

GENDER DIFFERENTIALS IN TIMES OF COVID-19

EDITED BY: Holger Andreas Rau, Christiane Schwierén, Stephan Müller
and Michele Belot

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GENDER DIFFERENTIALS IN TIMES OF COVID-19

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Editorial: Gender Differentials in Times of COVID-19

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Keywords: COVID-19, gender differences, preferences, health protection, educational/career choices, gender inequality

Editorial on the Research Topic

Gender Differentials in Times of COVID-19

WHY GENDER DIFFERENTIALS MATTER DURING THE PANDEMIC

The COVID-19 pandemic constitutes a large exogenous shock for economies and societies worldwide. The crisis affected policymakers, firms, and households to similar extents. Because of the health threat, the primary goal was to fight the dissemination of the virus. As a consequence, the society experienced drastic changes due to policy measures such as social-distancing rules, lockdowns, school and university closures, and restricted access to public places. Furthermore, vivid discussions on legal vaccination requirements drove a division of society, stimulated conspiracy theories (e.g., Bierwaczzonek et al., 2020; Pummerer et al., 2022), and political polarization (e.g., Hart et al., 2020; Kerr et al., 2021). Compliance to these policy measures is important to preserve a healthy society with functioning labor markets, access to human capital in schools and universities, which guarantees growth (Keser and Rau, 2022). Social sciences may provide valuable insights, as the success of these measures depends on individual behavior. In this respect, people's preferences (Campos-Mercade et al., 2021; Müller and Rau, 2021), their perception of the crisis, and their socioeconomics are important factors that influence behavior.

Social psychology and behavioral economics emphasize evidence of gender differences in preferences (Croson and Gneezy, 2009; Meyers-Levy and Loken, 2015) that may play a crucial role for the observed outcomes during the Corona crisis. Women are consistently found to be more risk averse (Charness and Gneezy, 2012), less competitive (Niederle and Vesterlund, 2007), and more prosocial (Eckel and Grossman, 1998; Branas-Garza et al., 2018) and empathic (Mesch et al., 2011) than men. Transferred to the pandemic, which constitutes a risky situation where egoistic behavior induces negative externalities on others, it follows that gender differences in compliance could exist. In line with this argument, it is found that women are more likely to wear a face mask (Capraro and Barcelo, 2020) and to agree and comply with restraining public policy measures (Galasso et al., 2020) than men. Focusing on the labor market during the pandemic recession, the decline in employment is more pronounced for women (Albanesi and Kim, 2021), as they spend more time at home for child care, which is in line with less competitive behavior—but also, and this should not be forgotten, with structural and normative differences.

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The papers mentioned above are examples demonstrating how gender differences in behavior may impact the outcomes during the pandemic, regarding compliance and behavior on labor markets. This Research Topic extends this evidence, contributing to the literature by analyzing gender differentials and their consequences in times of the COVID-19 crisis.

THIS RESEARCH TOPIC

This Research Topic encompasses 10 articles that apply data from survey studies and online experiments to answer their research questions on gender differentials in the COVID-19 pandemic. The content ranges from contributions that analyze gender differences in the perception of remote teaching (Korlat et al.), in the perception of risk and the stability of risk preferences (Alsharawy et al.; Zhang and Palma), in partisanship (Antinyan et al.), up to psychological aspects, such as symptoms of depression (Abreu et al.), and stress of expectant and postpartum parents (Tavares et al.). Further studies analyze the impacts of lockdowns on family life (Biroli et al.), and on potentially addictive behaviors (Attanasi et al.), as well as gender and wealth differences with respect to the allocation of scarce medical resources (Michailidou). Finally, Morgan et al. present a literature review on the different ways how all genders are affected by COVID-19.

Findings reveal that Austrian school girls report a higher perceived teacher support than boys (Korlat et al.). Regarding the perception of risk during the pandemic, Alsharawy et al. find in a US data set that women report greater fear and more negative expectations on health-related consequences of COVID-19 than men, while Zhang and Palma find in an MTurk study that general risk preferences of women and men and their difference seem to be stable during the COVID-19 crisis. Antinyan et al. show in their US survey experiment that exposing subjects to alternative narratives on the causes of the pandemic increases the partisanship gender gap, since women become more liberal. Several papers report gender differences in the effects of countermeasures against the pandemic, and specifically lockdowns: Abreu et al. present evidence of German cross sectional data ("Live with Corona" survey), which suggests that COVID-19 and its countermeasures are associated with a stronger increase in aggression for men than for women. Tavares et al. find in a Portuguese online survey with expectant parents that men under lockdowns report higher levels of stress than those who were not exposed to lockdowns. Women reported higher levels of depression and more social support. Biroli et al. demonstrate in a survey study in Italy, UK, and the US that lockdowns also affected family life. They report that men took an increasing share of childcare, and especially grocery shopping. Women overall do more, and families with increased reallocation report greater tensions. Attanasi et al. show in a

survey conducted in France that lockdowns may also affect gender-related potentially addictive behaviors. That is, women were more likely than men to report losing control of their usual diet and having increased smartphone usage, while no significant gender difference was detected for increased video game play. Furthermore, Michailidou focuses on differential treatment of men and women with respect to the (hypothetical) allocation of scarce medical resources among COVID-19 patients. In an online choice experiment with US participants, she finds that female and less healthy "patients" are treated preferentially, while people make no difference between more or less wealthy patients. Finally, in a review paper, Morgan et al. summarize how people of different genders are differentially affected by COVID-19 and why this is the case. The authors show that—while it is important to understand the different ways the groups are affected, discussing which group is most affected makes no sense.

SUMMARY AND FUTURE DIRECTIONS

This Research Topic highlights the importance of a focus on gender when analyzing the outcomes of the COVID-19 pandemic. On the one hand, it turns out that in line with gender differences in economic preferences and personality traits, women and men perceive the crisis differently. This may affect their behavior in times of the crisis in a heterogeneous way in many domains (e.g., educational sector, labor market, households) that were subject to significant changes during the pandemic. On the other hand, the COVID-19 crisis has a different impact on women and men, which follows from their different situation in the labor market and the family. In this respect, the Research Topic demonstrates that gender differences—also beyond the male-female dichotomy—in the perception and impact of the crisis are ubiquitous. Norms and societal limitations affect these gender differences and their perception and effects. A better understanding of these mechanisms may help to tailor policies and information campaigns that address compliance, educational problems, political polarization, and well-being in lockdowns and beyond.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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REFERENCES

- Albanesi, S., and Kim, J. (2021). Effects of the covid-19 recession on the us labor market: occupation, family, and gender. *J. Econ. Perspect.* 35, 3–24. doi: 10.1257/jep.35.3.3
- Bierwaczek, K., Kunst, J. R., and Pich, O. (2020). Belief in COVID-19 conspiracy theories reduces social distancing over time. *Appl. Psychol.* 12, 1270–1285. doi: 10.1111/aphw.12223
- Branas-Garza, P., Capraro, V., and Rascon-Ramirez, E. (2018). Gender differences in altruism on mechanical turk: expectations and actual behaviour. *Econ. Lett.* 170:19–23. doi: 10.1016/j.econlet.2018.05.022
- Campos-Mercade, P., Meier, A. N., Schneider, F. H., and Wengström, E. (2021). Prosociality predicts health behaviors during the COVID-19 pandemic. *J. Public Econ.* 195, 104367. doi: 10.1016/j.jpubeco.2021.104367
- Capraro, V., and Barcelo, H. (2020). The effect of messaging and gender on intentions to wear a face covering to slow down COVID-19 transmission. *arXiv[Preprint].arXiv:2005.05467*. doi: 10.31234/osf.io/tg7vz
- Charness, G., and Gneezy, U. (2012). Strong evidence for gender differences in risk taking. *J. Econ. Behav. Organ.* 83, 50–58. doi: 10.1016/j.jebo.2011.06.007
- Croson, R., and Gneezy, U. (2009). Gender differences in preferences. *J. Econ. Lit.* 47, 448–474. doi: 10.1257/jel.47.2.448
- Eckel, C. C., and Grossman, P. J. (1998). Are women less selfish than men?: evidence from dictator experiments. *Econ. J.* 108, 726–735. doi: 10.1111/1468-0297.00311
- Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., and Foucault, M. (2020). Gender differences in COVID-19 attitudes and behavior: panel evidence from eight countries. *Proc. Natl. Acad. Sci. U.S.A.* 117, 27285–27291. doi: 10.1073/pnas.2012520117
- Hart, P. S., Chinn, S., and Soroka, S. (2020). Politicization and polarization in COVID-19 news coverage. *Sci. Commun.* 42, 679–697. doi: 10.1177/1075547020950735
- Kerr, J., Panagopoulos, C., and van der Linden, S. (2021). Political polarization on COVID-19 pandemic response in the united states. *Pers. Individ. Dif.* 179, 110892. doi: 10.1016/j.paid.2021.110892
- Keser, C., and Rau, H. A. (2022). “Policy incentives and determinants of citizens’ COVID-19 vaccination motives,” in *University of Göttingen Working Paper in Economics*, No. 434.
- Mesch, D. J., Brown, M. S., Moore, Z. I., and Hayat, A. D. (2011). Gender differences in charitable giving. *Int. J. Nonprofit Volunt. Sector Market.* 16, 342–355. doi: 10.1002/nvsm.432
- Meyers-Levy, J., and Loken, B. (2015). Revisiting gender differences: what we know and what lies ahead. *J. Consum. Psychol.* 25, 129–149. doi: 10.1016/j.jcps.2014.06.003
- Müller, S., and Rau, H. A. (2021). Economic preferences and compliance in the social stress test of the COVID-19 crisis. *J. Public Econ.* 194, 104322. doi: 10.1016/j.jpubeco.2020.104322
- Niederle, M., and Vesterlund, L. (2007). Do women shy away from competition? do men compete too much? *Q. J. Econ.* 122, 1067–1101. doi: 10.1162/qjec.122.3.1067
- Pummerer, L., Böhm, R., Lilleholt, L., Winter, K., Zettler, I., and Sassenberg, K. (2022). Conspiracy theories and their societal effects during the COVID-19 pandemic. *Soc. Psychol. Pers. Sci.* 13, 49–59. doi: 10.1177/19485506211000217

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Gender Differences in Digital Learning During COVID-19: Competence Beliefs, Intrinsic Value, Learning Engagement, and Perceived Teacher Support

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The spread of the COVID-19 pandemic quickly necessitated digital learning, which bore challenges for all pupils but especially for groups disadvantaged in a virtual classroom. As some studies indicate persistent differences between boys and girls in use of technologies and related skills, the aim of this study was to investigate gender differences in the digital learning environment students faced in spring 2020. Previous studies investigating gender differences in digital learning largely used biological sex as the only indicator of gender. This study includes both biological sex and gender role self-concept in order to investigate the role of gender in different components of this stereotyped domain in a more differentiated way. A total of 19,190 Austrian secondary school students (61.9% girls, $M_{\text{age}} = 14.55$, $SD_{\text{age}} = 2.49$, age range 10–21) participated in an online study in April 2020 and answered questions regarding their competence beliefs, intrinsic value, engagement, and perceived teacher support in digital learning during the pandemic-induced school closures. Results showed higher perceived teacher support, intrinsic value, and learning engagement among girls than boys, while no significant sex differences were found in competence beliefs regarding digital learning. Furthermore, our results indicated clear benefits of an androgynous gender role self-concept for all studied components of digital learning. Implications of the findings for theory and practice are discussed.

Keywords: gender differences, gender role self-concept, digital learning, COVID-19, adolescents

INTRODUCTION

Due to the spread of COVID-19, countries worldwide implemented unprecedented measures in various sectors of society to contain the pandemic (OECD, 2020). This situation affected the education sector as well, causing the largest disruption of education systems in history (UN, 2020). As of March 2020, a majority of countries had announced temporary school closures, preventing around 1.6 billion children and young people from physically attending school (UNICEF, 2020). As a response, most schools switched to digital learning, creating a unique situation for all actors in the education field (UN, 2020). While various European Union bodies and international

organizations had long called for technology adoption in education systems (OECD, 2001; European Commission, 2018), most European school systems had continued to employ face-to-face teaching as their main *modus operandi* before COVID-19 (Wahlmüller-Schiller, 2017; Schrenk, 2020). The urgent imperative to move online following the outbreak of the virus forced digital learning upon unprepared school systems (Hodges et al., 2020), putting at risk all pupils but especially groups that might be particularly disadvantaged in the virtual classroom. UNESCO and scholars have called for recognizing the gender dimension of school closures due to COVID-19, especially in light of the gender digital gap (IIEP-UNESCO, 2020; Nefesh-Clarke et al., 2020). As there are studies indicating that gender differences persist in use of technologies and related skills (Kayany and Yelsma, 2000; Colley and Comber, 2003; Li and Kirkup, 2007; Drabowicz, 2014), it is critical to investigate gender differences in important components of digital learning—a stereotyped domain that became a necessity in schoolchildren lives during COVID pandemic.

Gender Differences in Stereotyped Domains

In line with gender stereotypes associating technical and math-intensive fields with masculine qualities (Charles and Bradley, 2009), computers and technology use have been perceived as masculine and therefore more suitable for boys than girls (Cooper, 2006; Adamus et al., 2009). The “digital gender gap” begins in early childhood, as parents and teachers act in accordance with the perception that computers are a male domain (Young, 2000). From earliest infancy, boys’ activities and toys tend to relate to technology and action, whereas girls’ activities and toys relate to nurturance and beauty (Blakemore and Centers, 2005; Kollmayer et al., 2018). Similarly, it has been shown that parents provide boys with more opportunities to do computing and sports, whereas girls are enabled more to read and to interact socially with their peers (Eccles et al., 1993). Hence, these gendered experiences can undermine girls’ confidence in their abilities and interest in computing-related subjects (Eccles, 2009). Accordingly, by the time of adolescence, boys report higher frequency of computer use and greater self-confidence in dealing with computers (Colley and Comber, 2003; Mucherah, 2003), display greater digital skills (Kayany and Yelsma, 2000; Li and Kirkup, 2007), and in general are more attracted to computers than girls (Mumtaz, 2001; Volman and van Eck, 2001; Colley and Comber, 2003). Similarly, it has been found that boys describe themselves in relation to computers (e.g., “computer freak” or “I like computers”) significantly more often than girls (Korlat et al., 2021). Newer studies support the finding that computer use for both education and entertainment purposes is more frequent among boys (Drabowicz, 2014). Girls, on the other hand, seem to use computers and the internet more for communication and social networking (McSporran and Young, 2001). As boys’ and girls’ motivational beliefs and behaviors are shaped by their experiences and are a result of gendered socialization processes (Eccles, 1994; Meece et al., 2006), the gender digital gap corresponds to societal gender stereotypes

that portray boys as autonomous, independent, and good at technology-related domains and girls as gentle, sociable, and good at nurturing domains. Not only can this influence girls’ use of computers but it may also have far-reaching consequences for girls’ education and career selection (Van Grootel et al., 2018), thus contributing to the “leaky pipeline” in science, technology, engineering, and mathematics (STEM) as well as the continued gendered division of labor (Wood and Eagly, 2012).

