletion, which found that the anxiety caused by the COVID-19 pandemic was positively correlated with ego depletion. It could be seen that individuals are more prone to ego depletion during the COVID-19 pandemic, and more ego depletion may lead to fewer prosocial behaviors. Nevertheless, society needs people to show more prosocial behaviors to jointly resist the COVID-19 during the pandemic. Therefore, it is particularly important to investigate the impact of ego depletion on prosocial behavior during the pandemic of COVID-19.

When individuals have cognitive loss, they are more likely to question their psychological capital, such as self-efficacy, and will subjectively think that they do not have enough efficacy to act. There are some studies promoting the association (Chow et al., 2015), while others find no significant association (Hagger et al., 2010). Chow et al. (2015) used three experiments to suggest that ego depletion undermines self-control by reducing the motivation (an important protective factor of self-control) to mobilize cognitive resources. One potential cognitive mechanism is the reduction of self-efficacy. Specifically, ego depletion could demotivate self-control by making people believe that they are inefficacious in exerting self-control in subsequent tasks (Chow et al., 2015). In other words, ego depletion can reduce the individual's self-efficacy. However, Hagger et al. (2010) did not find a relationship between self-efficacy and ego depletion. This may be because self-efficacy was the independent variable and ego depletion was the dependent variable in their study. In Chow et al. (2015)'s study, ego depletion was the independent variable and self-efficacy was the dependent variable. It can be speculated that ego depletion will lead to the decline of self-efficacy, but the level of self-efficacy cannot affect ego depletion. Social self-efficacy is a manifestation of self-efficacy in the social field, which is a special internal resource. Social self-efficacy affects the establishment and maintenance of individual interpersonal relationships in social situations, as well as the application and exertion of their interpersonal abilities (Gu et al., 2014; Zheng et al., 2019). Based on this, we hypothesized that ego depletion would be linked with social self-efficacy.

The theory of social cognition proposes that the human self-system can play a role in controlling and regulating behavior and can affect people's choice of behavioral activities and social environment, as well as cognitive and behavioral methods (Gong et al., 2021). Individuals with high self-efficacy will recognize themselves more, compare their existing knowledge and experience with the current situation, and believe that they have enough ability to solve the problems in a positive way. Underestimate the damage or believe that the benefits outweigh the disadvantages, making individuals more inclined to perform prosocial behaviors (Gong et al., 2021). The positive connection between self-efficacy and prosocial behavior has been confirmed and verified in numerous studies. Deng et al. (2018) have conducted a questionnaire survey on 768 junior high school students from Grade one to Grade three in Shandong province and Chongqing province, their results indicated that self-efficacy was the most predictive of prosocial behavior. Gong et al. (2021) have selected 320 college students for investigation and research and found that the higher the self-efficacy of college students, the easier it is for them to implement prosocial behaviors. Patrick et al. (2018) concluded that social self-efficacy could be associated with certain types of prosocial behavior in a survey of a sample of 338 adolescents, which is considered to provide confidence for adolescents to participate in prosocial behavior. Furthermore, as mentioned above, studies have found that self-efficacy plays a mediating role in the impact of ego depletion on self-control (Chow et al., 2015). Based on above analysis, we speculated that social self-efficacy was positively related to individual's prosocial behavior. In summary, social self-efficacy may play a mediating role between ego depletion and prosocial behavior.

Individuals need to believe in a just world (BJW) in which everybody gets what they deserve, because this enables them to deal with their physical and social environment, as if it were stable and orderly (Lerner, 1980; Dalbert and Stoeber, 2006). Individuals with high level of BJW are better able to cope with the anger-evoking situations, and BJW can be seen as a personal resource to protect not only mental but also physical health (Dalbert, 2002). Personal belief in a just world is an important dimension of belief in a just world, which means that individuals believe that the world is fair to them and that they can be treated fairly (Lipkus et al., 1996; Zhou and Guo, 2013; Liu et al., 2020a). General belief in a just world refers to people's belief that the world is just in a general sense (Dalbert, 1999; Tian et al., 2019). It has been shown that individuals tend to endorse personal BJW more strongly than general BJW (Dalbert, 1999; Dalbert and Stoeber, 2006). Personal BJW is positively correlated with willingness to help others. Individuals who hold a high personal BJW have more confidence in the future and are more inclined to use fair means to achieve their goals (Ji et al., 2014). Whereas, general BJW is positively correlated with severe social attitudes and social discrimination, and negatively correlated with helping behavior (Bègue et al., 2008; Ji et al., 2014). Therefore, current study focus on the role of personal BJW in prosocial behavior.

If an individual has strong personal BJW, he will firmly believe that his current contributions will not be rewarded immediately, but he will be rewarded in the future. So when someone asks for help, he is more likely to act prosocial (Cook and Rice, 1987). From the perspective of fairness, only by helping others can you get help from others when you need it. This could suggest that the stronger personal BJW, the stronger his willingness to help others. In other words, individuals who hold strong personal beliefs in a just world are more likely to perform prosocial behaviors. Quan (2020) analyzed a sample of 960 adults who completed the prosocial behavior questionnaire and the personal just world belief questionnaire and found that personal BJW is more related to prosocial behavior. The higher personal BJW, the greater tendency of individuals to implement prosocial behaviors. Moreover, social self-efficacy can enhance the confidence of individuals to implement prosocial behaviors (Patrick et al., 2018). That is to say, personal BJW could enhance the positive connection between social self-efficacy and prosocial behavior (**Figure 1**).

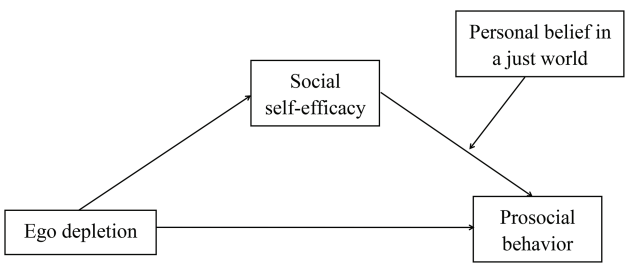

FIGURE 1 | The proposed moderated mediation model.

MATERIALS AND METHODS

Procedure and Participants

An online survey was conducted among 1,189 college students. We deleted data for participants who completed the questionnaires within 3 min and who did not complete the questionnaires. And, 1,122 college students (including 493 full-time college students and 629 part-time college students) completed these questionnaires in Central China during the COVID-19 pandemic period (April–May 2021). Participants were informed that they could terminate their participation in the online questionnaire at any time. Moreover, participants were also informed that the online survey followed the principles of anonymity, confidentiality, and independence, and the data will only be used for academic survey.

There were 293 male college students and 829 female college students; 407 first-year university students, 216 s-year university students, 206 third-year university students, and 293 fourth-year university students. The average age of the participants was 24.11 ± 5.96 years old.

Measurement

Ego Depletion Scale

We used the ego depletion scale compiled by Nes et al. (2013) and revised by Wang et al. (2015) to measure the ego depletion level. This scale includes 16 items with rating on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated greater levels of ego depletion. A sample item is: "I find it difficult to exercise as much as I should." This ego depletion scale was widely used among college students in China (Chen and Xiao, 2020; Ho et al., 2020; Wang et al., 2020; Wang et al., 2021b). In current study, the Cronbach's α of this scale was 0.79.

Prosocial Behavior Scale

We used the prosocial behavior scale compiled by Carlo and Randall (2002) and revised by Kou et al. (2007) to measure the prosocial behavior tendency of college students. This scale includes 26 items with rating on a 5-point Likert scale from 1 (totally inconsistent) to 5 (totally consistent). Higher score indicated stronger levels of prosocial behavior. A sample item is: "I think that helping others without them knowing is the best type of situation." This prosocial behavior scale was often used among college students in China (Liu et al., 2020b; Zhang et al., 2020b; Fang and Chang, 2021; Gao et al., 2021; Lv and Zhou, 2021). In current study, Cronbach's α of this scale was 0.93.

Perceived Social Self-Efficacy Scale

The social self-efficacy scale was first compiled by Smith and Betz (2000), which revised by Meng et al. (2007) in China. We used the revised version of social self-efficacy to measure participants' social self-efficacy. This scale includes 18 items with rating on a 5-point Likert scale from 1 (no confidence at all) to 5 (very confidence). Higher scores indicated greater levels of social self-efficacy. A sample item is: "Ask a group

of people who you do not know and who are engaging in a social activity if you can join them." This perceived social self-efficacy scale was widely used among college students in China (Meng et al., 2007, 2012; Liu et al., 2020c; Zhang et al., 2020a). In current study, Cronbach's α of this scale was 0.96.

Personal Belief in a Just World Scale

Participants' personal beliefs in a just world were measured by using the personal BJW scale compiled by Dalbert and Stoeber (2006)and revised by Su et al. (2012). This scale includes 7 items with rating on a 6-point Likert scale from 1 (totally disagree) to 6 (totally agree). Higher scores indicated stronger levels of personal BJW. A sample item is: "I am usually treated fairly." This personal beliefs in a just world scale was widely used among college students in China (Tian et al., 2017; Li et al., 2019; Chen, 2021; Wang et al., 2021c). In current study, Cronbach's α of this scale was 0.86.

RESULTS

Control and Inspection of Common Method Deviation

The data collected in this survey mainly came from the self-reports of participants, which may cause common method deviations. We adopted procedural control methods to minimize the impact of common method deviations, such as anonymous questionnaire surveys and balanced item order. In addition, in order to further examine whether common method bias exists, we used the Harman single factor method to carry out the common method deviation test. There were a total of 11 factors whose characteristic roots were greater than 1, and the explanatory rate of the first factor was 16.47% (<40%), which indicated that the common method bias was not serious (Podsakoff et al., 2012).