Eccles-Parsons et al. (1983) developed a model to explain gender differences in adolescents’ achievement choices and lower proportion of girls and women in advanced high school math courses or math and science careers (Wigfield and Eccles, 2020). According to their *expectancy-value model* (Eccles-Parsons et al., 1983; Wigfield and Eccles, 2000), students are more likely to engage in academic activities within the range of their perceived ability to successfully perform them (competence beliefs) and which they consider valuable in terms of the enjoyment they will get from the task (subjective task value). Previous studies found both competence beliefs and values as important predictors for engagement and achievement in gender-stereotyped STEM subjects (Chow et al., 2012; Watt et al., 2012). However, there is evidence of gender differences in both ability-related and subjective task value-related beliefs in stereotyped domains (Eccles, 2009). For instance, girls reported lower competence beliefs in sports but higher competence beliefs in language arts compared to boys (Jacobs et al., 2002; Lupart et al., 2004). Similarly, some studies showed lower competence beliefs in mathematics for girls compared to boys (e.g., Lupart et al., 2004; Herbert and Stipek, 2005). In the similar vein, girls reported liking math and physics less than boys and rated math as less useful than boys (Eccles and Harold, 1991; Eccles, 2011). Persistent differences favoring boys has been found also for engagement in STEM fields (e.g., Moss-Racusin et al., 2018). To explain these sex differences in stereotyped domains, Eccles-Parsons et al. (1983) theorized that men and women acquire different patterns of competence beliefs and values, and consequently different levels of engagement across various activities, which are aligned with their gender role due to divergent gender-role socialization. In a longitudinal study of adolescent life transitions, they found that girls placed more value than boys on the importance of making occupational sacrifices for one’s family, whereas boys placed more value on seeking out challenging tasks and doing work that involves the use of math and computers (Eccles, 2007). The authors argued that, when investigating precursors of competence beliefs and values, focus should not be merely on sex differences but on gender roles and level of fitness of the task with one’s gender role self-concept developed through the socialization process (see Eccles, 2009).

The Role of Gender in Digital Learning

As girls seem to face specific barriers and difficulties in their experiences with computers and information and communication technologies (ICT) in general, concerns about equity in digital learning have been raised (Yates, 2001; Price, 2006). Specifically, it has been suggested that boys may have an advantage over girls in the online classroom solely based on their higher perceived ability, comfort, and engagement

with computers (Ashong and Commander, 2012). However, the results of studies investigating sex differences in this context are heterogeneous. While boys have a clear advantage over girls in confidence in their ICT abilities (Mumtaz, 2001; Durnell and Haag, 2002; Broos, 2005; Broos and Roe, 2006; Meelissen and Drent, 2007)—and this pattern seems to be quite consistent from elementary school to university (see Vekiri and Chronaki, 2008, for a review)—a more recent meta-analysis with university students revealed higher competence beliefs regarding learning in digital setting in young women compared to young men (Perkowski, 2013). This might be due to higher academic competence beliefs in girls and women (Britner and Pajares, 2001) that annuls the negative stereotyped effects in this digital context. When it comes to values toward ICT and digital learning, some research has shown that girls tend to have less positive beliefs about the value of ICT and about their own ICT skills compared to boys (Volman and van Eck, 2001), have less positive perceptions of digital learning (Ong and Lai, 2006), and have lower satisfaction with digital learning than male students (Lu and Chiou, 2010). On the other hand, there are studies suggesting that there are no differences between boys and girls in attitudes toward digital learning (Cuadrado-García et al., 2010; Hung et al., 2010) or in average ICT participation and motivation (Cuadrado-García et al., 2010). Other studies indicate advantages for girls when it comes to learning motivation in digital contexts (e.g., McSporran and Young, 2001; Price, 2006). In general, some authors argue that sex differences in digital competence, attitudes, and motivation are becoming less prevalent, indicating a narrowing of the gender digital gap (e.g., Vekiri, 2013).

However, as ICT is perceived as a stereotypically masculine field, it seems plausible that gender differences in digital learning map onto students' gender role self-concepts rather than their biological sex. The recognition that individuals can describe themselves in terms of both stereotypically feminine and stereotypically masculine attributes regardless of their biological sex has led to an increased focus on gender role self-concept and its relationship with gendered domains (e.g., Athenstaedt, 2002; Kessels and Steinmayr, 2013; Wolter and Hannover, 2016). Previous studies have shown that adolescents who describe themselves using masculine qualities (e.g., independent, competitive, and brave) have higher perceived mathematics-related competence (Wolter and Hannover, 2016) and performance (Signorella and Jamison, 1986), whereas adolescents who describe themselves with feminine traits (e.g., gentle, kind, and sensitive) have better reading performance and motivation in reading—a stereotypically feminine domain (McGeown et al., 2012; Wolter and Hannover, 2016). Furthermore, it has been found that individuals high on both masculinity and femininity—androgynous individuals—are more flexible and adaptable to different situations, as they possess a broader repertoire of traits and behaviors (e.g., Bem, 1981; Pauletti et al., 2017). Conversely, individuals scoring low on both dimensions—undifferentiated individuals—exhibit the lowest levels of adaptability and functioning (Markstrom-Adams, 1989; Pauletti et al., 2017). Despite the significant role of gender role self-concept for adolescents' competence and value-related beliefs and engagement regarding gendered domains, studies

investigating gender differences in digital learning have so far concentrated on biological sex only, neglecting the role of gender role self-concept. Moreover, all previous studies on sex differences in digital learning were conducted pre-pandemic when pupils were not necessarily continuously exposed to it, especially not in the mandatory and exclusive form of learning as they are during the pandemic lockdowns. Therefore, the goal of this study was to include both biological sex and gender role self-concept in order to investigate gender differences in digital learning context during pandemic-induced school closures.

Perceived Support

Except for personal characteristics such as one's gender identity, learning achievement is influenced by a broad array of social factors, which include socializers' (especially parents' and teachers') beliefs and behaviors (Eccles, 2009). Although parental beliefs are significant predictors of youths' motivational beliefs and behavior (Eccles et al., 1993; Simpkins et al., 2012), studies have indicated that support from teachers most accurately predicts school-related variables (Ryan et al., 1994; Demaray et al., 2005). Indeed, it has been shown that teachers' support is positively related to competence beliefs regarding academic skills (Patrick et al., 2007), intrinsic motivation (Ryan et al., 1994), and achievement. Some studies report higher levels of perceived teacher affective support among girls (e.g., Reddy et al., 2003), whereas other studies indicate that boys and girls perceive similar levels of teacher support (Malecki and Demaray, 2003; De Wit et al., 2010). Teachers' ability expectations are influenced by their domain-specific gender stereotypes (Chalabaev et al., 2009), which can influence boys' and girls' competence beliefs about ICT through differences in communication patterns or pedagogical practices (Crombie et al., 2002). However, research investigating teacher support for boys' and girls' digital learning are scarce. Vekiri (2010), for instance, found no differences between boys and girls in perceived teacher expectations and support but a stronger association between teacher support and girls' competence beliefs. Nevertheless, perceived teacher support is even more important in digital learning setting, particularly in a situation such as the COVID-19 pandemic, in which students' motivation may begin to degrade if they lack the motivational regulation needed to succeed in this learning setting (Fryer and Bovee, 2016).

Present Study

The primary goal of the current study is to test gender differences within the expectancy-value model (Eccles-Parsons et al., 1983; Eccles, 2005) in components of digital learning relevant for learning process during pandemic-induced school closures. As the model posits different patterns of competence and value-related beliefs and engagement across various activities associated with gender roles in boys and girls (Eccles, 2009), this study encompasses both biological sex as well as gender role self-concept in investigating gender differences in digital learning during COVID-19 pandemic. Although Eccles and colleagues have suggested gender roles as a factor influencing attainment value as an aspect of subjective task value that is most related to broader identity issues (cf., Eccles, 2009), a recent

study showed that components of students' task values (intrinsic, attainment, and utility values) relate to one another, with the correlations being quite high, in the context of stereotyped STEM classes (Perez et al., 2019). Moreover, in stereotypical domains such as math and reading, the relations of intrinsic value to their competence belief were stronger than the relations of a combined usefulness–importance variable to competence beliefs among children (Wigfield and Eccles, 2020). Therefore, in this study, we focus on gender differences in intrinsic value in digital learning context. Moreover, Eccles-Parsons et al. (1983) posited that individuals' competence value-related beliefs are the most proximal psychological determinants of engagement in the chosen activities. Specifically, when children place high intrinsic value on an activity, they often become deeply engaged in it and can persist at it for a long time (Eccles, 2005). As concentrating and staying focused on a learning activity in digital learning setting during COVID might be particularly challenging due to the lack of the motivational regulation in digital learning setting (Fryer and Bovee, 2016), especially for groups that might be at risk in virtual classroom, we decided to test gender differences in this component of digital learning as well. In addition, perceived teacher support is included as a contextual factor important for learning.

The first research objective focuses on differences between boys and girls in these four components of digital learning—competence beliefs, intrinsic value, learning engagement, and perceived teacher support—while the second research objective addresses differences between adolescents with different gender role self-concept—masculine, feminine, androgynous, and undifferentiated—in those components of digital learning during pandemic-induced school closures. Interaction between two gender dimensions is also tested.

In line with studies that found clear dominance of boys over girls when it comes to competence beliefs in this domain among high school students and adolescents (Mumtaz, 2001; Broos and Roe, 2006; Meelissen and Drent, 2007), we expect higher competence beliefs among boys compared to girls. Regarding the intrinsic value of digital learning, there was no directed hypothesis posed due to inconsistent results yielded from previous studies on sex differences in values toward ICT and digital learning (e.g., Ong and Lai, 2006; Price, 2006; Cuadrado-García et al., 2010; Lu and Chiou, 2010). Based on studies reporting higher engagement with computers in education purposes in boys (e.g., Drabowicz, 2014), we expect higher learning engagement in boys compared to girls in digital learning setting during COVID. As ICTs are still a gender-stereotyped domain and perceived as a masculine field, we expect students who ascribe masculine characteristics to themselves to a high degree (masculine and androgynous individuals) to show the highest levels of both competence and intrinsic value beliefs as well as engagement within the digital learning context.

Regarding the perceived teacher support, aligning with the previous study on perceived teacher support (Vekiri, 2012), we expect insignificant differences between boys and girls in perceived teacher support during pandemic-induced digital learning. However, as the orientation toward social support and social relationships is a stereotypically feminine quality,

we expected the highest levels of perceived teacher support in feminine and androgynous students. For undifferentiated adolescents, the lowest levels of competence beliefs, perceived values, engagement, and perceived teacher support during digital learning are expected compared to the other three types. As competence and value-related beliefs show a decline through school years (Jacobs et al., 2002; Cimpian, 2017), as well as learning engagement (Fredricks et al., 2004) and perception of social support (Ryan et al., 1994), we controlled for age in all analyses.

METHOD

Participants, Procedure, and Context of Data Collection

The data was collected in April 2020 in Vienna, Austria, as part of a larger project investigating learning under the conditions of the COVID-19. For the purposes of this study, a subsample consisting of boys and girls only was selected, excluding 0.6% of students that declared their gender as diversified. In total, the selected study sample comprised 19,190 secondary school students (61.9% girls, $M_{\text{age}} = 14.55$, $SD_{\text{age}} = 2.49$, age range 10–21) from all types of Austrian secondary schools (general secondary school, technical and vocational secondary schools, and apprenticeship). Data was collected with online questionnaires. To recruit participants, we distributed the link to the online questionnaire by contacting manifold stakeholders such as school boards, educational networks, and school principals with the help of the Austrian Federal Ministry for Education, Science, and Research. Participation was voluntarily and anonymous. Only students who gave active consent were included in the dataset. In Austria, schools stopped providing onsite learning on March 16. Throughout the entire data collection period, schools were obliged to ensure that education continued in the form of digital learning. Teachers and schools were given autonomy in the organization and design of remote instruction. While there was no on-site teaching, schools remained open to provide childcare to individual students where necessary (Federal Ministry of Education, 2020b). However, this option was taken up by ~2% of the student population only (Federal Ministry of Education, 2020a).

Measures

Due to the novelty of the COVID-19 situation, it was necessary to adapt existing scales or develop new items for scales that served as dependent variables in order to address the current circumstances. To ensure the content validity of the adapted or newly formulated items, we revised them based on expert judgments. The measures were then piloted with cognitive testing among adolescents of different ages. For details on the measures and the complete set of items, see Schober et al. (2020). All items were rated on a five-point scale ranging from 1 (strongly agree) to 5 (strongly disagree). Participants were instructed to answer the items with respect to their current digital learning activities. Analyses were conducted with recoded items so that higher values reflected higher agreement with the statements.

Competence Beliefs

To assess competence beliefs in digital learning, three newly developed items were used (sample item: “Overall, I am managing e-learning pretty well”), $\alpha = 0.711$.

Intrinsic Value

Intrinsic value was assessed with three items adapted from the Scales for the Measurement of Motivational Regulation for Learning in University Students (SMR-LS; Thomas et al., 2018; sample item: “Currently, I really enjoy studying and working for school”), $\alpha = 0.916$.

Learning Engagement

Learning engagement was measured with three slightly adapted items from the engagement subscale of the EPOCH Measure (Kern et al., 2016; sample item: “Currently when I am working on my schoolwork, I get completely absorbed in what I am doing”), $\alpha = 0.732$.

Perceived Teacher Support

To measure the social component of digital learning, three additional items concerning interaction with teachers were used (sample item: “Currently, my teachers help me with e-learning”), $\alpha = 0.745$.

Gender Role Self-Concept

To assess self-perceived femininity and masculinity, positive traits from the Inventory for Measuring Adolescents' Gender Role Self-Concept (GRI-JUG) were used (Krahé et al., 2007). Participants were presented with five masculine attributes (humorous, courageous, sporty, companionable, and strong; $\alpha = 0.676$) and five feminine attributes (emotional, romantic, industrious, sympathetic, and empathic; $\alpha = 0.651$) and were asked to rate to what extent each attribute is characteristic of them. Separate scores were calculated for masculinity and femininity. The median split procedure adopted by Spence et al. (1975) and Bem (1977) was used to determine the four types of gender role self-concepts. Participants were classified into a 2×2 table according to whether they fell above or below the median score on the masculinity and femininity scales. Scores falling exactly on the median were classified as “high” scores (Carver

et al., 2013). In the present sample, the median masculinity score was 4.2 and the median femininity score was 4.0.

RESULTS

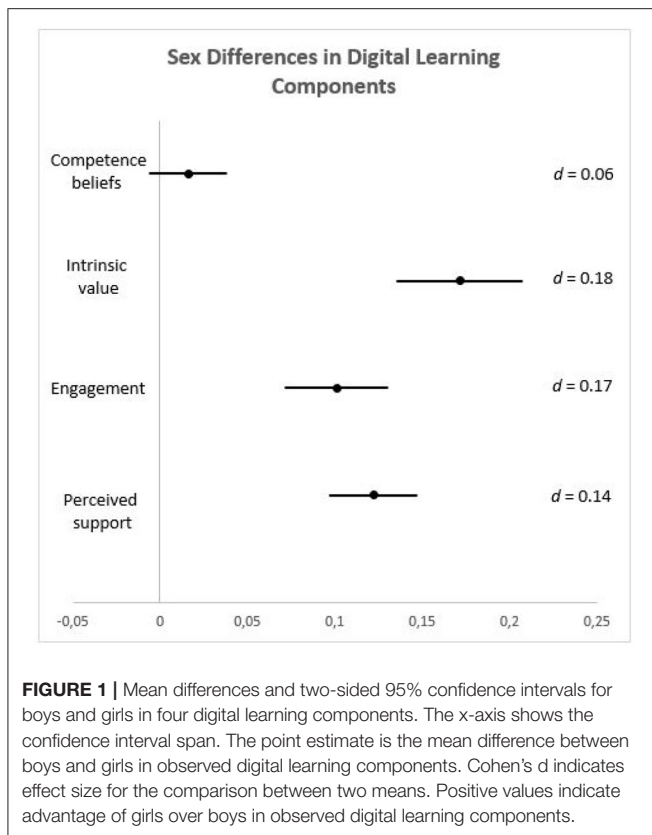
In order to examine differences in digital learning components among adolescents, four separate analyses of covariance (ANCOVAs) were conducted with sex (male/female) and gender role self-concept (androgynous/masculine/feminine/undifferentiated) as between-subject factors and age as a covariate. The mean scores for digital learning competence beliefs, intrinsic value, engagement, and perceived support in digital learning served as the dependent variables. Higher values reflect higher scores on these observed digital learning components. When interpreting the results, we focused on the effect sizes of the group differences alongside statistical significance, following Cohen's (1988) recommendations, with values around 0.10 representing small effects, values around 0.30 representing medium effects, and values > 0.50 representing large effects. Means and standard deviations for all dependent variables by sex and gender role self-concept are presented in **Table 1**. Effect sizes and confidence intervals for main effects of gender dimensions on four digital learning components are presented in **Figure 1** (biological sex) and **Figure 2** (gender role self-concept).

Competence Beliefs in Digital Learning

The results showed a statistically significant effect of age, $F_{(1,19157)} = 67.75$, $p = 0.000$, $\eta^2_p = 0.004$, indicating a negative relationship between age and competence beliefs in digital learning, $r_{(19,181)} = -0.063$, $p = 0.000$. The main effect of sex was not significant, $F_{(1,19157)} = 2.06$, $p = 0.151$, $\eta^2_p = 0.000$. There was a statistically significant main effect of gender role self-concept after controlling for adolescents' age, $F_{(3,19157)} = 147.07$, $p = 0.000$, $\eta^2_p = 0.023$. A Bonferroni *post hoc* test showed that androgynous adolescents reported significantly higher competence beliefs in digital learning than masculine, feminine, and undifferentiated adolescents. Feminine adolescents exhibited a slightly higher level of competence beliefs in digital learning compared to masculine adolescents. Undifferentiated adolescents had statistically significantly lower levels of competence beliefs

TABLE 1 | Means and standard deviations of digital learning components by gender role self-concept and sex.

Gender role self-concept	Sex	Competence beliefs			Intrinsic value		Learning engagement		Perceived teacher support	
		N	M	SD	M	SD	M	SD	M	SD
Androgynous	Boys	2,175	4.22	0.751	2.95	1.184	3.40	0.945	4.20	0.841
	Girls	3,878	4.29	0.648	3.21	1.149	3.53	0.890	4.32	0.734
Masculine	Boys	2,089	4.11	0.713	2.59	1.074	3.06	0.920	4.06	0.843
	Girls	1,486	4.10	0.697	2.84	1.153	3.20	0.919	4.15	0.797
Feminine	Boys	825	4.13	0.706	2.88	1.129	3.27	0.960	4.04	0.835
	Girls	3,771	4.12	0.661	2.88	1.133	3.31	0.885	4.12	0.765
Undifferentiated	Boys	2,217	3.98	0.724	2.52	1.074	2.95	0.908	3.92	0.850
	Girls	2,733	3.96	0.704	2.61	1.109	3.05	0.906	4.01	0.788



in digital learning than adolescents with other gender role self-concepts. The interaction between gender role self-concept and sex was statistically significant, $F_{(3,19157)} = 5.60$, $p = 0.001$, $\eta^2_p = 0.001$, indicating higher levels of competence beliefs in digital learning among androgynous girls compared to androgynous boys and all other groups. Feminine boys and girls, masculine boys and girls, and undifferentiated boys and girls achieved similar scores.

Intrinsic Value

The results showed a statistically significant effect of age, $F_{(1,19157)} = 209.64$, $p = 0.000$, $\eta^2_p = 0.011$, indicating a negative relationship between age and intrinsic value, $r_{(19,179)} = -0.094$, $p = 0.000$. The main effect of sex was statistically significant after controlling for adolescents' age, $F_{(1,19157)} = 89.50$, $p = 0.000$, $\eta^2_p = 0.005$, with girls reporting higher intrinsic value of digital learning compared to boys. There was also a statistically significant main effect of gender role self-concept after controlling for adolescents' age, $F_{(3,19157)} = 194.91$, $p = 0.000$, $\eta^2_p = 0.030$. A Bonferroni *post hoc* test showed that androgynous adolescents reported significantly higher intrinsic value than masculine, feminine, and undifferentiated adolescents. Feminine adolescents showed higher levels of intrinsic value compared to masculine adolescents. Undifferentiated adolescents had statistically significantly lower intrinsic value than adolescents with other gender role self-concepts. The interaction between gender role self-concept and sex was also statistically significant,

$F_{(3,19157)} = 12.04$, $p = 0.000$, $\eta^2_p = 0.002$, indicating higher levels of intrinsic value in androgynous girls compared to androgynous boys and all other groups, as well as in masculine girls compared to masculine boys. Feminine girls and boys achieved similar results, as did undifferentiated boys and girls.

Learning Engagement

The results showed a statistically non-significant effect of age, $F_{(1,19157)} = 0.46$, $p = 0.500$, $\eta^2_p = 0.000$. The main effect of sex was statistically significant, $F_{(1,19157)} = 47.21$, $p = 0.000$, $\eta^2_p = 0.002$, with girls scoring higher on learning engagement compared to boys. The main effect of gender role self-concept after controlling for adolescents' age was also statistically significant, $F_{(3,19157)} = 247.44$, $p = 0.000$, $\eta^2_p = 0.037$. A Bonferroni *post hoc* test showed that androgynous adolescents reported statistically significantly higher levels of learning engagement than masculine, feminine, and undifferentiated adolescents. Feminine adolescents showed a higher level of learning engagement compared to masculine adolescents. Undifferentiated adolescents had lower levels of learning engagement than adolescents with other gender role self-concepts. The interaction between gender role self-concept and sex was not statistically significant, $F_{(3,19157)} = 1.72$, $p = 0.161$, $\eta^2_p = 0.000$.

Perceived Teacher Support in Digital Learning

The results showed a statistically significant effect of age, $F_{(1,19157)} = 602.61$, $p = 0.000$, $\eta^2_p = 0.030$, indicating a negative relationship between age and perceived teacher support in digital learning, $r_{(19,181)} = -0.170$, $p = 0.000$. The main effect of sex was also statistically significant after controlling for adolescents' age, $F_{(1,19157)} = 92.47$, $p = 0.000$, $\eta^2_p = 0.005$, with girls reporting higher perceived teacher support in digital learning compared to boys. There was also a statistically significant main effect of gender role self-concept after controlling for adolescents' age, $F_{(3,19157)} = 110.70$, $p = 0.000$, $\eta^2_p = 0.017$. A Bonferroni *post hoc* test showed that androgynous adolescents reported statistically significantly higher levels of perceived teacher support in digital learning than masculine, feminine, and undifferentiated adolescents. Feminine adolescents reported higher perceived teacher support in digital learning compared to masculine adolescents. Undifferentiated adolescents reported statistically significantly lower perceived teacher support in digital learning than adolescents with other gender role self-concepts. The interaction between gender role self-concept and sex was not statistically significant, $F_{(3,19157)} = 0.76$, $p = 0.515$.

DISCUSSION

The main goal of this study was to investigate the gender differences in a digital learning context during a period of pandemic-induced school closures, including both biological sex and gender role self-concept in tackling the differences in this stereotyped domain. The study encompassed four components of digital learning identified as not only important for learning success but also susceptible for stereotyped gender gap:

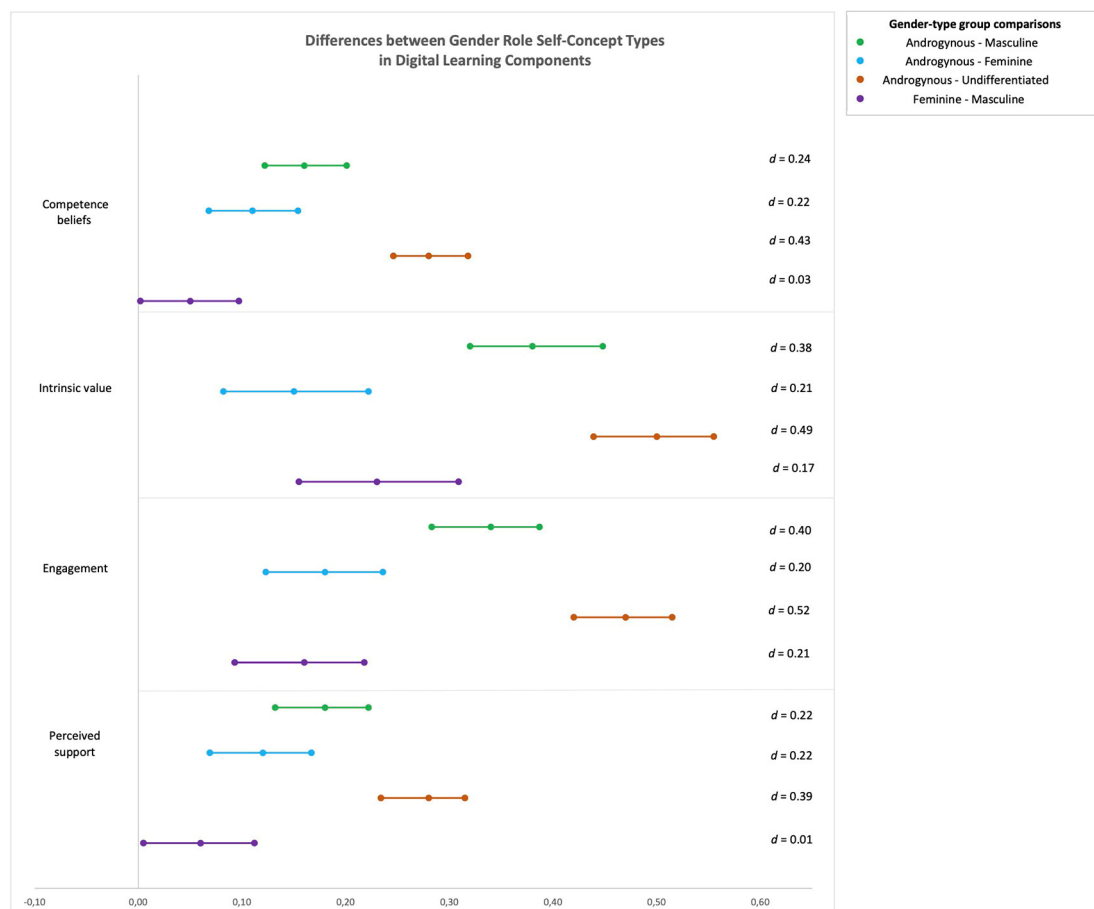


FIGURE 2 | Mean differences and two-sided 95% confidence intervals for the gender role self-concept group comparisons in four digital learning components. The x-axis shows the confidence interval span. The point estimate is the mean difference between gender role self-concept types (gender-type groups) in observed digital learning components. Cohen's d indicates effect size for the comparison between two means. Positive values indicate advantage of androgynous over masculine, feminine, and undifferentiated adolescents in observed digital learning components, and advantage of feminine over masculine adolescents in observed digital learning components.

competence beliefs, intrinsic value, engagement, and perceived teacher support. The first objective of the study focused on sex differences in the examined components of digital learning.