Preliminary Analyses

We have reported the mean, standard deviation, and correlation coefficients of ego depletion, social self-efficacy, personal BJW, and prosocial behavior in **Table 1**. From the data summarized in the table, it could be seen that the participants' ego depletion was significantly negatively correlated with their social self-efficacy, personal BJW, and prosocial behavior. Participants' social self-efficacy was significantly positively correlated with personal BJW and prosocial behavior. Moreover, the participants' personal BJW was significantly positively correlated with prosocial behavior. Post-hoc Power analysis found that statistical test power was greater than 0.99.

The Relationship Between College Students' Ego Depletion and Their Prosocial Behavior: A Test of Mediation Effect

We used the PROCESS 3.4 (Hayes, 2013) to analyze the mediation model. Ego depletion was used as the independent variable, social self-efficacy was used as the mediating variable, and prosocial behavior was used as the dependent variable. We used Model 4 and Bootstrap method (sample size is 5,000, 95% confidence interval) to test the significance of the mediation effect (see **Table 2**).

Ego depletion is significantly negatively associated with social self-efficacy ($\beta = -0.25$, $t = -8.58$, $p < 0.001$), and social self-efficacy is significantly positively linked to prosocial behavior ($\beta = 0.32$, $t = 11.00$, $p < 0.001$). Furthermore, ego depletion is still significantly negatively connected with the participants' prosocial behavior ($\beta = -0.12$, $t = -4.16$, $p < 0.001$). Post-hoc Power analysis found that statistical test power was greater than 0.99. This result suggested that social self-efficacy played a mediating role between ego depletion and prosocial behavior of the participants. For further verification, we also draw 5,000 samples to estimate the 95% confidence interval of the mediation effect. The indirect effect of ego depletion on prosocial behavior, that is, the Bootstrap 95% confidence interval of ego depletion on social self-efficacy was [−0.31, −0.18] (alpha = 0.05), the Bootstrap 95% confidence interval of social self-efficacy for prosocial behavior was [0.25, 0.38] (alpha = 0.05). In summary, the interval did not contain a value of 0, indicating that social self-efficacy had a significant mediating effect in ego depletion and prosocial behavior among participants. Moreover, the Bootstrap 95% confidence interval of the direct effect of ego depletion on prosocial behavior is [−0.24, −0.13] (alpha = 0.05), and the interval did not contain a value of 0. This shows that participants' social self-efficacy could play a mediating role between ego depletion and prosocial behavior. And, total effect of ego depletion on prosocial behavior is −0.20 ($t = -6.77$, $p < 0.001$), direct effect of ego depletion on prosocial behavior is −0.12 ($t = -4.16$, $p < 0.001$).

Test of the Moderating Effect of Personal BJW Between Social Self-Efficacy and Prosocial Behavior

We use PROCESS 3.4 (Hayes, 2013) to further analyze the moderating effect of personal BJW. Ego depletion was used as the independent variable, social self-efficacy was used as the mediator, prosocial behavior was used as the dependent variable, and personal BJW was used as the moderator. And we running Model 14 and Bootstrap method (sample size is 5,000, 95% confidence interval) to test the moderating effect

TABLE 1 | Descriptive statistics and correlation analysis of the variables involved in this measurement ($N = 1,122$).

Variables	*M*	*SD*	1	2	3	4
Ego depletion	2.76	0.48	–			
Social self-efficacy	3.24	0.65	−0.25***	–		
personal belief in a just world	4.24	0.74	−0.34***	0.31***	–	
prosocial behavior	3.65	0.45	−0.20***	0.35***	0.42***	–

***$p < 0.001$.

TABLE 2 | The mediating effect of social self-efficacy between ego depletion and prosocial behavior.

Predictors	Equation 1 (variable: Social self-efficacy)			Equation 2 (variable: Prosocial behavior)			Equation 3 (variable: Prosocial behavior)		
	β	*t*	95% CI	*β*	*t*	95% CI	*β*	*t*	95% CI
Ego depletion	−0.25	−8.58***	[−0.41, −0.26]	−0.20	−6.77***	[−0.24, −0.13]	−0.12	−4.16**	[−0.31, −0.18]
Social self-efficacy							0.32	11.00***	[0.25, 0.38]
R^2		0.06			0.04			0.13	
F		73.67***			45.79***			85.89***	

*Standardized values were used for all variables. ***p < 0.001, and **p < 0.01.*

TABLE 3 | The moderating effect of personal BJW between social self-efficacy and prosocial behavior.

Predictors	Equation 1 (variable: Social self-efficacy)			Equation 2 (variable: Prosocial behavior)			Equation 3 (variable: Prosocial behavior)		
	β	*t*	95% CI	*β*	*t*	95% CI	*β*	*t*	95% CI
Ego depletion	−0.25	−8.58***	[−0.41, −0.26]	−0.20	−6.77***	[−0.24, −0.13]	−0.03	−1.13	[−0.09, 0.24]
Social self-efficacy							0.23	8.19***	[0.17, 0.28]
Personal BJW							0.33	11.26***	[0.27, 0.38]
Social self-efficacy × Personal BJW							0.08	3.13**	[0.03, 0.12]
R^2		0.06			0.04			0.23	
F		73.67***			45.79***			84.51***	

*Standardized values were used for all variables. ***p < 0.001, and **p < 0.01.*

of personal BJW. The interaction of personal BJW and social self-efficacy was significantly related to college students' prosocial behavior ($\beta = 0.08$, $t = 3.13$, $p < 0.01$, bootstrap 95% confidence interval was [0.02, 0.13], alpha = 0.05, see **Table 3**), indicating that personal BJW moderated the relationship between social self-efficacy and prosocial behavior. $R^2 = 0.23$, $F = 84.51$, $p < 0.001$. Post-hoc Power analysis found that statistical test power was greater than 0.99. So, personal BJW had a significant moderating effect between social self-efficacy and prosocial behavior. And direct effect of ego depletion on prosocial behavior is −0.03 ($t = -1.13$, $p = 0.26$), index of moderated mediation is −0.02([−0.03, −0.00]; 95% confidence interval, alpha = 0.05).

Participants were divided into a lower group ($Z = -1$) and a higher group ($Z = 1$) based on the standard scores of personal BJW. A simple slope test was used to examine the impact of social self-efficacy on prosocial behaviors of participants who hold different levels of personal BJW. Participants who hold a lower level of personal BJW, social self-efficacy could predict prosocial behavior significantly ($\beta_{simple} = 0.15$, $t = 4.00$, $p < 0.001$, Bootstrap 95% confidence interval was [0.08, 0.23], alpha = 0.05); Participants who hold a higher level of personal BJW, their social self-efficacy would be connected with prosocial behavior more significant ($\beta_{simple} = 0.30$, $t = 8.68$, $p < 0.001$, Bootstrap 95% confidence interval was [0.24, 0.37], alpha = 0.05). On the whole, the mediating role of social self-efficacy in ego depletion and prosocial behavior was moderated by the level of participants' BJW (**Figure 2**).

FIGURE 2 | The moderation of personal BJW between social self-efficacy and prosocial behavior.

DISCUSSION

The current study revealed the relationship between ego depletion and prosocial behavior of college students during the COVID-19 pandemic, as well as the mediating role of social self-efficacy and the moderating role of personal BJW through a moderated mediation model.

The current study found that social self-efficacy mediates the relationship between ego depletion and prosocial behavior, which is consistent with the Strength Model of Self-control. Based on the strength model of self-control, self-control resources are limited. When individual is in a state of self-depletion, individuals would

have ego depletion effect (Wang et al., 2021b). Our study also found a negative correlation between self-depletion and self-efficacy. The more self-depletion, the lower the self-efficacy, which is consistent with previous research results (Chow et al., 2015). Moreover, based on the theory of social cognition (human self-system could play a role in controlling and regulating behavior, and can influence its choice of behavioral activities and behavior; Gong et al., 2021), individuals with high self-efficacy would consider themselves competent enough to solve the problems encountered in a positive way, and thus are more inclined to perform prosocial behaviors (Gong et al., 2021). Our investigation of the positive relationship between social self-efficacy and prosocial behavior during the COVID-19 pandemic was more consistent with previous research conclusions (Deng et al., 2018; Patrick et al., 2018; Gong et al., 2021). For example, research conducted by Patrick et al. (2018)'s study suggested that social self-efficacy could be associated with certain types of prosocial behaviors. Thus we can see that social self-efficacy plays an indispensable role in enhancing prosocial behaviors. Therefore, improving the establishment and maintenance of individual interpersonal relationships in social situations and the application and exertion of interpersonal skills can increase the possibility of prosocial behaviors. In short, college students' ego depletion can be associated with their prosocial behaviors through their social self-efficacy during the COVID-19 pandemic.

The moderating effect of personal BJW between social self-efficacy and prosocial behavior was also verified. Current research suggested that when individuals hold strong personal BJW, the positive connection between social self-efficacy and prosocial behavior was stronger. At a motivational level, personal BJW is related to social goals that require the suspension of immediate self-interest. Personal BJW shows associations with the human motivational values of benevolence，as well as a desire to learn more about others, talk about feelings, and make others feel better (Bartholomaeus and Strelan, 2019). If someone asks for help, individuals are more likely to be willing to perform prosocial behavior, when they have the confidence to participate in prosocial actions (Patrick et al., 2018). We may also be able to understand the moderating effect of personal BJW between social self-efficacy and prosocial behavior from the perspective of the resource conservation model. The model of resource conservation stated that people strive to retain, protect, and build resources, and that what is threatening to them is the potential or actual loss of these valued resources (Hobfoll, 1989). That is to say, individuals already possess some resources and will often strive to acquire, maintain, and protect resources that they consider valuable (Hu and Shen, 2020). Individuals with more resources are less susceptible to resource loss attacks and are more capable of obtaining resources, thus forming a value-added spiral (Hobfoll et al., 2003; Hu and Shen, 2020). Prosocial behavior is often an act of helping others at the expense of one's own interests. Therefore, from the perspective of personal material gain, prosocial behavior is often accompanied by losses (Schwartz, 2010; Patrick et al., 2018). Personal BJW can be understood as additional resource making this losses more bearable. In conclusion, personal BJW can enhance the positive connection between social self-efficacy and prosocial behavior. This result suggests that we should pay attention to the difference in the strength of personal BJW when intervening to improve individuals' prosocial behavior tendencies by enhancing individual social self-efficacy.

Our investigation has enriched the application of the strength model of self-control and the theory of social cognition in the relationship between ego depletion and prosocial behavior during the COVID-19 pandemic, which has positive enlightening significance for how to enhance people' s prosocial behaviors during the COVID-19 pandemic.

We can start by reducing the ego depletion of college students. Based on the ego depletion theory, when individuals modify the way they think, feel, or behave to adapt to societal norms and expectations, they draw from a limited pool of regulatory resources (Baumeister et al., 2000; Caldas et al., 2021). If individuals draw from this pool too much, this results in resource depletion that ultimately "renders the self temporarily less able and less willing to function normally or optimally" (Baumeister et al., 2007; Caldas et al., 2021). We need to take concrete action to mitigate the ego depletion among college students during the COVID-19 pandemic. For instance, we can encourage college students to actively participate in repeated practice on self-control tasks (e.g., regulating mood and monitoring eating habits), which have been proved to be effective in alleviating ego depletion (Hagger et al., 2010).

LIMITATIONS

In addition, this survey could still be improved in the following aspects: Firstly, Since this survey was a cross-sectional study, it could not make causal inferences about the relationship among college students' ego depletion, prosocial behaviors, social self-efficacy, and personal BJW. Secondly, what we reveal was the relationship between ego depletion and prosocial behaviors of college students during the COVID-19 pandemic. This kind of prosocial behavior is holistic, and the relationship between ego depletion and specific dimensions of prosocial behavior (such as anonymity) would be investigated in the future, which will provide us with more detailed information about the relationship between ego depletion and prosocial behavior. Thirdly, we have discussed the mediating role of social self-efficacy, a sense of self-efficacy in the social field, between ego depletion and prosocial behavior. The possible role of other special self-efficacy between ego depletion and prosocial behavior still has value to study. Finally, the discussion on the relationship between ego depletion and prosocial behaviors during the COVID-19 pandemic was mainly based on college students. The research objects could be further expanded to increase the reliability of the conclusions.

CONCLUSION

College students' ego depletion could reduce their prosocial behaviors, which has been confirmed by many studies during regular periods (Fennis, 2011; Ren et al., 2014; Osgood and Muraven, 2015; Fei et al., 2016). The current study further enriches this result with an online questionnaire survey on the relationship between ego depletion and prosocial behaviors of college students during the COVID-19 pandemic. The current

study found that the ego depletion of college students could be linked to their prosocial behaviors through social self-efficacy. Moreover, the stronger the personal BJW held by college students, the more significant the connection between their social self-efficacy and prosocial behaviors.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Academic Committee of Wannan Medical College. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LH and LL designed the survey. HL, CY and GW collected data. LL wrote the manuscript. LH and CY revised the manuscript. All authors contributed to the article and approved the submitted version.

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The Evolution of Psychological and Behavioral Consequences of Self-Isolation During Lockdown: A Longitudinal Study Across United Kingdom and Italy

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Introduction: Several countries imposed nationwide or partial lockdowns to limit the spread of COVID-19 and avoid overwhelming hospitals and intensive care units. Lockdown may involve restriction of movement, stay-at-home orders and self-isolation, which may have dramatic consequences on mental health. Recent studies demonstrated that the negative impact of lockdown restrictions depends on a wide range of psychological and socio-demographic factors.

Aims: This longitudinal study aimed to understand how internal factors such as personality and mindfulness traits, and external factors, such as daily habits and house features, affect anxiety, depression and general wellbeing indicators, as well as cognitive functions, during the course of a lockdown.

Methods: To address these questions, 96 participants in Italy and the United Kingdom filled out a survey, once a week for 4 weeks, during the first-wave lockdowns. The survey included questions related to their habits and features of the house, as well as validated questionnaires to measure personality traits, mindful attitude and post-traumatic symptoms. Indicators of wellbeing were the affective state, anxiety, stress and psychopathological indices. We also measured the emotional impact of the pandemic on cognitive ability by using two online behavioral tasks [emotional Stroop task (EST) and visual search].

Results: We found that internal factors influenced participants' wellbeing during the first week of the study, while external factors affected participants in the last weeks. In the first week, internal variables such as openness, conscientiousness and being non-judgmental toward one's own thoughts and emotions were positively associated with wellbeing; instead, neuroticism and the tendency to observe and describe one's own thoughts and emotions had detrimental effects on wellbeing. Toward the end of the study, external variables such as watching television and movies, browsing the internet, walking the dog, and having a balcony showed a protective value, while social

networking and engaging in video calls predicted lower values of wellbeing. We did not find any effects of wellbeing on cognitive functioning.

Conclusion: Recognizing specific traits and habits affecting individuals' wellbeing (in both short and long terms) during social isolation is crucial to identify people at risk of developing psychological distress and help refine current guidelines to alleviate the psychological consequences of prolonged lockdowns.

Keywords: COVID-19, lockdown, pandemic, longitudinal, stress, wellbeing, anxiety, depression

INTRODUCTION

Coronavirus (COVID-19) was first declared a public health emergency of international concern in January 2020 and then confirmed as a global pandemic in March 2020 (1). On the 13th March 2020, Italy imposed a total lockdown to manage the spread of Coronavirus and to prevent hospitals and intensive care units from being overwhelmed. The United Kingdom entered into lockdown on the 23rd March 2020, with a less restrictive strategy compared with the Italian lockdown. People in the United Kingdom were allowed to leave their homes to shop for basic necessities, for medical needs, to exercise once a day (run, walk, or cycle) alone or with members of their households and to travel to and from work. In contrast, the Italian government imposed full confinement, requiring the population to stay at home (108, 109). Physical activity (PA) outside was allowed only if conducted individually and not more than 250 meters from home; non-essential shops were closed and a restrictive derogative travel certificate was mandatory for any travel outside of the home (2).

Even when temporary, lockdown restrictions and self-isolation can have dramatic consequences on people's health and wellbeing (3); in particular, recent international studies have reported increased symptoms of anxiety, depression, sleep disorders, and psychological distress during lockdown (4–10). The factors that negatively influence the individual include separation from loved ones, loss of freedom, uncertainty over disease status, inadequate supplies, inadequate information, frustration, and boredom. Individuals cope with traumatic experiences in different ways, and in periods of uncertainty and environmental change, the role of personality differences becomes more evident (11, 12). Because there is substantial evidence linking personality traits with depressive symptoms and distress (13), some recent studies have explored the role of personality traits during the first lockdown stage, suggesting that vulnerable factors (neuroticism) and protective factors (extraversion and conscientiousness) can predict mental health status [e.g., (14, 15)].

Very little is known about the factors that may protect mental health during traumatic environmental change. The present longitudinal study, conducted over 4 weeks during the initial stages of lockdown in Italy and the United Kingdom in 2020, aimed to identify resilience factors that might mitigate the negative consequences of lockdown and self-isolation, as well as the risk factors that may worsen mental health outcomes. Participants were tested once a week and they were required to answer a questionnaire exploring indexes of depression, stress, and anxiety, as well as daily routines and habits. The questionnaire was paired with two cognitive tasks investigating emotional interference and visual selective attention. Factors related to personality and mindfulness traits were defined as "internal factors," while factors indicating daily routine, habits and living conditions were defined as "external factors."

Internal Factors: Personality and Mindfulness Traits

Personality Traits

One internal factor that can be measured to predict health outcomes in stressful situations is personality. The "Big Five" personality test is based on a five-factor model of personality [extraversion, agreeableness, conscientiousness, neuroticism, and openness; (16)], and it has recently been used to explore the relationship between personality traits and mental health during the COVID-19 outbreak. Neuroticism has been associated mostly with worry and stress (17–19). Also, individuals who scored higher on neuroticism have shown a reduced likelihood of engaging in potential safety behaviors [e.g., searching for COVID-19 symptoms on the internet; (18)]. Lower extraversion and higher neuroticism were also associated with higher stress (20). Cases reported by Nikčević and Spada (15) support the hypothesis that certain Big Five personality traits might be related to generalized anxiety and depressive symptoms during the first stage of lockdown. In their study of 502 participants from the United States, three personality traits (extraversion, agreeableness, and conscientiousness) were negatively associated with generalized anxiety and depressive symptoms. In contrast, neuroticism was directly associated with, and considered as a vulnerability factor for generalized anxiety and depressive symptoms. The study by Nikčević and Spada. (15) supported the hypothesis that agreeableness and extraversion might contribute to activating coping strategies (e.g., connecting with others) during the lockdown, and consequently might be considered protective factors that could mitigate negative affect (15).

Mindfulness Traits

A second internal factor that may contribute to predicting health outcomes is mindfulness traits. Mindfulness is defined as the ability to be intentionally aware of the present moment and the capacity to acknowledge both internal experiences and external information using a non-reactive (i.e., letting one's thoughts and

feelings go without focusing or elaborating them) and non-judgmental perspective, i.e., taking a non-judgmental stance toward one's inner experience (21).