Our results showed no differences between boys and girls in competence beliefs in digital learning, indicating that girls and boys had equal levels of perceived abilities in digital learning. Although previous studies have revealed higher levels of competence beliefs related to computers and technologies in general among adolescent boys (see Vekiri and Chronaki, 2008), our results showed equality between boys and girls with respect to managing digital learning, using technologies and technical equipment to complete their school tasks and comprehension of tasks performed in a digital learning format. This finding is inconsistent with our assumption, but it can be explained with girls' general higher academic competence beliefs in adolescence (Britner and Pajares, 2001), which potentially translated into digital learning setting leveling thus the sex differences in this context. On the other hand, while studies have continuously showed higher engagement with computers in general among

boys (Colley and Comber, 2003; Drabowicz, 2014), girls exhibited higher digital learning engagement in our study. This is not surprising given girls' higher levels of engagement in school-related tasks in general (Lam et al., 2012). It has been shown that even though boys are perceived as more skilled than girls (Bian et al., 2017), girls are more engaged with learning activities and more study oriented (Van Houtte, 2004). Thus, it might be that girls transferred their established learning practices into new learning context when schools switched to digital learning. This seems especially plausible given the unpreparedness of schools and teachers for this new teaching context (Hodges et al., 2020), which could have caused them to apply usual didactic techniques from face-to-face teaching, without fully adapting to the digital context. Thus, stereotypical aspects of digital context potentially were not pronounced enough to threaten girls' engagement. In differently organized digital learning setting where typically masculine technical skills would be more required, results might show stereotypical results of boys' dominance in engagement with technology even in a learning context.

Our results showed the same non-stereotypical pattern for intrinsic value of digital learning, which corresponds to the results of some previous studies finding higher intrinsic motivation in digital learning contexts among girls (e.g., McSparran and Young, 2001; Price, 2006). Various studies have shown that boys are less motivated than girls and have less positive attitudes toward school in general (Cox, 2000; Francis, 2000), which potentially overflowed into digital learning context during this pandemic. This is especially plausible given that data was collected soon after schools in Austria switched to online learning. Results might be different now after a year of digital learning practice when both boys and girls are more habituated to it.

Regarding the contextual factor in learning, our results have shown higher perceived teacher support among girls than among boys. While previous studies on ICT did not find differences between boys and girls in perceived teacher expectations and support (Vekiri, 2010), this finding is not surprising given the stronger orientation toward social relationships and social support in the feminine gender role associated with girls compared to the masculine gender role associated with boys in Western societies (Helgeson, 1994; Korlat et al., 2021). In line with gender stereotypes, previous studies showed that girls rely more upon social support, especially in difficult or stressful situations (Helsen et al., 2000; Tamres et al., 2002), which might have been the case for digital learning during COVID-19. In addition, it has been shown that girls value student-teacher interaction more than boys do (e.g., Frymier and Houser, 2000). Thus, girls might be more proactive than boys in reaching out to teachers, thus establishing better relationships with them. On the other hand, teachers might provide more support to girls due to stereotypes about ICT and girls' potential disadvantages in the virtual classroom. Learning heavily relies on interactions between students and teachers (Taylor et al., 2007), so the potentially lower social support perceived by boys could affect their learning processes, particularly in light of the fact that the digital context in pandemic-induced learning might require more active interaction with the teacher than in-person instruction.

Taken together, our results challenge the notion of girls' potential disadvantages in the virtual classroom and reveal their relatively higher levels of perceived social support from teachers, intrinsic value, and engagement for digital learning. This calls attention to the challenges boys might face in the digital learning context, which could potentially intensify boys' existing underperformance in terms of overall academic achievement (Duckworth and Seligman, 2006; Hartley and Sutton, 2013). It is important to note that the effect sizes of the sex differences found in our study are small (Cohen's d ranging from 0.14 to 0.18), supporting the gender similarity hypothesis (Hyde, 2005), according to which gender differences on most psychological variables are small or close to zero. Nevertheless, boys' potential disadvantages regarding interaction with teachers, intrinsic value, and learning engagement during the pandemic-induced period of mandatory digital learning should not be easily discarded. Given the possibility that learning during pandemic might be organized in a way that resembles face-to-face learning—where boys lack

engagement and study-oriented culture (Van Houtte, 2004)—but in a distance form when students are forced to organize their learning autonomously without external regulation as in face-to-face learning (Huber et al., 2020), schooling during COVID could create an even higher risk for boys' academic achievement compared to pre-pandemic conditions. Moreover, boys' higher engagement with computers for entertainment purposes such as video games (Terlecki et al., 2011; Drabowicz, 2014) might have a negative influence for their self-regulated learning, posing great challenge to their focus and learning process in this context. Hence, schools and teachers should take into account all potential threats to both boys' and girls' learning process when organizing teaching in digital context during pandemic.

As ICTs are still a gender-stereotyped domain and perceived as a masculine field, it could be that gender differences in digital learning map onto students' gender role self-concept rather than their biological sex. Thus, the second objective of our study was to investigate differences between boys and girls with different gender role self-concepts in the studied components of digital learning during the pandemic-induced school closures. As expected, feminine adolescents reported higher levels of perceived social support than masculine and undifferentiated adolescents. This finding supports the notion of the compatibility between gender roles and gendered activities proposed by Eccles-Parsons et al. (1983) and Eccles (2009), as social support and social relationships represent the core of stereotypical femininity. Surprisingly, and contrary to our expectations, femininity was a contributing factor to higher levels of *stereotypically masculine* components of digital learning as well: feminine students exhibited higher levels of competence beliefs, intrinsic value, and engagement in digital learning compared to masculine and undifferentiated students. One explanation for this could be the higher relevance of femininity compared to masculinity for adolescents in the school context. Studies have found stronger school-related self-esteem and stronger feelings of belonging at school among feminine adolescents (Skinner et al., 2019). Moreover, feminine students are often more liked by teachers (Heyder and Kessels, 2013), which, alongside higher perceived teacher support, could contribute to higher intrinsic value and engagement in digital learning in girls, even in the digital context. However, the effect sizes for the differences between adolescents with feminine and masculine gender role self-concepts on all variables were small or close to zero (Cohen's d ranging from 0.01 for perceived support to 0.21 for learning engagement). Importantly, our results showed clear advantages of androgyny over both femininity and masculinity for digital learning with medium to large effect sizes, indicating the higher value of possessing both feminine and masculine characteristics than one sort only. Although Eccles (2009) assumed educational benefits in case of fitness between the stereotypicality of a task and one's gender role self-concept, this finding is not surprising given the broader repertoire of traits and behaviors (e.g., Pauletti et al., 2017) in androgynous individuals compared to others. This finding confirms better coping in different life situations related to androgyny suggested by Bem (1981), applied to altered learning setting in a pandemic era. Interestingly, it seems

that girls with androgynous characteristics have the clearest advantage over boys and girls with different gender role self-concept in competence and value-related beliefs regarding digital learning. As both ability and value beliefs are important for learning achievement (Wigfield and Eccles, 2000), androgynous girls might benefit the most from the pandemic-induced digital learning situation. Similarly, masculine girls showed higher levels of intrinsic value in the digital learning context compared to masculine boys. This is in line with the general advantage of girls over boys found in this study, however only with the small magnitude. As expected, undifferentiated adolescents achieved lower scores in all digital learning components under study, due to a lack of beneficial attributes and behaviors for coping.

In line with previous studies showing a decline in competence and value-related beliefs throughout adolescence (Jacobs et al., 2002; Cimpian, 2017), our results showed lower competence beliefs and intrinsic value for digital learning with increasing age. One reason for that might be an over-optimistic assessment in young children about their competencies in different areas and consequent high placed value (see Cimpian, 2017 for discussion). In addition, scholars argue that learning becomes more and more decontextualized and performance-oriented in adolescence, which undermines intrinsic motivation (Gnambis and Hanfstingl, 2016). At the same time, adolescence is a period where social relations and peers increase in importance (Simons-Morton and Chen, 2009; LaFontana and Cillessen, 2010), which might take adolescents' focus off learning. Accordingly, younger students were found to report higher perceived teacher support in this study. While the effect sizes are very small, it could be that teachers provide more assistance to younger students in digital learning, taking into account their lower experience with ICT and potentially longer adaptation period to this new learning setting. As the results indicate older students, along with boys, might particularly struggle with digital learning, teachers and schools should offer more support to them and pay particular attention to their management of school-related tasks in this new learning context. In addition, developing curricular activities and a virtual classroom environment that enhance both feminine and masculine traits and behaviors in both boys and girls may enhance their digital learning in the COVID-19 era.

Limitations and Future Directions

While this study has several strengths, including a large sample size, some limitations must be considered. First, even though pandemic-induced school closure provides a good opportunity to

investigate digital learning in a large sample of students, schools employed different digital platforms and teaching methods (e.g., synchronous and asynchronous) to support their teaching during the school closures. Future studies should investigate the role of gender in terms of both biological sex and gender role self-concept in digital learning settings with more uniform teaching and learning practices. Second, the data was collected online, which led to a self-selected sample. Third, future studies should include other value components (utility, importance, and cost) of the expectancy-value model, other contextual variables such as parental beliefs, and variables regarding the digital learning environment such as access to ICT. Finally, this study only takes into account positive aspects of gender role self-concept. Future studies should include both positive and negative aspects in order to more fully investigate the role of gender and stereotyped components of digital learning.

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://doi.org/10.11587/VRQL3B>.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not provided by the participants' legal guardians/next of kin because data was collected online due to circumstances of the COVID-19 and only consent from students was collected. Only students who gave active consent were included in the data set.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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REFERENCES

- Adamus, T., Kerres, M., Getto, B., and Engelhardt, N. (2009). "Gender and E-tutoring – a concept for gender sensitive E-tutor training programs," in *5th European Symposium on Gender & ICT Digital Cultures: Participation – Empowerment – Diversity* (University of Bremen: Center for Gender Studies).
- Ashong, C. Y., and Commander, N. E. (2012). Ethnicity, gender, and perceptions of online learning in higher education. *J. Online Teach. Educ.* 8:98.
- Athenstaedt, U. (2002). Gender role self-concept, gender role attitudes and the participation in gender-typed vocational and leisure sport courses. *Psychol. Beiträge* 44, 585–595.
- Bem, S. L. (1977). On the utility of alternative procedures for assessing psychological androgyny. *J. Consult. Clin. Psychol.* 45, 196–205. doi: 10.1037/0022-006X.45.2.196
- Bem, S. L. (1981). Gender schema theory: a cognitive account of sex typing. *Psychol. Rev.* 88, 354–364. doi: 10.1037/0033-295X.88.4.354
- Bian, L., Leslie, S.-J., and Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science* 355, 389–391. doi: 10.1126/science.aah6524
- Blakemore, J. E. O., and Centers, R. E. (2005). Characteristics of boys' and girls' toys. *Sex Roles* 53, 619–633. doi: 10.1007/s11199-005-7729-0