Such traits have been shown to play a significant role in depression vulnerability and emotion self-regulation (22). Previous studies conducted during the first stage of lockdown reported that high levels of mindfulness are associated with lower levels of distress (23) and that mindfulness awareness is associated with more preventative health behaviors (24). Lower mindfulness traits have been associated with increased depression, stress, and anxiety (25). Higher scores for non-judgmental traits predicted lower levels of depression, anxiety and stress, and higher scores for mindfulness awareness predicted lower depressive symptoms (26). A web-based survey of a sample of about 6,000 Italians showed that, during the lockdown, increased levels of mindfulness correlated with decreased levels of distress, and were negatively correlated with the Symptom Checklist [SCL-90; (27)] subscales (measuring psychopathological symptoms); in particular, participants who scored lower on mindfulness traits reported higher obsessive-compulsive symptoms (23).

External Factors: Daily Habits

Lifestyle and daily habits are external factors that can affect how an individual overcomes stressful situations. Research measuring the daily routines of 670 Italians during the first stages of lockdown showed that a person's daily routine might have a critical effect on their mental health. In a study by Di Corrado et al. (28), most of the participants continued exercising during the lockdown restrictions, but participants whose habits were disrupted during the lockdown reported higher levels of nervousness. In contrast, participants who maintained their training habits reported feeling more energy, less fatigue, and more calm. In addition, participants who started exercising during the lockdown reported higher levels of happiness. Di Corrado et al. (28) suggested that maintaining regular habits during lockdown might prevent individuals from experiencing psychological and physical distress. However, more recently, contradictory evidence has emerged concerning the role played by PA during the lockdown. Some findings indicate a negative correlation between PA and mental health (29, 30), whereas other studies have reported benefits from keeping a regular PA habit during lockdown (31, 32). A longitudinal study between March and April 2020 in German and French populations showed that PA and exposure to nature were significant predictors of psychological health (33).

Walking is associated with physical wellbeing. Owning and walking a dog is recognized as contributing to human health (34, 35). Dog walking was one of the few activities allowed during the lockdown in Italy and the United Kingdom, consequently motivating people to acquire new puppies ("pandemic puppies") or to adopt rescue dogs (36). Because walking a dog and being a dog owner have been associated with lower depression, these were categorized as protective factors (37–39).

During the lockdown, people took up or increased their involvement in diverse activities, such as creative hobbies (e.g., cooking, reading, etc.), but also spent more time using digital social platforms to connect with others. Digital activity can be a strategy to cope with stressful events (40). However, there are contradictory findings regarding the effects of social media on individuals' wellbeing during the lockdown. Recent studies conducted showed that the use of social media during the pandemic was associated with feeling overwhelmed due to information overload related to COVID-19, and had a significant impact on users' wellbeing (41). In contrast, other studies suggested that social media had a positive effect on individuals' mental health during lockdown (42, 43). The digital activities considered in this study were: using social media, browsing the web, watching movies and television series, watching the news, and listening to music, radio, or podcasts.

Evolution of Internal and External Factors Over Time

Most recent attention has focused on the weekly progression of psychological wellbeing over the lockdown. For example, a study investigating the correlation between depressive symptoms and PA in Spain reported that the intensity of PA could predict the intensity and the presence of depressive symptoms (44). Ripoll et al. (45) conducted a longitudinal study over 8 weeks during the lockdown in Spain and reported that psychological wellbeing, life satisfaction and self-perceived health did not remain stable during the duration of the study. Anxiety and depressive symptoms improved after weeks four and five, suggesting that people might show resilience to the negative consequences of lockdown (45). A study conducted at three separate times during the first month of lockdown in Italy suggested an increase in stress, anxiety and life satisfaction levels between the second and the third testing sessions, but a stable depression level over time (46). Another longitudinal study in Italy, comparing participants' clinical levels of depression, stress and anxiety during the first week and the last week of lockdown showed that mental health outcomes changed over time and might be predicted by maladaptive personality traits (47). This recent literature suggests that lockdown can have a negative impact initially on psychological wellbeing, but also that some factors tend to stabilize over time. External factors, such as PA or daily activities, and internal factors such as personality and mindfulness traits, might predict the direction in which mental health outcomes develop. To the best of our knowledge, this is the first study investigating the evolution of how both internal and external variables influenced wellbeing over time.

Behavioral Measures: Cognitive Tasks

One of the most used experimental paradigms to assess cognitive processes related to anxiety and stress is the Emotional Stroop Task [EST; (48)]. The EST effect involves a slower reaction time to threatening words compared to neutral ones, suggesting the allocation of attention toward threatening targets (an attentional bias). The task has been successfully used with individuals with panic disorder (49), post-traumatic stress disorder (50), generalized anxiety disorder (51), social phobia (52), and health anxiety (53).

When considering our experimental design, it is important to compare the EST to a task that assesses purely cognitive processes, not influenced by emotional or distressing features. Indeed, some studies have shown that COVID-19-related anxiety is associated with poorer cognitive performance (54, 55), as well as increased attention toward social cues (56). One of the most relevant and frequently used approaches to studying visual cognitive processing is through visual search tasks (57, 58). Performance efficiency in visual search tasks typically represents a reliable indicator of cognitive processing efficiency (59).

In the present longitudinal study, we invited participants to perform the EST (consisting of COVID-19 related and neutral words) and a visual search task every 7 days throughout the complete duration of the lockdown in Italy and the United Kingdom, to assess participants' levels of anxiety toward the pandemic outbreak and their cognitive processing efficiency.

Aims of the Research

In addition to examining the roles of potential protective and risk factors for mental health during the first lockdown in two European countries, this is the first study (to our knowledge) investigating the effects of lockdown and self-isolation on attention and vigilance. The aims were: (1) to characterize the prevalence of anxiety and depressive symptoms, and the overall levels of wellbeing, in an Italian and a United Kingdom sample at the start of lockdown; (2) to test whether anxiety, depression and wellbeing are correlated with personality traits and lifestyles at the beginning of the lockdown, since this may reveal coping strategies that can alleviate psychological distress and promote wellbeing at this critical time; (3) to examine whether anxiety, depression, and wellbeing are related to cognitive functioning at the beginning of the lockdown; (4) to understand how anxiety, depression, wellbeing and cognitive functioning evolve over the course of the lockdown; and (5) to explore how anxiety, depression and wellbeing are influenced by personality, mindfulness traits and daily habits over the course of the lockdown.

MATERIALS AND METHODS

Participants

A sample of 96 participants was recruited to a 4-week longitudinal study. Twenty-five students from Kingston University (London, United Kingdom) signed up through an online research participation scheme in exchange for course credits. Seventy-one Italian participants were recruited *via* email or other social platforms (primarily Facebook). All sample characteristics (i.e., gender, age, job type, house size) are detailed in **Table 1**. Participants were informed of the study's aims and they gave their electronic consent before starting the study. The research protocol was approved by the Kingston University Research Ethics Committee, and the study was conducted according to the ethical standards of the British Psychological Society and the Declaration of Helsinki 1964.

TABLE 1 | Sample characteristics.

	Males	**Females**
Italy	*N* = 32	*N* = 39
	Age = 40 ± 14	Age = 41 ± 15
	Job type:	Job type:
	Student = 6	*Student = 7*
	Occasional = 3	*Occasional = 2*
	Fixed-term = 2	*Fixed-term = 5*
	Permanent = 10	*Permanent = 11*
	Entrepreneur = 9	*Entrepreneur = 8*
	Retired = 1	*Retired = 3*
	Don't know = 0	*Don't know = 2*
	Unemployed = 1	*Unemployed = 1*
	House size:	House size:
	<40 mq/studio/1 bed = 2	*< 40 mq/studio/1 bed = 0*
	40–80 mq/2 beds = 8	*40–80 mq/2 beds = 10*
	80–120 mq/3 beds = 7	*80–120 mq/3 beds = 14*
	> 120 mq/ > 3 beds = 15	*> 120 mq/ > 3 beds = 15*
United Kingdom	*N* = 5	*N* = 20
	Age = 43 ± 17	Age = 23 ± 6
	Job type:	Job type:
	Student = 1	*Student = 16*
	Occasional = 0	*Occasional = 1*
	Fixed-term = 0	*Fixed-term = 0*
	Permanent = 3	*Permanent = 3*
	Entrepreneur = 0	*Entrepreneur = 0*
	Retired = 0	*Retired = 0*
	Don't know = 0	*Don't know = 0*
	Unemployed = 1	*Unemployed = 0*
	House size:	House size:
	<40 mq/studio/1 bed = 2	*<40 mq/studio/1 bed = 2*
	40–80 mq/2 beds = 0	*40–80 mq/2 beds = 5*
	80–120 mq/3 beds = 0	*80–120 mq/3 beds = 4*
	> 120 mq/ > 3 beds = 3	*> 120 mq/ > 3 beds = 9*

Survey Overview

The web-based survey sent in the first week comprised 11 questionnaires. The first section focused on trait characteristics: demographic and general information about participants (i.e., age, gender, occupation, house size, household composition), personality traits (Big Five), pandemic impact as a traumatic personal event (IES-R), and the shorter version of the Five Facets Mindfulness Scale (FFMQ). The second part of the survey included a battery of questionnaires measuring state characteristics: questions about participants' daily routines and habits, the shorter version of the SCL90-R (27 items), depression, anxiety and stress (DASS-21), sleep disorders (ISI) and general questions about drinking habits and nicotine/substance use. The survey was followed by two cognitive tasks assessing attention and vigilance. While personality and mindfulness traits, demographics and household information were asked only the first time, the second part of the survey assessing state characteristics and factors changing over time, was sent to participants during the remainder of the study (three subsequent sessions). On each session, behavioral data (attention and

vigilance scores from the EST) were collected directly after participants finished the questionnaire (presented *via* Qualtrics); they were directed to the PsyToolkit web-based platform[1] to perform the cognitive tasks. Participants were contacted by email every 7 days for 4 weeks and asked to complete the questionnaires and the cognitive tasks.

Questionnaires

We used the Big Five Inventory as a 44-items questionnaire measuring personality traits. This tool is based on the assumption that personality can be divided into five broad traits: Extraversion, Openness to Experience, Conscientiousness, Agreeableness, and Neuroticism (60). Items are answered on 5-point Likert scales ranging from 1: very inaccurate to 5: very accurate (i.e., "I see myself as curious about many different things"; "I see myself as worrying a lot"). The Italian version of the Big Five Inventory showed good internal reliability, with Cronbach's alpha values ranging from 0.71 to 0.85 for the different subscales across three different samples (61).

The Depression, Anxiety and Stress Scale 21 (DASS-21; (62)) is a well-validated and effective tool that has widely been used to assess depression, anxiety and stress levels (divided into three factors) in clinical (63) and non-clinical studies (64), (i.e., "I found it hard to wind down"; "I found it difficult to work up the initiative to do things"). The DASS-21 has been shown to have good internal consistency: Cronbach's alphas were 0.94 for Depression, 0.87 for Anxiety, and 0.91 for Stress (63).

The short version of the Insomnia Severity Index [ISI; (65)] was used to measure sleep difficulties. The shorter version has been validated and is highly correlated with the original version (66). The questionnaire assesses the severity of initial, middle and late insomnia, the variables being: sleep satisfaction, interference of insomnia with daytime functioning, noticeability of sleep problems by others, and distress about sleep difficulties (i.e., "How noticeable to others do you think your sleep problem is in terms of impairing the quality of your life?"; "How worried/distressed are you about your current sleep problem?"). ISI internal consistency was excellent for both clinical and non-clinical samples (alpha of 0.90 and 0.91) (67).

The Impact of Event Scale-Revised [IES-R; (68)] is a 22-item questionnaire to assess subjective responses to a specific traumatic cause (for this study, the instructions specify that the traumatic event is the outbreak of COVID-19 and its consequences). The tool consists of a set of affirmations measuring intrusion (intrusive thoughts, nightmares, intrusive feelings and imagery, dissociative-like re-experiencing), avoidance (numbing of responsiveness, avoidance of feelings, situations, and ideas), and hyperarousal (anger, irritability, hypervigilance, difficulty concentrating, heightened startle), (i.e., Instructions: "How much were you distressed or bothered by these difficulties?" Responses: "Any reminder brought back feelings about it"; "I avoided letting myself get upset when I thought about it or was reminded of it"). The IES-R demonstrated high internal consistency for the total scale (Cronbach's alpha = 0.96), as well as for the three subscales (intrusion: 0.94; avoidance: 0.87; hyperarousal: 0.91) (69).

Mindfulness traits were assessed using the short form of the original Five Facet Mindfulness Questionnaire [FFMQ; (70)]. The FFMQ is a 39 items scale that measures five elements of mindfulness: observing, describing, acting with awareness, non-judging of and non-reactivity to the inner experience (i.e., "I'm good at finding words to describe my feelings"; "I notice how foods and drinks affect my thoughts, bodily sensations, and emotions"). The FFMQ-SF is a shorter version consisting of 24 items and has been validated as a measure of the variables related to mindfulness (71). The Italian version of the FFMQ showed good to excellent internal consistency as a whole (alpha = 0.86) with sub-scale consistency ranging from 0.65 to 0.81 (72).

The Symptoms Checklist Revised (SCL-90-R) is widely used to assess a range of psychopathological symptoms (27). The short form of the questionnaire, which comprises 27 of the original 90 items [SCL-27; (73)], was used here. The symptoms can be categorized into six subscales: depressive symptoms, dysthymia symptoms, vegetative symptoms, agoraphobic symptoms, symptoms of social phobia and symptoms of mistrust. In our analyses, the total score was the main measure (i.e., Instructions: "For the past week, how much were you bothered by:" Responses: "Trouble remembering things"; "Feeling low in energy or slowed down"). All scales of the SCL-27 showed good to satisfactory reliability (i.e., Cronbach's alpha between 0.70 and 0.90) (73).

Daily Habits

A list of 29 activities (i.e., web browsing, reading newspaper, painting etc.) was used to assess participants' daily routines and "going outside" habits. Items were answered on 5-point Likert scales ranging from 1: I do not carry out this activity to 5: More than 3 h a day. The complete questionnaires are shown in the **Supplementary Material**.

Cognitive Tasks

Two cognitive tasks were used: the EST and the Visual Search Task. The EST is widely used in both clinical and basic research (48). The task measures the impact of emotional stimuli on attentional processes, with prolonged response latencies recorded when participants name the ink colors of emotional words compared to neutral words, indicating so-called emotional interference (measured as mean response latency for emotional words minus mean response latency for neutral words). Many studies have examined attentional biases for trauma-related stimuli using the EST [e.g., (74)]. The EST is based on the assumption that attentional biases are driven by bottom-up processing: attention is involuntary and automatically directed toward threatening stimuli, and might impair participants' performance [e.g., (48, 49)]. In this study, the EST consisted of 25 neutral and 25 coronavirus-related (e.g., pandemic, isolation, infection) sets of words, repeated twice (100 trials in total).

The visual search paradigm is a task in which participants seek a specific target item among several non-targets (distractors) and they are asked to press a key if the target is present. The task measures visual perception and selective attention based on the Feature-Integration Theory of perception (75). According to

[1]http://psytoolkit.org/

this theory, the visual search process consists of two sequential stages: (i) the first stage is early, preattentive and perceptive, consisting of a fast parallel search of a single target feature; (ii) the second stage is late, attentive and consists of a slower serial search of all objects in the visual scene, aimed at identifying specific conjunction of more than one target features. The time needed to identify the target item increases as the number of distractors increases in the second stage (i.e., serial search, when looking for specific conjunction of features). This task is aimed at evaluating participants' visual processing skills, independently of semantically relevant information (which is manipulated in the EST task). A large number of studies have validated the visual search paradigm to explore visual attention mechanisms in healthy and clinical populations [e.g., (76–79)]. The task included 50 trials in total, i.e., 25 with the target and 25 without the target, presented in random order. On each trial, participants were asked to press the spacebar if they found the target figure (e.g., a red T among inverted Ts and blue Ts, acting as distractors). The set size (i.e., the number of distractors + target) was randomly determined among 5, 10, 15, and 20 figures in each trial. Feedback was given after each trial if the participant's response was incorrect.

Statistical Analyses

Main Analyses

All analyses were guided by five research questions based on the five research aims stated in the Introduction:

- Q1. What is the prevalence of anxiety and depressive symptoms, and the overall levels of wellbeing, in an Italian and a United Kingdom sample at the start of lockdown?
- Q2. Are anxiety, depression and wellbeing correlated with personality traits and lifestyle at the beginning of the lockdown?
- Q3. Are anxiety, depression, and wellbeing related to cognitive functioning at the beginning of the lockdown?.
- Q4. How does the relationship between anxiety, depression, wellbeing and cognitive functioning evolve over the course of the lockdown?
- Q5. How are anxiety, depression and wellbeing influenced by personality, mindfulness traits and daily habits over the course of the lockdown?

To address the first research question (Q1), we explored mean values of the wellbeing variables (i.e., depression, anxiety, stress in DASS-21, insomnia in ISI, SCL-27 total score) for the first week of data collection (T1) and compared the mean values with the normative sample mean of each questionnaire using a *t*-test to investigate whether our sample was statistically different from the general population. We also examined how many participants showed an IES-R total score above the clinical threshold [thus suggesting a possible post-traumatic stress disorder diagnosis; threshold = 33, (80)]. The same was done for the ISI insomnia score [clinical threshold = 14, (67)].

For Q2, at the first time point (T1) we tested the relationship between both internal (i.e., Big Five personality traits and FFMQ mindfulness traits) and external (i.e., house characteristics, daily routines components, "going outside" habits components, and use of nicotine) independent variables and wellbeing dependent variables (i.e., depression, anxiety, stress in DASS-21, and SCL-27 total score) in two multivariate linear models: the first model included the three dependent variables from DASS-21 in a multivariate design (since they are correlated by definition), while the second model tested the effects on the SCL-27 total score separately. Data from the substance use questions were excluded from these analyses as a preliminary analysis found very sparse data (the vast majority of participants reported no substance use), perhaps affected by a social desirability bias (81). In all models, days after the lockdown began were added as an independent variable. By using the exact number of days after the beginning of lockdown, we covaried the differences related to the specific dates that participants reported as lockdown start. In these models, the statistical significance threshold was lowered to $\alpha = 0.0125$ to avoid type I errors (false positives); since we tested four different measurements in time, we divided the α value by four as in a typical Bonferroni correction for multiple comparisons.

To address Q3, we tested the correlation matrix between participants' performance on each cognitive task (i.e., EST and Visual Search Task) and the same wellbeing variables cited above for T1. To compute participants' performance on the tasks, Inverse Efficiency Scores (IES) were calculated as the ratio between individual response times (RTs after removing outlier scores more than 2 SD from the mean, computed for each participant separately) and the mean proportion of correct answers. For the EST, an emotional interference index was computed as the difference between individual IES in trials related to coronavirus and IES in neutral trials. Therefore, the higher this index, the greater the interference created by coronavirus-related trials (i.e., worse performance–higher IES–in coronavirus-related trials than in neutral trials). For the Visual Search task, a serial visual search cost index was computed as the difference between individual IES in trials with the highest set size (i.e., number of figures in the display set; 20) and the lowest set size (5). Therefore, the higher this index, the greater was the cost of serial visual search in terms of performance decrease. To test the evidence in favor of null hypothesis (H_0) vs. alternative hypothesis (H_1), we also computed a Bayesian correlation matrix, displaying the Bayes Factor for each correlation. In this case, the Bayes Factor (BF_{01}) reflects the ratio between the likelihood of the data given H_0 and the likelihood of the data given H_1 (82). In other words, the higher the BF, the more likely are the data given one of the two hypotheses.