- Britner, S. L., and Pajares, F. (2001). Self-efficacy beliefs, motivation, race, and gender in middle school science. *J. Women Minor. Sci. Eng.* 7, 271–285. doi: 10.1615/JWomenMinorScienEng.v7.i4.10
- Broos, A., and Roe, K. (2006). The digital divide in the playstation generation: self-efficacy, locus of control and ICT adoption among adolescents. *Poetics* 34, 306–317. doi: 10.1016/j.poetic.2006.05.002
- Broos, A. R. (2005). Gender and information and communication technologies (ICT) anxiety: male self-assurance and female hesitation. *Cyber Psychol. Behav.* 8, 21–32. doi: 10.1089/cpb.2005.8.21
- Carver, L. F., Vafaie, A., Guerra, R., Freire, A., and Phillips, S. P. (2013). Gender differences: examination of the 12-item bem sex role inventory (BSRI-12) in an older Brazilian population. *PLoS ONE* 8:e76356. doi: 10.1371/journal.pone.0076356
- Chalabaev, A., Sarrazin, P., Trouilloud, D., and Jussim, L. (2009). Can sex-undifferentiated teacher expectations mask an influence of sex stereotypes? Alternative forms of sex bias in teacher expectations. *J. Appl. Soc. Psychol.* 39, 2469–2498. doi: 10.1111/j.1559-1816.2009.00534.x
- Charles, M., and Bradley, K. (2009). Indulging our gendered selves? sex segregation by field of study in 44 countries. *Am. J. Sociol.* 114:924–976. doi: 10.1086/595942
- Chow, A., Eccles, J. S., and Salmela-Aro, K. (2012). Task value profiles across subjects and aspirations to physical and IT-related sciences in the United States and Finland. *Dev. Psychol.* 48, 1612–1628. doi: 10.1037/a0030194
- Cimpian, A. (2017). “Early reasoning about competence is not irrationally optimistic, nor does it stem from inadequate cognitive representations,” in *Handbook of Competence and Motivation: Theory and Application*, 2nd Edn., eds A. Elliott, C. S. Dweck, and D. Yeager (New York, NY: Guilford), 387–407.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*, 2nd Edn. Hillsdale, NJ: Lawrence Erlbaum Associates Publishers.
- Colley, A., and Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed? *Educ. Res.* 45, 155–165. doi: 10.1080/0013188032000103235
- Cooper, J. (2006). The digital divide: the special case of gender. *J. Comp. Assist. Learn.* 22, 320–334. doi: 10.1111/j.1365-2729.2006.00185.x
- Cox, T. (2000). “Pupils’ perspectives on their education,” in *Combating Educational Disadvantage. Meeting the Needs of Vulnerable Children*. ed T. Cox (London: Falmer Press), 136–155.
- Crombie, G., Abarbanel, T., and Trinneer, A. (2002). All-female classes in high school computer science: positive effects in three years of data. *J. Educ. Comp. Res.* 27, 385–409. doi: 10.2190/VRD4-69AF-WPQ6-P734
- Cuadrado-García, M., Ruiz-Molina, M. E., and Montoro-Pons, J. D. (2010). Are there gender differences in e-learning use and assessment? Evidence from an interuniversity online project in Europe. *Proc. Soc. Behav. Sci.* 2, 367–371. doi: 10.1016/j.sbspro.2010.03.027
- De Wit, D., Karioja, K., and Rye, B. (2010). Student perceptions of diminished teacher and classmate support following the transition to high school: are they related to declining attendance? *School Effect. School Improve.* 21, 451–472. doi: 10.1080/09243453.2010.532010
- Demaray, M. K., Malecki, C. K., Davidson, L. M., Hodgson, K. K., and Rebus, P. J. (2005). The relationship between social support and student adjustment: a longitudinal analysis. *Psychol. Schools* 42, 691–706. doi: 10.1002/pits.20120
- Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: a comparative study of 39 countries. *Comput. Educ.* 74, 98–111. doi: 10.1016/j.compedu.2014.01.016
- Duckworth, A. L., and Seligman, M. E. P. (2006). Self-discipline gives girls the edge: gender in self-discipline, grades, and achievement test scores. *J. Educ. Psychol.* 98, 198–208. doi: 10.1037/0022-0663.98.1.198
- Durndell, A., and Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitudes towards the internet and reported experience with the internet, by gender, in an East European sample. *Comput. Human Behav.* 18, 521–535. doi: 10.1016/S0747-5632(02)00006-7
- Eccles, J. (2011). Gendered educational and occupational choices: applying the Eccles et al. model of achievement-related choices. *Int. J. Behav. Dev.* 35, 195–201. doi: 10.1177/0165025411398185
- Eccles, J. S. (1994). Understanding women’s educational and occupational choices. *Psychol. Women Q.* 18, 585–609. doi: 10.1111/j.1471-6402.1994.tb01049.x
- Eccles, J. S. (2005). “Subjective task values and the Eccles et al. model of achievement related choices,” in *Handbook of Competence and Motivation*. eds A. J. Elliot and C. S. Dweck (New York, NY: Guilford), 105–121.
- Eccles, J. S. (2007). “Where are all the women? Gender differences in participation in physical science and engineering,” in *Why Aren’t More Women in Science? Top Researchers Debate the Evidence*, eds S. J. Ceci, and W. M. Williams (Washington, DC: American Psychological Association), 199–210.
- Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educ. Psychol.* 44, 78–89. doi: 10.1080/00461520902832368
- Eccles, J. S., and Harold, R. D. (1991). Gender differences in sport involvement: applying the Eccles’ expectancy-value model. *J. Appl. Sport Psychol.* 3, 7–35. doi: 10.1080/10413209108406432
- Eccles, J. S., Wigfield, A., Harold, R., and Blumenfeld, P. B. (1993). Age and gender differences in children’s self- and task perceptions during elementary school. *Child Dev.* 64, 830–847. doi: 10.2307/1131221
- Eccles-Parsons, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., et al. (1983). “Expectancies, values, and academic behaviors,” in *Achievement and Achievement Motivation*. ed J. T. Spence (W. H. Freeman).
- European Commission (2018). *Study on Supporting School Innovation Across Europe*. Final report. Luxembourg: Publications Office. doi: 10.2766/466312
- Federal Ministry of Education (2020a). *BMBWF: Mehr als Sechsmal so Viele Kinder in Schulischer Betreuung als vor Ostern*. Retrieved from: <https://www.bmbwf.gv.at/Ministerium/Presse/20200423.html> (accessed February 24, 2021).
- Federal Ministry of Education (2020b). *Coronavirus (COVID-19)*. Retrieved from: <https://www.bmbwf.gv.at/Ministerium/Informationspflicht/corona.html> (accessed February 24, 2021).
- Francis, B. (2000). *Boys, Girls and Achievement. Addressing the Classroom Issues*. London; New York, NY: Routledge/Falmer.
- Fredricks, J. A., Blumenfeld, P. C., and Paris, A. H. (2004). School engagement: potential of the concept, state of the evidence. *Rev. Educ. Res.* 74, 59–109. doi: 10.3102/00346543074001059
- Fryer, L. K., and Bovee, H. N. (2016). Supporting students’ motivation for e-learning: teachers matter on and offline. *Internet Higher Educ.* 30, 21–29. doi: 10.1016/j.iheduc.2016.03.003
- Frymier, A. B. and Houser, M. L. (2000). The teacher student relationship as an interpersonal relationship. *Commun. Educ.* 49, 207–219. doi: 10.1080/03634520009379209
- Gnamb, T., and Hanfstring, B. (2016). The decline of academic motivation during adolescence: an accelerated longitudinal cohort analysis on the effect of psychological need satisfaction. *Educ. Psychol.* 36, 1698–1712. doi: 10.1080/01443410.2015.1113236
- Hartley, B. L., and Sutton, R. M. (2013). A stereotype threat account of boys’ academic underachievement. *Child Dev.* 84, 1716–1733. doi: 10.1111/cdev.12079
- Helgeson, V. S. (1994). Relation of agency and communion to well-being: evidence and potential explanations. *Psychol. Bull.* 116, 412–428. doi: 10.1037/0033-2909.116.3.412
- Helsen, M., Vollebergh, W., and Meeus, W. (2000). Social support from parents and friends and emotional problems in adolescence. *J. Youth Adolesc.* 29, 319–335. doi: 10.1023/A:1005147708827
- Herbert, J., and Stipek, D. (2005). The emergence of gender differences in children’s perceptions of their academic competence. *J. Appl. Dev. Psychol.* 26, 276–295. doi: 10.1016/j.appdev.2005.02.007
- Heyder, A., and Kessels, U. (2013). Is school feminine? Implicit gender stereotyping of school as a predictor of academic achievement. *Sex Roles* 69, 605–617. doi: 10.1007/s11199-013-0309-9
- Hodges, C., Moore, S., Locker, B., Trust, T., and Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educ. Rev.* Retrieved from: <https://er.educase.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning> (accessed February 24, 2021).
- Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J., et al. (2020). *COVID-19 und Aktuelle Herausforderungen in Schule und Bildung*. Münster: Waxmann. doi: 10.31244/9783830942160
- Hung, M. L., Chou, C., Chen, C. H., and Own, Z. Y. (2010). Learner readiness for online learning: scale development and student perceptions. *Comput. Educ.* 55, 1080–1090. doi: 10.1016/j.compedu.2010.05.004
- Hyde, J. S. (2005). The gender similarities hypothesis. *Am. Psychol.* 60, 581–592. doi: 10.1037/0003-066X.60.6.581

- IIEP-UNESCO (2020). *COVID-19 School Closures: Why Girls Are More at Risk*. Available online at: <http://www.iiep.unesco.org/en/covid-19-school-closures-why-girls-are-more-risk-13406> (accessed February 24, 2021).
- Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., and Wigfield, A. (2002). Changes in children's self-competence and values: gender and domain differences across grades one through twelve. *Child Dev.* 73, 509–527. doi: 10.1111/1467-8624.00421
- Kayany, J. M., and Yelsma, P. (2000). Displacement effects of online media in the socio-technical contexts of households. *J. Broadcast. Electron. Media* 44, 215–229. doi: 10.1207/s15506878jobem4402_4
- Kern, M. L., Benson, L., Steinberg, E. A., and Steinberg, L. (2016). The EPOCH measure of adolescent well-being. *Psychol. Assess.* 28, 586–597. doi: 10.1037/pas0000201
- Kessels, U., and Steinmayr, R. (2013). Macho-man in school: toward the role of gender role self-concepts and help seeking in school performance. *Learn. Individ. Differ.* 23, 234–240. doi: 10.1016/j.lindif.2012.09.013
- Kollmayer, M., Schultes, M.-T., Schober, B., Hodosi, T., and Spiel, C. (2018). Parents' judgments about the desirability of toys for their children: associations with gender role attitudes, gender-typing of toys, and demographics. *Sex Roles* 79, 329–341. doi: 10.1007/s11199-017-0882-4
- Korlat, S., Foerst, N. M., Schultes, M.-T., Schober, B., Spiel, C., and Kollmayer, M. (2021). Gender role identity and gender intensification: agency and communion in adolescents' spontaneous self-descriptions. *Eur. J. Dev. Psychol.* doi: 10.1080/17405629.2020.1865143
- Krahé, B., Berger, A., and Möller, I. (2007). Entwicklung und validierung eines inventars zur erfassung des geschlechtsrollen-selbstkonzepts im jugendalter [Development and Validation of an Inventory for Measuring Gender Role Self-Concept in Adolescence]. *Zeitschrift Sozialpsychol.* 38, 195–208. doi: 10.1024/0044-3514.38.3.195
- LaFontana, K. M., and Cillessen, A. H. N. (2010). Developmental changes in the priority of perceived status in childhood and adolescence. *Soc. Dev.* 19, 130–147. doi: 10.1111/j.1467-9507.2008.00522.x
- Lam, S. F., Jimerson, S., Kikas, E., Cefai, C., Veiga, F. H., Nelson, B., et al. (2012). Do girls and boys perceive themselves as equally engaged in school? The results of an international study from 12 countries. *J. School Psychol.* 50, 77–94. doi: 10.1016/j.jsp.2011.07.004
- Li, N., and Kirkup, G. (2007). Gender and cultural differences in Internet use: a study of China and the UK. *Comput. Educ.* 48, 301–317. doi: 10.1016/j.compedu.2005.01.007
- Lu, H., and Chiou, M. (2010). The impact of individual differences on e-learning system satisfaction: a contingency approach. *Brit. J. Educ. Technol.* 41, 307–323. doi: 10.1111/j.1467-8535.2009.00937.x
- Lupart, J. L., Cannon, E., and Telfer, J. A. (2004). Gender differences in adolescent academic achievement, interests, values and life-role expectations. *High Ability Stud.* 15, 25–42. doi: 10.1080/1359813042000225320
- Malecki, C. K., and Demaray, M. K. (2003). What type of support do they need? Investigating student adjustment as related to emotional, informational, appraisal, and instrumental support. *School Psychol. Q.* 18, 231–252. doi: 10.1521/scpq.18.3.231.22576
- Markstrom-Adams, C. (1989). Androgyny and its relation to adolescent psychosocial well-being: a review of the literature. *Sex Roles* 21, 325–340. doi: 10.1007/BF00289595
- McGeown, S., Goodwin, H., Henderson, N., and Wright, P. (2012). Gender differences in reading motivation: does sex or gender identity provide a better account? *J. Res. Read.* 35, 328–336. doi: 10.1111/j.1467-9817.2010.01481.x
- McSporran, M., and Young, S. (2001). Does gender matter in online learning? *Res. Learn. Technol.* 9, 3–15. doi: 10.1080/0968776010090202
- Meece, J. L., Glienke, B. B., and Burg, S. (2006). Gender and motivation. *J. Sch. Psychol.* 44, 351–373. doi: 10.1016/j.jsp.2006.04.004
- Meelissen, M. R. M., and Drent, M. (2007). Gender differences in computer attitudes: does the school matter? *Comput. Human Behav.* 24, 969–985. doi: 10.1016/j.chb.2007.03.001
- Moss-Racusin, C. A., Sanzari, C., Caluori, N., and Rabasco, H. (2018). Gender bias produces gender gaps in STEM engagement. *Sex Roles* 79, 651–670. doi: 10.1007/s11199-018-0902-z
- Mucheral, W. M. (2003). The influence of technology on the classroom climate of social studies classrooms: a multidimensional approach. *Learn. Environ. Res.* 6, 37–57. doi: 10.1023/A:1022903609290
- Mumtaz, S. (2001). Children's enjoyment and perception of computer use in the home and the school. *Comput. Educ.* 36, 347–362. doi: 10.1016/S0360-1315(01)00023-9
- Nefesh-Clarke, L., Orser, B., and Thomas, M. (2020). *COVID-19 Response Strategies, Addressing Digital Gender Divides*. Available online at: https://www.g20-insights.org/policy_briefs/covid-19-response-strategies-addressing-digital-gender-divides/ (accessed February 24, 2021).
- OECD (2001). *E-learning: The Partnership Challenge*. Paris: OECD Publishing. doi: 10.1787/9789264193161-en
- OECD (2020). *Education Responses to Covid-19: Embracing Digital Learning and Online Collaboration*. Retrieved from: https://read.oecd-ilibrary.org/view/?ref=120_120544-8ksud7oaj2&title=Education_responses_to_Covid-19_Embracing_digital_learning_and_online_collaboration (accessed February 24, 2021).
- Ong, C. S., and Lai, J. Y. (2006). Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Comput. Human Behav.* 22, 816–829. doi: 10.1016/j.chb.2004.03.006
- Patrick, H., Ryan, A. M., and Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *J. Educ. Psychol.* 99, 83–98. doi: 10.1037/0022-0663.99.1.83
- Pauletti, R. E., Menon, M., Cooper, P. J., Aults, C. D., and Perry, D. G. (2017). Psychological androgyny and children's mental health: a new look with new measures. *Sex Roles* 76, 705–718. doi: 10.1007/s11199-016-0627-9
- Perez, T., Wormington, S. V., Barger, M. M., Schwartz-Bloom, R. D., Lee, Y., and Linnenbrink-Garcia, L. (2019). Science expectancy, value, and cost profiles and their proximal and distal relations to undergraduate science, technology, engineering, and math persistence. *Sci. Educ.* 103, 264–286. doi: 10.1002/sce.21490
- Perkowski, J. (2013). The role of gender in distance learning: a meta-analytic review of gender differences in academic performance and self-efficacy in distance learning. *J. Educ. Technol. Syst.* 41, 267–278. doi: 10.2190/ET.41.3.e
- Price, L. (2006). Gender differences and similarities in online courses: challenging stereotypical views of women. *J. Comp. Assist. Learn.* 22, 349–359. doi: 10.1111/j.1365-2729.2006.00181.x
- Reddy, R., Rhodes, J. E., and Mulhall, P. (2003). The influence of teacher support on student adjustment in the middle school years: a latent growth curve study. *Dev. Psychopathol.* 15, 119–138. doi: 10.1017/S0954579403000075
- Ryan, R. M., Stiller, J. D., and Lynch, J. H. (1994). Representations of relationships to teachers, parents, and friends as predictors of academic motivation and self-esteem. *J. Early Adolesc.* 14, 226–249. doi: 10.1177/027243169401400207
- Schober, B., Lüftenegger, M., and Spiel, C. (2020). *Learning Conditions During COVID-19 Pupils*. AUSSDA.
- Schrenk, R. (2020). Distance learning mit moodle – aktuelles aus österreichs schulen. *GW Unterricht.* 158, 51–56. doi: 10.1553/gw-unterricht158s51
- Signorella, M. L., and Jamison, W. (1986). Masculinity, femininity, androgyny, and cognitive performance: a meta-analysis. *Psychol. Bull.* 100, 207–228. doi: 10.1037/0033-2909.100.2.207
- Simons-Morton, B., and Chen, R. (2009). Peer and parent influences on school engagement among early adolescents. *Youth Soc.* 41, 3–25. doi: 10.1177/0044118X09334861
- Simpkins, S. D., Fredricks, J. A., and Eccles, J. S. (2012). Charting the Eccles' expectancy-value model from mothers' beliefs in childhood to youths' activities in adolescence. *Dev. Psychol.* 48, 1019–1032. doi: 10.1037/a0027468
- Skinner, O. D., McHale, S. M., Wood, D., and Telfer, N. A. (2019). Gender-typed personality qualities and African American youth's school functioning. *J. Youth Adolesc.* 48, 680–691. doi: 10.1007/s10964-018-0919-1
- Spence, J. T., Helmreich, R., and Stapp, J. (1975). Ratings of self and peers on sex role attributes and their relation to self-esteem and conceptions of masculinity and femininity. *J. Pers. Soc. Psychol.* 32, 29–39. doi: 10.1037/h0076857
- Tamres, L. K., Janicki, D., and Helgeson, V. S. (2002). Sex differences in coping behavior: a meta-analytic review and an examination of relative coping. *Personal. Soc. Psychol. Rev.* 6, 2–30. doi: 10.1207/S15327957PSPR0601_1
- Taylor, A., Bailey, A. L., Cooper, P., Dwyer, C., Kramarae, C., et al. (2007). "Gender equity in communication skill," in *Handbook for Achieving Gender Equity Through Education*. ed S. Klein (New York, NY: Lawrence Erlbaum Associates), 281–303.
- Terlecki, M., Brown, J., Harner-Steci, L., Irvin-Hannum, J., Marchetto-Ryan, N., Ruhl, L., et al. (2011). Sex differences and similarities in video game