Analyses related to Q4 were extensions of the previous analysis, as we tested the same correlation matrix, but used the angular coefficients of these variables over time. The angular coefficient was computed by fitting a regression for each participant for each score (dependent variable) and using the days after the lockdown start as the independent variable. Therefore, these coefficients represented the variation of these variables during the lockdown, in other words, the individual increase or decrease over time. As with Q2, by using the exact number of days after the beginning of lockdown, we covaried the differences related to the specific dates that participants reported as lockdown start. Since we needed at least two time points to

fit a regression line for each participant, only participants with at least two recordings of all variables were included in this analysis. Indeed, participants who failed to complete the survey after the second week (N = 27) were excluded from the longitudinal analysis, yielding a final sample of 69 participants for Q4 and Q5 analyses. Again, a Bayesian correlation matrix was computed to display the evidence for H_0 vs. H_1.

In the same fashion, the analyses for Q5 were effectively the same as for Q2 but extended longitudinally. Data from all questionnaires were analyzed cross-sectionally, thus testing how the relationships among variables changed over time. Therefore, separate models were created for each week of data collection, from T1 (first week) to T4 (final week). Each model investigated the relationship between the same independent and dependent variables described in Q2. The $\alpha = 0.0125$ threshold was used also in these models (as in Q2), to avoid type I errors.

All statistical analyses were performed using RStudio software (83), and the following packages: Lavaan (84), Psych (85), and Dplyr (86).

Principal Components Analyses

In order to reduce dimensionality and to identify commonalities in data from the two questionnaires about daily routines and "going outside" habits, we performed two Principal Components Analyses (PCAs) on these data (87). The criteria used to choose the number of components were (1) scree plot, (2) eigenvalue of each component >1, (3) results interpretability. Tables for each criterion are reported for the two PCAs in the Results section. Factors rotation was chosen based on the correlation between components, i.e., oblique rotation ("*oblimin*") when at least one correlation was >0.2 or <−0.2; orthogonal rotation ("*varimax*") when no correlations showed values above or below the aforementioned thresholds. Factorial scores from the two PCAs were saved and used as individual scores in further analyses.

RESULTS

Principal Components Analyses

The PCA performed on daily routines highlighted a 5-component solution, with "*varimax*" rotation, as the highest correlation among components in a solution with oblique rotation was 0.19. Loadings and explained variance are given in **Table 2**. In the 5-component solution that we used, contemplative and experiential habits loaded on component 1 (practicing yoga/pilates, practicing mindfulness, listening to podcasts, painting, cooking, listening to audiobooks); TV-related habits loaded on component 2 (watching TV, watching movies or series, and negatively playing musical instruments, and reading); social and non-social activities loaded on component 3 (listening to the radio, calling friends, and negatively watching Youtube); internet-related and physical activities loaded on component 4 (watching Youtube, using social networks, listening to music, web browsing, and doing PA); recreational activities loaded on component 5 (playing card games, attending online courses, playing videogames, watching the news).

TABLE 2 | PCA loadings for daily routines.

	Loading cutoff = 0.40				
Routine	**RC1**	**RC5**	**RC4**	**RC2**	**RC3**
Practicing yoga/pilates	**0.73**	−0.18	−0.15	−0.10	0.06
Practicing mindfulness	**0.64**	0.14	0.22	−0.31	−0.14
Listening to podcasts	**0.55**	0.25	0.29	0.03	0.10
Painting	**0.66**	0.06	0.09	−0.01	0.29
Cooking	**0.56**	0.02	−0.37	0.12	0.01
Listening to audiobooks	**0.61**	0.36	0.17	−0.02	0.07
Playing card games	0.15	**0.66**	0.08	0.00	0.09
Attending online courses	0.16	**0.59**	0.00	−0.04	0.09
Playing videogames	−0.05	**0.65**	0.26	0.10	−0.30
Watching Youtube	0.32	0.20	**0.55**	−0.02	**−0.47**
Using social networks	−0.04	−0.14	**0.68**	0.12	0.37
Listening to music	0.05	0.11	**0.65**	−0.29	0.12
Watching movies or series	0.09	0.19	0.17	**0.65**	0.00
Watching TV	0.04	0.18	−0.01	**0.61**	0.37
Playing musical instruments	0.26	0.35	0.15	**−0.58**	0.06
Listening to the radio	0.09	0.29	−0.02	0.00	**0.55**
Calling friends	0.19	−0.06	0.15	−0.01	**0.58**
Web browsing	−0.02	0.14	**0.41**	0.36	−0.10
Doing physical activity	0.05	0.05	**0.45**	0.05	−0.02
Watching the news	−0.24	**0.47**	−0.17	0.27	0.25
Reading	0.21	0.21	0.10	**−0.46**	0.28
RC = Rotated component					
	RC1	**RC5**	**RC4**	**RC2**	**RC3**
SS loadings	2.73	2.10	2.07	1.77	1.53
Proportion variance	0.13	0.10	0.10	0.08	0.07
Cumulative variance	0.13	0.23	0.33	0.41	0.49

The PCA performed on "going outside" habits produced a 4-component solution, with "*varimax*" rotation, as the highest correlation among components in a solution with oblique rotation was 0.14. Loadings and explained variance are given in **Table 3**. In the 4-component solution we used, indispensable activities loaded on component 1 (working, and going to the off-license/tobacco shop); buying groceries, going to the pharmacy, and buying newspapers loaded on component 2; going outside for PA loaded on component 3; going outside to walk the dog loaded on component 4.

Q1: Prevalence of Anxiety and Depressive Symptoms

Descriptive statistics for all main variables are shown in **Table 4**. The t-tests against normative samples scores indicated significantly higher scores in our sample compared to the general population for the DASS: depression [participants' mean = 11.57; validation mean = 7.19; $t(91) = 4.36$, $p < 0.001$], stress [participants' mean = 13.72; validation mean = 10.54; $t(91) = 3.06$, $p = 0.003$]; SCL-27 total score [participants' mean = 0.75; validation mean = 0.52; $t(95) = 3.87$, $p < 0.001$]. However, the DASS anxiety score did not differ significantly [participants' mean = 6.09; validation mean = 5.23; $t(91) = 0.996$, $p = 0.322$]. IES-R scores revealed that 21% of participants (20/96) displayed a possible post-traumatic stress disorder

TABLE 3 | PCA loadings for "going outside" habits.

	Loading cutoff = 0.40			
Habit	**RC1**	**RC2**	**RC3**	**RC4**
Working	**0.80**	0.15	0.11	−0.17
Going to the off license/tobacco shop	**0.84**	−0.08	−0.17	0.19
Buying groceries	0.36	**0.61**	0.33	−0.33
Going to the pharmacy	−0.03	**0.77**	0.07	0.09
Buying newspapers	0.03	**0.64**	−0.38	0.14
Physical activity	−0.04	−0.01	**0.91**	0.11
Walking the dog	0.02	0.11	0.10	**0.94**
RC = Rotated component				
	RC1	**RC2**	**RC3**	**RC4**
SS loadings	1.48	1.41	1.13	1.10
Proportion variance	0.21	0.20	0.16	0.16
Cumulative variance	0.21	0.41	0.57	0.73

diagnosis (total score >33) in T1, while only 3% of participants (3/96) showed a diagnostic value in the ISI (score >14). In summary, several indices showed increased levels of depression, stress, psychiatric symptoms and risk of PTSD in participants in lockdown.

Q2: How Anxiety, Depression and Wellbeing Are Correlated With Personality, Mindfulness and Lifestyle at the Beginning of the Lockdown

All of the results from these models are detailed in the T1 section in the **Supplementary Material**. Protective effects were statistically negative (since depression/anxiety/stress/symptoms scores decreased as the variable of interest increased), while detrimental effects were statistically positive (since depression/anxiety/stress/symptoms scores increased as the variable of interest increased). Only internal variables showed statistically significant effects on wellbeing variables in T1: we found significant protective effects of openness (on depression: $b = -0.891$, $z = -4.263$, $p < 0.001$; on anxiety: $b = -0.488$, $z = -2.749$, $p = 0.006$; on stress: $b = -0.858$, $z = -3.765$, $p < 0.001$; on SCL-27: $b = -0.039$, $z = -3.206$, $p = 0.001$) and detrimental effects of neuroticism (on depression: $b = 0.706$, $z = 3.182$, $p = 0.001$; on anxiety: $b = 0.518$, $z = 2.747$, $p = 0.006$; on stress: $b = 0.959$, $z = 3.965$, $p < 0.001$; on SCL-27: $b = 0.051$, $z = 4.242$, $p < 0.001$) on all four dependent variables (i.e., DASS: depression, anxiety, stress; SCL-27 total score). Moreover, we found a significant detrimental effect of the FFMQ factor "description" on DASS: depression ($b = 1.082$, $z = 2.656$, $p = 0.008$) and a significant protective effect of conscientiousness on the DASS component stress ($b = -0.484$, $z = -2.737$, $p = 0.006$). In summary, only internal variables showed an effect on wellbeing at the beginning of the lockdown. In particular, openness and conscientiousness had protective value, while neuroticism and description had a detrimental effect.

TABLE 4 | Descriptive statistics in T1.

	IT (71)		United Kingdom (25)	
Variable	**M (32)**	**F (39)**	**M (4)**	**F (20)**
DASS: Depression	6.94 (5.88)	11.89 (9.65)	14.0 (19.80)	17.60 (10.50)
DASS: Anxiety	1.63 (2.18)	5.62 (7.30)	7.00 (9.90)	13.60 (10.75)
DASS: Stress	8.56 (7.19)	15.62 (9.66)	9.00 (12.73)	19.00 (11.08)
ISI: Insomnia	5.28 (4.42)	6.86 (4.80)	1.00 (1.51)	3.50 (0.71)
SCL-27: Total score	0.40 (0.29)	0.77 (0.51)	0.61 (0.61)	1.14 (0.70)

DASS, depression anxiety stress scale–21 items version; ISI, insomnia severity index; SCL-27, symptom checklist–27 items version.

Q3: How Anxiety, Depression, and Wellbeing Are Related to Cognitive Functioning at the Beginning of the Lockdown

The frequentist and Bayesian correlation matrices for T1 between behavioral tasks scores and wellbeing scores are given in **Table 5**. The only statistically significant negative correlation was between the Visual Search cost index and the DASS: stress score. Additionally, the Bayesian correlations showed general evidence for the null hypothesis, with BF_{01} ranging from 1.977 to 5.868. These results suggest that the data are 1.977 to 5.868 more likely to be observed under H_0 than under H_1. Bayesian correlation indicated an inconclusive outcome concerning the only statistically significant correlation (between the Visual Search cost index and the DASS: stress score), with a $BF_{01} = 0.775$. This Bayes Factor value does not consistently support either H_0 or H_1.

Q4: How the Relationship Between Anxiety, Depression, Wellbeing and Cognitive Functioning Evolves Over the Course of the Lockdown

The frequentist and Bayesian correlation matrices between the time course of behavioral tasks scores and wellbeing scores are detailed in **Table 6**. No statistically significant effects were identified between the variables of interest. Bayesian correlations suggested only anecdotal-to-medium support for H_0 (BF_{01} ranging from 2.427 to 5.579). In summary, wellbeing did not show any significant correlations with cognitive functioning, neither at the beginning of the lockdown (Q3) nor over its course (Q4).

Q5: How Anxiety, Depression and Wellbeing Are Influenced by Personality, Mindfulness and Lifestyle Over the Course of the Lockdown

All cross-sectional results from these models are detailed in the **Supplementary Material**. A summary of the main findings from cross-sectional analyses is also shown in **Table 7**. Results for T1 are given above (Q2). For T2, we found statistically significant protective (statistically negative) effects of the FFMQ factor "non-judgment" on DASS factor depression ($b = -1.290$, $z = -2.503$, $p = 0.012$), an effect of presence of balcony on DASS factor

TABLE 5 | Frequentist and Bayesian correlation matrix in T1 between behavioral tasks scores and wellbeing variables.

	DASS: Depression	DASS: Anxiety	DASS: Stress	SCL-27: Total score
Emotional stroop task: Emotional interference index	$r = 0.10$	$r = 0.12$	$r = 0.06$	$r = 0.12$
	$p = 0.42$	$p = 0.36$	$p = 0.66$	$p = 0.33$
	$BF_{01} = 4.72$	$BF_{01} = 4.26$	$BF_{01} = 5.87$	$BF_{01} = 4.07$
Visual search task: Serial visual search cost index	$r = -0.16$	$r = -0.13$	$r = -0.26$	$r = -0.19$
	$p = 0.20$	$p = 0.29$	$p = 0.04$*	$p = 0.12$
	$BF_{01} = 2.91$	$BF_{01} = 3.72$	$BF_{01} = 0.775$	$BF_{01} = 1.98$

*DASS, depression anxiety stress scale–21 items version; ISI, insomnia severity index; SCL-27, symptom checklist–27 items version. *Statistically significant effect, $p < 0.05$.*

TABLE 6 | Frequentist and Bayesian correlation matrix between angular coefficients of behavioral tasks scores and wellbeing variables over time.

	DASS: Depression	DASS: Anxiety	DASS: Stress	SCL-27: Total score
Emotional stroop task: Emotional interference index	$r = 0.03$	$r = -0.19$	$r = 0.09$	$r = -0.03$
	$p = 0.82$	$p = 0.19$	$p = 0.53$	$p = 0.86$
	$BF_{01} = 5.52$	$BF_{01} = 2.43$	$BF_{01} = 4.69$	$BF_{01} = 5.58$
Visual search task: Serial visual search cost index	$r = -0.08$	$r = -0.14$	$r = 0.06$	$r = -0.11$
	$p = 0.58$	$p = 0.33$	$p = 0.68$	$p = 0.46$
	$BF_{01} = 4.89$	$BF_{01} = 3.54$	$BF_{01} = 5.23$	$BF_{01} = 4.36$

*DASS, depression anxiety stress scale–21 items version; ISI, insomnia severity index; SCL-27, symptom checklist–27 items version. *Statistically significant effect, $p < 0.05$.*

anxiety ($b = -4.345$, $z = -2.708$, $p = 0.007$) and an effect of openness on the SCL-27 total score ($b = -0.036$, $z = -2.629$, $p = 0.009$). The protective effect of "non-judgment" on DASS factor depression remained significant also in T3 ($b = -1.552$, $z = -2.713$, $p = 0.007$), while no other statistically significant outcomes were apparent at this time point. For T4, only external variables showed significant effects on wellbeing: daily routines component 3 (social and non-social activities) produced a detrimental (statistically positive) effect on DASS: depression ($b = 5.135$, $z = 3.075$, $p = 0.002$) and the SCL-27 total score ($b = 0.333$, $z = 4.416$, $p < 0.001$). Also, the household variable (i.e., number of households) showed a detrimental effect on the SCL-27 total score ($b = 0.187$, $z = 3.768$, $p < 0.001$), while daily routines component 2 (TV- and internet-related habits; $b = -0.253$, $z = -3.225$, $p = 0.001$), "going outside" component 4 (walking the dog; $b = -0.237$, $z = -3.042$, $p = 0.002$) and presence of balcony ($b = -0.562$, $z = -2.648$, $p = 0.008$) showed a protective (negative) effect on the SCL-27 total score. In summary, over the course of the lockdown, internal variables (personality and mindfulness scales) gradually lost relevance as predictors of wellbeing, while external variables (house characteristics and lifestyle) increased their predictive power by the end of the lockdown.

DISCUSSION

Lockdown and self-isolation are measures deployed during the COVID-19 pandemic that have been shown to negatively affect individuals in different ways. However, several resilience factors can help individuals to cope better with self-isolation. This study aimed to identify resilience factors that could mitigate the negative impacts of the COVID-19 quarantine on mental health through a longitudinal methodology that evaluated participants during the first lockdown in Italy and the United Kingdom.

Overall, our study showed that self-reported measures of psychological distress were elevated relative to average scores for the general adult population. Participants reported higher levels of depression and stress during the COVID-19 lockdown, which is consistent with results from other studies during the same period [e.g., (88–91)]. The sample reported higher scores on the SCL-27 compared with population norms, supporting recent studies that have indicated an increase in symptom scores measured by the SCL-27 during self-isolation (92). Potential internal and external factors that played a role in self-isolation were also investigated including personality and mindfulness traits, daily routines, and living conditions. Indeed, longitudinal analyses revealed that internal variables influenced participants' wellbeing more during the first weeks of the study, while external variables influenced it more during the last measurements.

Internal Factors: Personality and Mindfulness Traits

Two personality traits, neuroticism and openness, affected DASS subscales in the first week, suggesting that those who score high for these traits are more likely to experience greater distress, anxiety, and depression. Previous findings from longitudinal studies have also shown that neuroticism can negatively affect mental health outcomes (47). However, these effects seem to be stable and do not increase over time, indicating an ability to adapt to the negative consequences of lockdown after 1 week. In accordance with the present results, previous longitudinal studies conducted in different countries have demonstrated changes in wellbeing indicators during different stages of lockdown (10, 46, 93). Ruggieri et al. (46) conducted a 4-week study between the 7th March and 14th April 2020 measuring loneliness, anxiety, depression, and life satisfaction among an Italian sample. Similar findings were reported from longitudinal studies conducted in

TABLE 7 | Summary of the main findings from cross-sectional analyses.

TIME	DASS: Depression	DASS: Anxiety	DASS: Stress	SCL-27: Total score
T1	BF: NEUROTICISM BF: OPENNESS FFMQ: DESCRIPTION	BF: NEUROTICISM BF: OPENNESS	BF: NEUROTICISM BF: OPENNESS BF: CONSCIENTIOUSNESS	BF: NEUROTICISM BF: OPENNESS
T2	FFMQ: NON-JUDGMENT	BALCONY		BF: OPENNESS
T3	FFMQ: NON-JUDGMENT			
T4	HABIT: COMPONENT 3 (social and non-social activities)			HOUSEHOLD HABIT: COMPONENT 2 (TV-related habits) HABIT: COMPONENT 3 (social and non-social activities) GOING OUTSIDE: COMPONENT 4 (walk the dog) BALCONY

GREEN VARIABLES = significant protective (statistically negative) effects.
RED VARIABLES = significant detrimental (statistically positive) effects.
DASS, depression anxiety stress scale–21 items version; ISI, insomnia severity index; SCL-27, symptom checklist–27 items version; BF, big five questionnaire; FFMQ, five factors mindfulness questionnaire.

China (10) and in the United States (93). Consistent with the literature, our research suggested significant deleterious effects after the first week, followed by stabilization of the scores during the subsequent quarantine period, supporting the view that individuals may adapt to the negative consequences of social isolation and home confinement (10, 46, 93).