- experience, preferences, and self-efficacy: implications for the gaming industry. *Curr. Psychol.* 30, 22–33. doi: 10.1007/s12144-010-9095-5
- Thomas, A. E., Müller, F. H., and Bieg, S. (2018). Entwicklung und validierung der skalen zur motivationalen regulation beim lernen im studium (SMR-LS) [Development and validation of scales for the measurement of motivational regulation for learning in university students (SMR-LS)]. *Diagnostica* 64, 145–155. doi: 10.1026/0012-1924/a000201
- UN (2020). *Education During COVID-19 and Beyond*. Available online at: https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf (accessed February 24, 2021).
- UNICEF (2020). *Keeping the World's Children Learning Through COVID-19*. Available online at: <https://www.unicef.org/coronavirus/keeping-worlds-children-learning-through-covid-19> (accessed February 24, 2021).
- Van Grootel, S., Van Laar, C., Meeussen, L., Schmader, T., and Sczesny, S. (2018). Uncovering pluralistic ignorance to change men's communal self-descriptions, attitudes, and behavioral intentions. *Front. Psychol.* 9:1344. doi: 10.3389/fpsyg.2018.01344
- Van Houtte, M. (2004). Why boys achieve less at school than girls: The difference between boys' and girls' academic culture. *Educ. Stud.* 30, 159–173. doi: 10.1080/0305569032000159804
- Vekiri, I. (2010). Boys' and girls' ICT beliefs: do teachers matter? *Comput. Educ.* 55, 16–23. doi: 10.1016/j.compedu.2009.11.013
- Vekiri, I. (2012). Information science instruction and changes in girls' and boys' expectancy and value beliefs: in search of gender-equitable pedagogical practices. *Comput. Educ.* 64, 104–115.
- Vekiri, I. (2013). Information science instruction and changes in girls' and boy's expectancy and value beliefs: in search of gender-equitable pedagogical practices. *Comp. Educ.* 64, 104–115. doi: 10.1016/j.compedu.2013.01.011
- Vekiri, I., and Chronaki, A. (2008). Gender issues in technology use: perceived social support, computer self-efficacy and value beliefs, and computer use beyond school. *Comput. Educ.* 51, 1392–1404. doi: 10.1016/j.compedu.2008.01.003
- Volman, M., and van Eck, E. (2001). Gender equity and information technology in education: the second decade. *Rev. Educ. Res.* 71, 613–634. doi: 10.3102/00346543071004613
- Wahlmüller-Schiller, C. (2017). Bildung 4.0 – der Weg in die zukunft. *Elektrotech. Information.* 134, 382–385. doi: 10.1007/s00502-017-0527-x
- Watt, H. M. G., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., and Eccles, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: a comparison of samples from Australia, Canada, and the United States. *Dev. Psychol.* 48, 1594–1611. doi: 10.1037/a0027838
- Wigfield, A., and Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemp. Educ. Psychol.* 25, 68–81. doi: 10.1006/ceps.1999.1015
- Wigfield, A., and Eccles, J. S. (2020). 35 years of research on students' subjective task values and motivation: a look back and a look forward. *Adv. Motiv. Sci.* 7, 161–198. doi: 10.1016/bs.adms.2019.05.002
- Wolter, B. I., and Hannover, B. (2016). Gender role self-concept at school start and its impact on academic self-concept and performance in mathematics and reading. *Eur. J. Dev. Psychol.* 13, 681–703. doi: 10.1080/17405629.2016.1175343
- Wood, W., and Eagly, A. (2012). Biosocial construction of sex differences and similarities in behavior. *Adv. Exp. Soc. Psychol.* 46, 55–123. doi: 10.1016/B978-0-12-394281-4.00002-7
- Yates, S. J. (2001). Gender, language and CMC for education. *Learn. Instruct.* 11, 21–34. doi: 10.1016/S0959-4752(00)00012-8
- Young, B. J. (2000). Gender differences in student attitudes toward computers. *J. Res. Comput. Educ.* 33, 204–216. doi: 10.1080/08886504.2000.10782310

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Beyond a Zero-Sum Game: How Does the Impact of COVID-19 Vary by Gender?

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Epidemics and pandemics, like COVID-19, are not gender neutral. Much of the current work on gender, sex, and COVID-19, however, has seemed implicitly or explicitly to be attempting to demonstrate that either men or women have been hardest hit, treating differences between women and men as though it is not important to understand how each group is affected by the virus. This approach often leaves out the effect on gender and sexual minorities entirely. Believing that a more nuanced approach is needed now and for the future, we brought together a group of gender experts to answer the question: how are people of different genders impacted by COVID-19 and why? Individuals working in women's, men's, and LGBTQ health and wellbeing wrote sections to lay out the different ways that women, men, and gender and sexual minorities are affected by COVID-19. We demonstrate that there is not one group "most affected," but that many groups are affected, and we need to move beyond a zero-sum game and engage in ways to mutually identify and support marginalized groups.

Keywords: gender, sex differences, pandemic, COVID-19, LGBTQ

INTRODUCTION

Epidemics and pandemics, like COVID-19, are not gender neutral (Wenham et al., 2020a). Much of the current work on gender, sex, and COVID-19, however, has seemed implicitly or explicitly to be attempting to demonstrate that either men or women have been hardest hit, while often leaving out the effect on gender and sexual minorities entirely (Bwire, 2020; Wenham et al., 2020b). Believing that a more nuanced approach is needed now, and will also be in the long term, we brought together a group of gender experts to answer the question: how are people of different genders impacted by COVID-19 and why? We also need to understand that sex and gender are different, and that when studying gender, it is necessary to move beyond binary approaches which place people into distinct categories. Each section below has been written by individuals working in the field of women's,

men's, and LGBTQ health and wellbeing. We also asked experts on sex differences to contribute so that we could gain a better understanding of how sex intersects with gender to lead to greater understanding of gendered impact of COVID-19.

By laying out the different ways that women, men, and sexual and gender minorities are affected by COVID-19, we demonstrate that there is not one group “most affected,” but that many groups are affected depending on the context, and we need to move beyond a zero-sum game and engage in ways to mutually identify and support those effected. Most importantly, we need to use an intersectional approach (Bowleg, 2012; Bowleg, 2020; Griffith, 2012), which explores how gender intersects with other social stratifiers including race, age, income, disability, sexual orientation—to better understand and address individual and group experiences and effects of the pandemic.

UNDERSTANDING SEX AND GENDER

Biological sex is defined as “the classification of living things, generally as male or female according to their reproductive organs and functions assigned by chromosomal complement” (Springer et al., 2012b), while gender is the “socially constructed roles, behaviors, activities, attributes and opportunities that any society considers appropriate for men and women, boys and girls” and people with non-binary identities (WHO, 2020c). Gender is both rooted in biology and shaped by environment and experience (Springer et al., 2012b).

There are different approaches to how gender is framed, including categorical (e.g., binary traits or identities), relational (defined by relationships and interactions between and among men and women), and intersectional (a form of power relation which intersects with other social identities, such as race, age, and sexual orientation, to influence individual experiences of marginalization and disadvantage), or a combination thereof (Springer et al., 2012a). In earlier sociological accounts that sought to distinguish gender from sex, (West and Zimmerman, 1987) conceptualized gender as something “we do” rather than an essence that one naturally possesses. They argued: “Doing gender involves a complex of socially guided perceptual, interactional, and micro-political activities that cast particular pursuits as expressions of masculine and feminine (West and Zimmerman, 1987: 126). Heise et al. (2019) refer to gender as a social system, as opposed to a being considered a trait or identity. Gender systems define “men and women as different and distributes power, resources, and status on the basis of that difference” (Heise et al., 2019: 2,441). Patriarchal gendered systems typically distribute greater power, resources, and status to men and behaviors considered masculine. Those who do not fit into the recognized gender systems, such as gender minorities and/or men or women who do ascribe to traditional masculinities or femininities, are often granted less legitimacy and experience greater stigma and discrimination (Connell, 2005; Heise et al., 2019). In regards to the COVID-19 pandemic, gendered norms, roles, and behaviors that individuals conform to (or are expected to conform to) can influence risk of infection

and exposure, as well as the social and economic impacts of pandemic response strategies.

HOW ARE WOMEN IMPACTED BY COVID-19?

While context, cultural, socio-economic status and numerous identity factors differentiate women's experiences of COVID-19, COVID-19 has also had particular effects on women that transcend borders and make explicit globalized structures of inequities. Around the world, women comprise 70% of the healthcare workforce and up to 90% of the social care workforce (WHO, 2020a). They are also more likely to be providing frontline care and are consequently at increased risk of COVID-19 infection—as is demonstrated by the analysis of cases among healthcare workers. For example, women account for 73% of COVID-19 infections among healthcare workers in Spain (UN Women, 2020). In India, women healthcare workers account for 38% of cases, even though they make up less than a third of the workforce (Dey and Pandit, 2020). At the Tonji Hospital in Wuhan, China, nurses (who are mostly women) had a 2.7-fold risk of contracting COVID-19 compared to physicians (who are mostly men) (Lai et al., 2020).

Globally women do two to three times more informal care work than men. In the context of COVID, they also absorbed expanding additional unpaid care work as a consequence of government responses to the pandemic (Lee and Frayn, 2008). COVID-19 related closures of schools in 193 countries, compounded by lockdown requirements, have increased the childcare and domestic work within households, and this falls disproportionately on women (Wenham et al., 2020b), due to the gender pay-gap, feminized sectors of the economy that were otherwise shut and social, cultural norms. Not only are women doing more of this domestic load, but research in the United Kingdom and Hong Kong has shown that women are suffering considerably worse mental health effects associated with this workload, particularly when juggling it alongside paid employment (Fawcett Society, 2020).

Care work in the home directly impacts women's economic security, reducing their time and ability to engage in paid labor. A Canadian study found mothers were five times more likely than fathers to reduce work hours to care for children (Qian and Fuller, 2020). Similar trends have been demonstrated in Argentina, Europe and South Africa (Blaskó et al., 2020; Casale and Posel, 2020; Costoya et al., 2020). The long-term negative effects on women's careers remain unknown, but evidence from North America demonstrates men are regain jobs lost due to COVID-19 at a much faster rate than women, particularly racialized women (Catalyst, 2020), and evidence from previous epidemics show that women remain out of the workforce for longer (Bandiera et al., 2019). Care work as a barrier to engaging in paid labor compounds the effects of a global economic downturn that is disproportionately affecting industries where the majority of workers are women, such as those of hospitality, restaurants, tourism and recreation (Franke, 2020).

A headline across the globe has been the soaring rates of calls to domestic violence hotlines during periods of lockdown (Chandra, 2020). Women are 90% of domestic violence victims and this extreme surge has been noted across continents. For example, in Colombia, calls to domestic violence hotlines have surged 130% (Reuters, 2020). Women are also disproportionately affected by COVID-19 through changes to access of sexual and reproductive health (SRH) services and maternal health care (Ahmed and Sonfield, 2020). The COVID-19 pandemic has affected both the supply and demand for SRH services. Supply chains for contraceptives, for example, have been disrupted, starting in Asia in early 2020, where most global contraceptives are produced. This resulted in stock-outs being reported, particularly in low and middle-income countries (LMICs) such as Myanmar and Mozambique (Purdy, 2020). This disruption is amplified by changes in demand, with quarantine orders and the closure of non-essential health services meaning that women may not be able to access contraceptives if they wish, or they may prefer not to seek these services, fearing clinics to be a location of transmission (Wenham et al., 2020b). In a context of scarce resources, quality and availability of health systems and fee for services costs will influence who has access to SRH and who does not. Further attention also needs to be paid to abortion access: some countries such as United States, Poland and Italy have used COVID-19 as an opportunity to further restrict women's reproductive freedom, ruling abortion a non-essential service during the pandemic. On the other hand, in England the pandemic has liberalized abortion policy to facilitate medical abortions at home, thereby reducing demand on the health system (Margolis, 2020; Stevis-Gridneff et al., 2020).

Though there are stark global trends among women in different contexts, experiences will be further structured by location (both in terms of national, urban or rural and neighborhood context), socio-economic status, race, citizen status, age, sexual orientation and gender identity, ability and other intersecting factors. In the United Kingdom, data from England and Wales shows Black women are 4.3 times more likely to die from a COVID-19-related death than white women (Office for National Statistics, 2020). Similar data from the US shows disproportionate rates of COVID-19 related deaths among black women, compared to white men (Rushovich et al., 2021). In Hong Kong, foreign domestic workers were ineligible to receive government COVID-19 support, even as large numbers lost their jobs when their employers left the city (Milhaud, 2020). Sex workers, the majority of whom are women, are also excluded from most government support programs due to the criminalization of their profession. Girls in LMICs are particularly put at risk by school closures, with (Save the Children, 2020) predicting that up to 2.5 million more girls around the world are at risk of being forced into child marriage over the next five years. Lesbian women, particularly in places where same sex behaviors are criminalized and lead to discrimination, may be particularly affected by isolation policies that separate them from partners and chosen families. The list of differential impacts among women could go on and requires nuanced detailed and dedicated analysis of the intersecting factors that structure women's risks. While global trends paint

a clear outline of how COVID-19 is exacerbating the inequalities women around the world face, further analysis is needed to fill in the details.

HOW ARE MEN IMPACTED BY COVID-19?

Men are significantly more likely than women to develop severe outcomes associated with COVID-19 and to die, with globally 13 male deaths for every 10 female deaths and 18 male ICU admissions for every 10 female ICU admissions (Global Health 50/50, 2020; WHO, 2020b). There has been considerable discussion about the biopsychosocial factors responsible for the disproportionate male mortality rate from the pandemic (Griffith et al., 2020; White and Kirby, 2020). An important component of men's vulnerability to COVID-19 is the effect of biological sex, as male susceptibility to COVID-19 is likely mediated by the genetic and hormonal influences, which are discussed in greater detail below.

These biological effects, however, are often influenced by masculinities and gendered practices, norms and policies, and how race, ethnicity, socioeconomic position, and other factors intersect with gendered structures (Griffith, 2016; Griffith, 2020; Griffith et al., 2020; Smith et al., 2020). Consequently, men who are most socially and economically disadvantaged, have much higher mortality rates, as do men from Black and ethnic minority communities (Public Health England, 2020). While it is common to consider these biological and socio-cultural factors separately, patterns of COVID-19 mortality have illustrated the importance of using an intersectional lens that considers how race/ethnicity, sexual orientation, employment sector, place/country and other factors intersect with sex and gender to identify men at risk more precisely (Bajunirwe et al., 2020; Goldblatt and Morrison, 2020; Islam et al., 2020).

The greater risk of the severe form of the disease and the higher death rates in men is not the whole story (White, 2020). The pandemic's impact on "normal life" and the looming potential economic recession is having a significant impact on men's mental health. One international study found that the three most common causes of anxiety for men were the health of vulnerable relatives, falling ill, and losing their job (Movember, 2020). Alcohol-specific deaths in men have risen significantly during lockdown in England and Wales reflecting increases in consumption, particularly among already heavy drinkers (Breen and Manders, 2021). There is a concern that the economic recession caused by the pandemic will, as with previous recessions (Reeves et al., 2015), result in a marked increase in suicide rates among men (Khan et al., 2020). Lockdowns have already been linked to an increase in violence perpetrated by men against women and girls (UN Women, 2020). While the impact on women and girls is rightly a priority issue to address, such violence is also associated with increased stress and mental illness among men (Peterman et al., 2020). In Eastern African countries, Uganda in particular, a study on men and GBV during the pandemic noted unreported violence cases experienced by men as well as social and economic stress and anxiety triggered by the unchanging expectations of men as providers amid pandemic job

losses and restricted mobility (Ahikire and Mwiine, 2020). The emphasis of policy and programmatic initiatives has been on criminalizing men rather than developing and disseminating successful prevention and intervention programmes (Heilman and Barker, 2020).

The pandemic is revealing the woeful lack of attention paid to promoting men's health; for example, little in the way of planning outreach to men with gender and broader intersectionality-sensitive health promotion advice, or focus on employment in risky male-dominated settings such as cross-border truck driving (Abalo, 2020), security work, meat processing plants, bus and taxi-driving (Burdorf et al., 2021). Interventions for men could include "male-friendly" messaging on handwashing, social distancing, wearing facemasks, accessing testing for COVID-19 infection, encouraging appropriate use of health services, as well as the mitigation of occupational risks (Griffith, 2020). However, although such broad-brush approaches can get messages out to the male population in general, for success there has to be a more nuanced targeting of messaging that recognizes how men of different ages, ethnicities, sexuality, disability and other lived experiences will respond. In addition, attention is needed to address the lag in COVID-19 vaccination among men in countries like the United States (Law, 2021).

The WHO has called for gender-responsive actions (WHO, 2020b) but, as yet, there is no evidence that these have been forthcoming. While COVID-19 provides further evidence of the need for gender mainstreaming in health policy (Varanka, 2008; White and Richardson, 2011), it also has highlighted the need for policy and planning to explicitly consider the diverse needs and interests of different categories of men (Smith et al., 2020). In the longer-term, health systems must develop a systematic approach to sex and gender that includes taking appropriate account of men's health needs alongside those of women and non-binary genders. Policies and practices are required to tackle the deep-seated causes of poor male health and premature mortality. This includes developing a better understanding of, and then tackling, the structural causes that put men at additional risk of death from COVID-19 and its wider repercussions.

HOW ARE GENDER AND SEXUAL MINORITIES IMPACTED BY COVID-19?

Much of the attention to sex and gender in relation to COVID-19 has been related to the impact on (presumed cisgender, heterosexual) women and men, while often leaving out the effect on gender and sexual minorities entirely (Cahill et al., 2020). But gender affects everyone. Here we have included both gender and sexual minorities due to the intertwined nature of gender and sexual orientation, which can sometimes be difficult to disentangle. The two are frequently conflated leading to similar patterns of marginalization and discrimination among this population. Intersectional approaches also signal the need to consider the intersection of sexual orientation and gender alongside other social identities and categories including race, socio-economic status, and migration status.

To understand the impact of COVID-19 on gender and sexual minorities a more nuanced and intersectional approach is needed. Lesbian, gay, bisexual, and transgender (LGBT) persons experience global health inequities rooted in structural stigma targeting LGBT identities alongside other axes of marginalization such as racism, sexism, and classism. The social, legal, and healthcare environment for LGBT persons varies widely within and between countries; however, globally discrimination and exclusion converge to worsen health while reducing access to care (Lucas Ramón Mendos and ILGA World, 2019). These pre-existing social and health disparities indicate that COVID-19 may disproportionately impact LGBT persons. We briefly identify challenges experienced by LGBT persons in the context of COVID-19.

First, LGBT persons may experience elevated risks for poor COVID-19 outcomes. For instance, LGBT persons are more likely to smoke compared with heterosexual, cisgender persons (Broverman, 2020; Whittington et al., 2020), and may have elevated cardiovascular disease risk (Caceres et al., 2017; Meads et al., 2018). Gay and bisexual men, and transgender (trans) women are overrepresented among persons living with HIV (UNAIDS, 2020b) who may experience respiratory and cardiovascular multi-morbidities (Cahill, 2020). Importantly, Black, Indigenous, and other racialized gay and bisexual men and transgender women are most impacted by HIV in many countries and it is those same racialized groups that are disproportionately burdened by COVID-19 (Bowleg, 2020; Islam et al., 2020). Further, COVID-19 threatens access to HIV prevention, testing and care services (UNAIDS, 2020a). A large online study of men who have sex with men (MSM) ($n = 2,732$) from 103 countries reported that 33% of participants living with HIV lost access to HIV providers due to COVID-19, and nearly one-fifth who were taking antiretroviral therapy reported challenges accessing medication (Santos et al., 2020). In another survey of MSM ($n = 10,654$) in 20 countries using geosocial networking apps, interruptions to HIV prevention services were common (e.g., 56% for pre-exposure prophylaxis, 38–55% for HIV testing) and significantly associated with the stringency of national restrictions related to COVID-19 (Rao et al., 2021). LGBT persons may also avoid COVID-19 testing or emergency care due to pre-existing fears of mistreatment in health facilities (Bauer et al., 2014). In a Canadian survey of 820 transgender and non-binary persons, 10.8% reported experiencing discrimination when accessing or attempting to access COVID-19 testing (Trans PULSE Canada, 2020).

Mental health effects are another concern. Quarantines and closures of LGBT spaces may elevate depression and anxiety while reducing access to social support (Brennan et al., 2020). In a US study of MSM, 69% reported decreased quality of life, 73% reported increased anxiety, and 56% reported feeling less connected to friends since COVID-19 (Sanchez et al., 2020). In a longitudinal cohort of LGBT people in the US, among people who did not have pre-existing depression or anxiety disorders, depression and anxiety symptoms increased during to the pandemic (Flentje et al., 2020). Globally, gender affirming surgeries have been cancelled or postponed for many trans persons (Streed and Siegel, 2020), which can elevate anxiety

and depression (Wang et al., 2020). Indeed, in an online global sample of 849 trans and non-binary individuals, reduced access to gender-affirming medical care and supplies, as well as socioeconomic loss, due to the pandemic were associated with poorer mental health (Restar et al., 2021). LGBT individuals, particularly youth, who are isolating with unsupportive family members may be at risk of experiencing violence or distress (Action International, 2020; Ahlenback, 2020; OutRight). Researchers have called for further investigation of how stay-at-home orders impact mental health and experiences of violence among sexual and gender minorities, particularly among adolescents who may have limited access to supportive peer groups (DeMulder et al., 2020). Santos et al. (2020) global MSM survey reported that more than one-third (35%) reported depression symptoms, and this rose to 50% among those who lost their employment due to COVID-19.

Socio-economic marginalization of LGBT persons is likely to be exacerbated by the pandemic. For instance, Stonewall (2020) report noted lower educational attainment, poverty, and housing and food insecurity among lesbian and bisexual women and trans persons related to stigma and discrimination across 26 countries. LGBT persons are overrepresented within sectors considered nonessential (e.g., food service) (Cahill, 2020; Whittington et al., 2020), and within occupations curtailed or made riskier by physical distancing protocols (e.g., sex work) (Goel, 2020). Finally, legal and policy responses to COVID-19 may compound impacts of the pandemic on LGBT persons. For instance, Panama and Peru enacted mobility policies whereby men and women were permitted to leave their homes on separate days; these laws resulted in police brutality and public humiliation targeting trans and gender nonconforming persons (Perez-Brumer and Silva-Santisteban, 2020). Abuse and punishment by officials enforcing quarantine and curfews disproportionately targeted and punished LGBT persons in Panama (Reid, 2020), Philippines (Reid, 2020), and Uganda (The Lancet, 2020). LGBT community members became scapegoats for COVID-19 transmission in a number of countries (BRAC, 2020; Goel, 2020; The Lancet, 2020).

Together these data signal that LGBT persons are in many ways disproportionately impacted by COVID-19 and its socio-economic consequences. The largest empirical COVID-19 studies with LGBT persons, however, have focused on cisgender men (Sanchez et al., 2020; Santos et al., 2020). Amplifying voices and experiences of COVID-19 among trans persons, and lesbian and bisexual women, and intersections with race, Indigeneity, ability, and other axes along which COVID-19 vulnerability is unequally distributed, is urgently needed to inform practice and policy to achieve health equity.

THE ROLE OF BIOLOGICAL SEX

To fully understand the impact of COVID-19 on women and men, one must also consider the role of biological sex. This is because sex and gender are so inherently intertwined, each affecting the other in complex ways. Most of the health effects we see are not the result of sex or gender but the entanglement or intersection of the two (Springer et al., 2012). As our

understanding of biological susceptibility beyond the sex/gender binary is limited, we do not consider the role of biological sex on gender minorities.

While gender places women at a disadvantage during the pandemic in many ways, female sex appears to offer some protection against severe disease and death from COVID-19. This biological sex difference is likely mediated by both genes and hormones. Viral infections begin with the virus binding to a receptor that is expressed on human cells. For SARS-CoV-2, the receptor is angiotensin-converting enzyme 2 (ACE2), a protein that is down-regulated by estrogens and expressed from a gene coded on the X-chromosome (Liu et al., 2010). As with all X-linked genes, males inherit a single version from their mothers, while females inherit a version from each parent. To accommodate the extra copy in females, each cell inactivates one X-chromosome creating a mosaic of expression whereby some cells express the maternal copy and others express the paternal copy (Gibson et al., 2020). Therefore, if a variant of ACE2 that is better able to bind SARS-CoV-2 is inherited, males will express it in all cells, while females will only express it in half of their cells, leading to greater vulnerability in males (Gibson et al., 2020; Li et al., 2020). In addition, in females, genes can escape X-inactivation, leading to increased expression of X-linked genes. In addition to ACE2, toll-like receptor 7 (TLR7), is encoded on the X-chromosome. Both ACE2 and TLR7 have been shown to escape X-inactivation in immune cells, allowing females to express both copies and conferring a greater ability to sense intracellular viruses (Souyris et al., 2018; Li et al., 2020). The virus's attachment onto ACE2 is the key route into the cell and its interaction with the enzyme also damages its normal protective function. With females potentially having two forms of the ACE2 enzyme (one from each X-chromosome), they have a greater likelihood of having unaffected ACE2 circulating, reducing the virus's damaging effects (Li et al., 2020).

Sex differences also continue as disease progresses. In several retrospective cohort studies in China, the virus persisted longer in males than in females with severe disease (Shi et al., 2020; Xu et al., 2020; Zheng et al., 2020). This is because, while the immune response is critical to containing infection, it can also become dysregulated and contribute to disease progression. There is accumulating evidence to suggest that severe disease and death from COVID-19 are mediated by an excessive inflammatory response, termed a "cytokine storm" (Ye et al., 2020). Cytokine storms are characterized by rapid infiltration of immune cells in the lungs, leading to acute respiratory distress syndrome (ARDS) and ultimately multi-organ failure (Ye et al., 2020). Hormone-mediated sex differences may exist in the development of cytokine storms. In both humans and animal models, estrogens, including estradiol, have anti-inflammatory effects that inhibit the pro-inflammatory response [reviewed in Mauvais-Jarvis et al., (2020)], potentially protecting females from severe disease. This does not, however, explain female protection at later stages of life (e.g., during the post-menopausal period) when estrogen levels are low.

Table 1 provides a summary of the gendered impacts on women, men, and gender and sexual minorities discussed above.

TABLE 1 | Summary of gendered impacts on women, men, and gender and sexual minorities.