This study also investigated the contribution of mindfulness facets to depression, anxiety, and stress during the lockdown. The ability to describe feelings, thoughts, and experiences with words seemed to be a predictor for depression in T1. This could be explained by the fact that high introspection scores may have reflected excessive rumination. It could be that distraction, although less efficient in the long run, could have been a better emotion regulation strategy in the specific context of the pandemic. Self-reported scores were collected at the beginning of a pandemic, when people knew very little about it and were required to deal emotionally with a completely novel situation based on uncertainty. In contrast, having a non-judgmental attitude predicted lower levels of depression at T2 and T3. Our findings are in line with the results from Medvedev et al. (94), which suggested that having a non-judgmental attitude could protect against depression over time. Together, these outcomes demonstrate that several aspects of mindfulness (in particular not being judgmental) might protect against depression in both normal and emergency conditions, especially during social isolation. Indeed, a systematic meta-analysis (95) found a significant increase in mindfulness and lower levels of psychological stress in participants using mindfulness apps. A recent study has also shown that an online mindfulness intervention significantly reduced perceived stress in Singaporean participants during lockdown (96), and online mindfulness training has also been shown to reduce anxiety and depression in people suffering from COVID-19 during isolation (97).

External Factors

Daily Routines: Digital Activities

Self-isolation and lockdown often forced individuals to engage in social-digital interactions [e.g., video calls] and to spend more time using social media platforms. Our results showed that an increase in time spent using social media and engaging in video calls had detrimental effects on individuals during the last (fourth) week of the study, thus suggesting a negative influence of digital activities if used over time. This finding is contrary to previous results which have suggested that people benefit from an increase in digital activities to compensate for loneliness (42, 43). Kopilaš et al., (42) looked at the role of digital activity during self-isolation in Croatia and Italy and suggested that participants increased digital activity to provide socialization when physically distancing. Their findings showed that digital activities, such as social media activity and the use of computers and smartphones, were associated with higher scores on the PANAS positive affect scale, supporting the assumption that digital activities might serve as a protective factor during self-isolation. A further longitudinal study investigating the role of social media and video calls during the lockdown has noted the importance of digital interactions and their positive consequences on participants' self-report depression scores (43). However, our findings support the suggestion by Islam et al. (41) that a negative effect of social media can occur due to the overwhelming amount of information that can be associated with it. Recent literature defined the excessive use of social media during the pandemic as a technological/social paradox, in which individuals increased their use of the internet to stay in contact with family and friends, due to the government's restrictions on social contact; nevertheless, the ubiquity of this medium in our life is also a cause of an increase of techno-stress (98, 99). Moreover, our sample consists of people of different ages and middle-aged or older individuals who may find communication using social media less beneficial, if not frustrating in the current circumstances.

The current study also showed that some digital activities can have positive consequences on individuals: watching television, movies, and series were associated with positive effects, and therefore were protective factors. However, this was not the case in a recent study that reported an association between depression and increased time spent watching television, movies, and playing computer games (100).

Daily Routines: Walking the Dog

Participants that engaged in dog walking reported fewer negative symptoms during the last week of the study, supporting the assumption that pets can prove beneficial during lockdowns (37, 101, 102). Ratschen et al. (103) also found that individuals who owned a pet showed less deterioration in mental health and reduced loneliness. Walking a dog also necessitates PA; Moore et al. (104) in Canada reported a positive correlation between family dog ownership and increased PA. Dog ownership and dog walking can therefore be considered protective factors during lockdown (37–39).

House Features

Different house features can also affect individuals' self-reported wellbeing during self-isolation. The results support previous findings suggesting that the presence of a balcony or a patio can contribute toward coping better with the lockdown situation (105–107) since private outdoor access (balcony) was associated with lower levels of anxiety during part of the lockdown (second week of the study). In contrast, the larger the number of people in the household the higher the SCL scores reported, suggesting that people were more likely to be dissatisfied with their housemate relationships over time, as reflected in the outcome during the last week of the study.

Cognitive Functioning

The cognitive measures showed no statistically significant correlations with wellbeing indices, and Bayesian tests consistently indicated a lack of evidence for any correlations. Considering the EST, these results seem to suggest that the anxiety and stress related to COVID-19 are efficiently captured by explicit measures (i.e., self-report questionnaires) but the lockdown did not particularly influence the attention toward emotional material. The Visual Search Task showed that selective attention, a purely cognitive function, was not affected by the psychological state during the lockdown. Therefore, our results suggest that the pandemic did not have an impact on attentional mechanisms, relating either to "emotional" or "non-emotional" stimuli. Previous literature showed that the COVID-19 lockdown was associated with poorer cognitive performance (54, 55) and increased attention toward social cues (56). Our findings seem to go against these results; this discrepancy likely reflects the specific components investigated and the measures used, since previous studies primarily focused on working memory (especially using n-back tasks) or gaze cueing tasks. Alternatively, these behavioral measures may have been affected by certain limitations: (i) online cognitive tasks were completed by fewer participants compared to the surveys; (ii) in some cases the cognitive tasks were completed at a different time from the surveys, making these data difficult to align or compare; (iii) online behavioral tasks cannot be as rigorously controlled as in-person laboratory experiments. Therefore the absence of significant correlations between behavioral tasks and wellbeing indices might reflect these limitations rather than the lack of any influence.

Limitations and Future Directions

This study has a number of strengths and limitations. While our results allow crucial insights on how internal and external variables influence wellbeing at different phases of a social lockdown, the main limitation is related to the sample size over time. The number of participants completing the weekly surveys decreased over time (as shown by the lower number of participants included in longitudinal analyses), mainly due to lack of engagement. This was probably related to the absence of monetary reward or other incentives, but this allowed us to avoid a selection bias toward participants who were reward-driven. The small sample size and the relevant attrition rate (as well as the oversampling of the active population, i.e., 15 to 64 years) cannot allow us to generalize our results to the general population, especially outside the countries we studied. Given the small sample size and in order to test the statistical power of our models, we ran an *a posteriori* power analysis which supported the statistical reliability of our results (see the **Supplementary Material** for the complete analysis). Further research is needed to explore cognitive variables (i.e., attention) that might be affected during stressful situations and in future lockdowns, possibly using more controlled settings. Another possible confound in this study is represented by the possible issues in interpreting the results from the IES-R questionnaire as a pure index of the pandemic traumatic impact. As a matter of fact, this scale investigated generic post-traumatic symptoms (with no specific reference to the lockdown) and, therefore, any other traumatic event may have implications on our results. Nevertheless, the pandemic may have represented the main traumatic event for most participants, given the overwhelming change in routines they experienced.

The implications of this study could be important, as it has provided new insights about how to address different phases of a social lockdown brought on by a national emergency. Health services may be better able to identify the most susceptible people (e.g., in terms of personality structure, during early phases; persons in difficult housing conditions in later phases) and help prevent a worsening of their psychological state by creating targeted interventions. Another important aspect to consider in future research is testing how these effects on wellbeing change over longer timeframes, e.g., after the end of the first wave lockdown and during subsequent waves of COVID-19 with consequent restrictions.

CONCLUSION

Self-isolation may have important consequences on individuals over time. The current study showed that internal factors, such as personality and mindfulness traits, were more predictive for wellbeing during the first weeks, but stabilized over time. In contrast, external factors, such as daily routines and house features, predicted more strongly a person's psychological wellbeing during the last weeks of the study.

This is the first study to our knowledge that adopted a mixed-methods approach to assess changes in psychological wellbeing and attention over time. Although our behavioral findings did

not show any association between cognitive performance and psychological wellbeing, this aspect deserves further study in the future. Our findings contribute to the growing literature that supports the use of tailored interventions for individuals who may struggle during self-isolation. Educational interventions implemented within the workplace or educational settings could guide individuals to learn protective and coping strategies that might prevent the negative effects of self-isolation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

All participants were provided with an exhaustive description of all the experimental procedures and were required to sign a written informed consent before taking part in the study. The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and under a protocol approved by the Kingston University Ethics Committee (protocol #2020-1549).

AUTHOR CONTRIBUTIONS

FZ, FB, and GG contributed to the design and the conception of the research. FZ and FB contributed to the implementation, administration of the surveys and behavioral tasks, and contributed to writing of the manuscript. FB and MR contributed to the analysis of the results. All authors contributed to the manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.826277/full#supplementary-material

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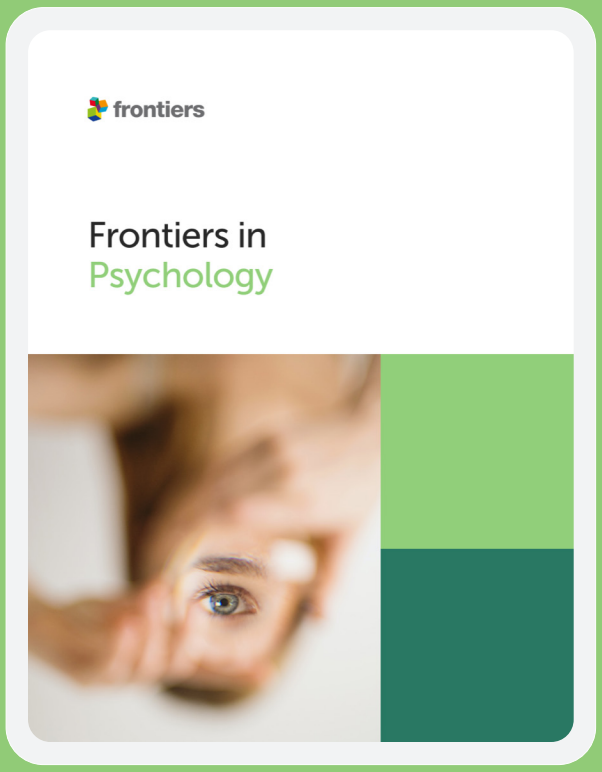

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