Women	Men	Gender and sexual minorities
<p>Increased rates of infection Women comprise majority of health and social care workforce and provide more frontline care leading to increased risk of infection.</p>	<p>Increased disease severity and mortality Men are significantly more likely than women to experience severe disease and to die from COVID-19. This disparity is mediated by genetic and hormonal influences. Men's susceptibility to certain underlying conditions (e.g., hypertension) is also a factor.</p>	<p>Risk of poor outcomes LGBT persons may experience elevated risks for poor COVID-19 outcomes to inequitable social contexts and healthcare discrimination that contribute to stress and pre-COVID-19 health disparities; for instance, LGBT persons are more likely to smoke compared with heterosexual, cisgender persons, and may have elevated cardiovascular disease risk.</p>
<p>Increased informal care Women engage in more informal care work than men and faced additional unpaid care work during pandemic, including childcare and domestic work.</p>	<p>Increased vulnerability and risk Men who are most socially and economically disadvantaged and those from black and ethnic minority communities have much higher mortality rates. Men in certain occupations (eg. transport) are also more at risk.</p>	<p>Increased vulnerability and risk Black, indigenous, and other racialized gay and bisexual men and transgender women may be disproportionately burdened by COVID-19 due to existing social and health disparities and intersecting stigma and discrimination across social/health spheres.</p>
<p>Economic insecurity Women's additional care work increases economic insecurity due to decreased opportunities for paid labor.</p>	<p>Harmful masculinities and gendered practices, norms and policies also can leave men more vulnerable. Mental health burden</p>	<p>Access to services impacted, including:</p>
<p>The majority of workers employed in industries which shut down during pandemic were women.</p>	<p>Men's mental health impacted by cessation of normal life and the looming potential economic recession. Concern that will result in increase in suicide rates among men. There is evidence of increased alcohol-related diseases in men during pandemic.</p>	<p>HIV prevention, testing and care services which can harm HIV clinical health outcomes, and gender affirming surgeries, which can elevate anxiety and depression.</p>
<p>Violence Women experienced increased rates of domestic and healthcare worker violence.</p>	<p>Violence Lockdowns have been linked to an increase in violence perpetrated by men against women and girls, which is associated with increased stress and mental illness among men.</p>	<p>Mental health burden Increased mental health burden and reduced access to social support due to closures of LGBT spaces.</p>
<p>Access to sexual and reproductive health services The pandemic affected access to sexual and reproductive health services, including access to contraception and abortion services; while sexual and reproductive health affects all genders, women usually bear the responsibility for accessing contraception and health services, and most severe consequences of lack of access.</p>	<p>Economic insecurity Unchanging expectations of men as providers amid pandemic job losses and restricted mobility triggered tensions in majority of households in LMICs.</p>	<p>Violence LGBT individuals, particularly youth, who are isolating with unsupportive family members may be at risk of experiencing violence or distress.</p>
<p>This also extends to access to maternity services, with service provision halted in many locations with impacts on maternal and neonatal outcomes. Early marriage</p>	<p>Gender imbalance in vaccination Many men are less likely than women to race for covid-19 vaccination, with low rates influenced, in part, by men's past experiences of healthcare seeking.</p>	<p>Economic insecurity LGBT persons are overrepresented within sectors considered nonessential (e.g., food service) and within occupations curtailed or made riskier by physical distancing protocols (e.g., sex work).</p>
<p>Girls in LMICs at increased risk of forced marriages especially with closure of schools. Increased vulnerability and risk</p>	<p>Absence from policy agendas Men tend to be invisible in policy making, with little attention paid to how to reach out and target them more effectively.</p>	<p>Stigma and discrimination Avoidance of COVID-19 testing or emergency care due to anticipated stigma and mistreatment in health facilities.</p>
<p>Minority women, including black women, lesbian women, foreign domestic workers, sex workers, have been disproportionately impacted by the above.</p>		<p>Legal and policy responses to COVID-19 may compound impacts of the pandemic on LGBT persons, such as mobility policies which permit men and women to leave homes on separate days.</p>

TAKING A HOLISTIC RESPONSE TO SEX AND GENDER

What is clear is that people are disproportionately impacted in different ways—by infection and mortality from the pathogen and from longer term socio-economic effects. We need to recognize that these impacts, while different, do not necessarily equate to one group of people being “more

impacted” than the other. The situation is much more complex than that, yet what remains clear is that gender does influence different primary short-term and secondary long-term effects of the pandemic. Primary effects include greater severity of disease and mortality among men, while secondary effects include higher social and economic consequences for women. And there is urgent need for more data on primary and secondary effects on gender and sexual minorities. When discussing the gendered

TABLE 2 | Recommendations for addressing gendered impacts of COVID-19.

Recommendations	
Cross-cutting	<p>Gender mainstreaming in health policy, including policy and planning explicitly considering the diverse needs and interests of different categories of men, women, and sexual and gender minorities.</p> <p>Collection and analysis of sex and gender disaggregated data.</p> <p>Data collection and analysis which include gender and feminist methodologies to capture the lived realities of communities and individuals otherwise missed.</p> <p>Biomedical research to understand underlying mechanisms of sex differences in disease severity and mortality.</p> <p>Intersectional analysis which looks at differences among different categories of men, women, and sexual and gender minorities.</p> <p>Nuanced targeting of messaging that recognizes how men of different ages, ethnicities, sexuality and disability etc. will respond.</p> <p>Include diverse representation in decision-making.</p> <p>Support for non-governmental organizations specializing in reaching specific gender groups.</p>
Women	<p>Increased attention to the socio-economic effects of government interventions and recognition of the impacts on women.</p> <p>Social support mechanisms established to minimize economic harms to women unable to work, and future planning for how to ensure the longevity of employers/sectors which disproportionately employ women (e.g., sector wide bailouts) or training schemes for women.</p> <p>Minimum service package of sexual and reproductive health and maternity services to continue during health emergencies.</p> <p>Additional service provision for domestic violence support and protection</p> <p>Care based economic development to recognize the formal and informal care work that women perform upon which our society depends.</p>
Men	<p>Increased attention to the health of men and boys needed, including increased planning outreach to men with gender and broader intersectionality sensitive health promotion advice.</p> <p>Focused health promotion in male-dominated employment settings such as cross-border truck driving, meat processing plants, and bus and taxi-driving.</p> <p>Interventions for men which include “male-friendly” messaging on handwashing, social distancing, wearing facemasks, accessing testing for COVID-19 infection, encouraging appropriate use of health services, as well as the mitigation of occupational risks.</p> <p>Policies and practices are required to tackle the deep-seated causes of poor male health and premature mortality, including developing a better understanding of, and then tackling, the structural causes that put men at additional risk of death from COVID-19.</p>
Sexual and gender minorities	<p>Urgent need for more data on primary and secondary effects on gender and sexual minorities, with a focus on adolescents, and the different experiences among lesbian, bisexual and queer women, gay and bisexual men by gender identity, race, socio-economic status, regionality.</p> <p>Focus in women’s health to consider transgender women and lesbian, bisexual and queer women, and in men’s health to consider sexual minority men and transgender men.</p> <p>Need to move beyond binary sex and gender to be inclusive of gender non-binary persons and intersex persons, and to understand the experiences of gender non-binary and intersex persons in COVID-19.</p>

impacts of pandemics, we must not only look at differences between but also among men, women and gender non-binary persons by considering how gender intersects with other biological and social stratifiers—like sex, race, age, gender identity, income, disability, sexual orientation—to create individual experiences of marginalization and vulnerability (Smith et al., 2020). The degree to which populations are affected will depend on their circumstances, which are shaped by wider historical and contemporary systems and structures of oppression and privilege.

COVID-19 has brought increasing attention to the role of sex and gender in health and the need for sex and gender disaggregated data and analysis (Gebhard et al., 2020; Griffith et al., 2020). Over the past year, papers and news articles have drawn attention to the role of sex and gender in relation to COVID-19. This is despite the fact that feminist scholars and advocates in the fields of men’s and women’s health have been arguing for the need for sex and gender disaggregated data and analysis for years, and it being agreed upon at the World Health Assembly Resolution 60.25 (2007). Why has it taken COVID-19 to finally show the importance of sex and gender-based analyses?

There are a number of possible reasons for this. One is likely due to the issue of power and who has historically set the agenda. Those who hold social identities which are given more power and privilege (i.e., white, male, high income, etc.) are overrepresented in decision-making (Bali et al., 2020). One can argue that those in positions of power typically prioritize issues that are in their interest. Sex and gender are often incorrectly equated with women and girls, despite the fact that sex and gender differences also affect men and gender non-binary persons, and that there is sexual diversity across the gender spectrum (Baker et al., 2020). Sex and gender have simply not been prioritized. In addition, for years data has been analyzed using the default (white) male as a reference point. Not only were women often left out of clinical trials, but studies using mice typically only used male mice (Klein and Morgan, 2020). Recommended dosages and signs and symptoms of ill health which were considered universal were in fact based on the male body. This has had negative consequences for women, not to mention for gender and sexual minorities. But men’s health has also remained an overlooked issue with just four countries having national men’s health policies and few addressing key issues such

as men's excess all-cause premature mortality burden (Baker et al., 2020).

This also draws attention to the complex issue of when to take a binary perspective and when we must move beyond the binary (Santos, 2014; Liszewski et al., 2018; Hart et al., 2019; Scandurra et al., 2019). For studies involving biological sex, while we recognize a more binary approach may be important due to the distinct ways that genes and hormones affect female and, males differently, a non-binary approach should be taken whenever possible so as to not exclude intersex people (Jorge et al., 2019; Costello, 2020; Joel, 2021). Due to the socially constructed and context specific nature of gender, and the ways in which it intersects with other social stratifiers, for studies involving gender taking a binary approach is no longer adequate and is in fact bad science. We must continue to fight for this distinction as sex and gender continue to be conflated.

Table 2 outlines key recommendations for addressing gendered impacts of COVID-19 based on the discussion above.

One has to wonder whether the fact that COVID-19 is causing wide ranging effects of sex and gender will result in leading to greater attention to sex and gender. Will decision-makers, researchers, and practitioners finally begin to prioritize the role sex and gender play in the health of all? While we have yet to see this, we hope that the increased attention will lead to a more equitable pandemic response.

REFERENCES

- Abalo, O. I. (2020). *Coronavirus Is Infecting More Men than Women in Uganda*. August: Daily Monitor.
- Action International (2020). LBTI Caucus Statement in Response to the Covid-19 Pandemic. Available at: <https://outrightinternational.org/content/lbti-caucus-statement-response-covid-19-pandemic> (Accessed August 28, 2020).
- Ahikire, J., and Mwiine, A. A. (2020). *Men and Gender Based Violence: Changing Masculinities for Effective COVID-19 Social Response in Uganda*. Kampala, Uganda.
- Ahlenback, V. (2020). Three Reasons Why We Need to Make the COVID-19 Response LGBTIQ Inclusive, Social Development Direct. Available at: <http://www.sddirect.org.uk/media/1898/three-reasons-why-we-need-to-make-the-covid-19-response-lgbtqi-inclusive-final-002.pdf> (Accessed August 28, 2020).
- Ahmed, Z., and Sonfield, A. (2020). *The COVID-19 Outbreak: Potential Fallout for Sexual and Reproductive Health and Rights* | New York, NY: Guttmacher Institute. Available at: <https://www.guttmacher.org/article/2020/03/covid-19-outbreak-potential-fallout-sexual-and-reproductive-health-and-rights> (Accessed 26 August 2020).
- Bajunirwe, F., Izudi, J., and Asimwe, S. (2020). Long-distance Truck Drivers and the Increasing Risk of COVID-19 Spread in Uganda. *Int. J. Infect. Dis.*, 98, 191–193. doi:10.1016/j.ijid.2020.06.085
- Baker, P., White, A., and Morgan, R. (2020). Men's Health: COVID-19 Pandemic Highlights Need for Overdue Policy Action. *The Lancet* 395 (10241), 1886–1888. doi:10.1016/S0140-6736(20)31303-9
- Bali, S., Dhatt, R., Lal, A., Jama, A., Van Daalen, K., and Sridhar, D. (2020). Off the Back Burner: Diverse and Gender-Inclusive Decision-Making for COVID-19 Response and Recovery. *BMJ Glob. Health*, 5(5):e002595, doi:10.1136/BMJGH-2020-002595
- Bandiera, O., Buehren, N., Goldstein, M., Rasul, I., and Smurra, A. (2019). "The Economic Lives of Young Women in the Time of Ebola : Lessons from an Empowerment Program," in *The Economic Lives of Young Women in the Time of Ebola : Lessons from an Empowerment Program, the Economic Lives of Young Women in the Time of Ebola : Lessons from an Empowerment Program*. Washington, DC: World Bank. doi:10.1596/1813-9450-8760

AUTHOR CONTRIBUTIONS

RM prepared the first draft and reviewed and edited the paper. PB, DG, AM, and AW contributed to the section on the impact on men. JS and CW contributed to the section on the impact on women. CL and AS contributed to the section on the impact on gender and sexual minorities. SK and JS contributed to the section on the biological impact of COVID-19. All authors reviewed and edited the introduction and conclusion.

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- Bauer, G. R., Scheim, A. I., Deutsch, M. B., and Massarella, C. (2014). Reported Emergency Department Avoidance, Use, and Experiences of Transgender Persons in Ontario, Canada: Results from a Respondent-Driven Sampling Survey. *Ann. Emerg. Med.* 63 (6), 713–720. doi:10.1016/j.annemergmed.2013.09.027
- Blaskó, Z., Papadimitriou, E., and Manca, A. R. (2020). *How Will the COVID-19 Crisis Affect Existing Gender Divides in Europe?*. doi:10.2760/37511
- Bowleg, L. (2012). The Problem with the Phrase Women and Minorities: Intersectionality-An Important Theoretical Framework for Public Health. *Am. J. Public Health* 102 (7), 1267–1273. doi:10.2105/AJPH.2012.300750
- Bowleg, L. (2020). We're Not All in This Together: On COVID-19, Intersectionality, and Structural Inequality. *Am. J. Public Health* 110, 917. doi:10.2105/AJPH.2020.305766
- Brac, J. P. G. S. P. H. (2020). On the Fringes: Impact of the COVID-19 Shutdown on Hijras Daily Personal, Social and Economic Lives. Available at: https://covid-bracjpsph.org/assets/files/research/brief/On the fringes Transgender Communities_April 19_final brief 2020-min.pdf (Accessed August 28, 2020).
- Breen, P., and Manders, B. (2021). Quarterly Alcohol-specific Deaths in England and Wales: 2001 to 2019. registrations and Quarter 1 (Jan to Mar) to Quarter 4 (Oct to Dec) 2020 provisional registrations, Office for National Statistics. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/quarterlyalcohol-specificdeathsinenglandandwales/2001to2019registrationsandquarter1jantomartoquarter4octtodec2020provisionalregistrations> (Accessed May 12, 2021).
- Brennan, D. J., Card, K. G., Collicot, D., Jollimore, J., and Lachowsky, N. J. (2020). How Might Social Distancing Impact Gay, Bisexual, Queer, Trans and Two-Spirit Men in Canada?. *AIDS Behav.* 24, 2480–2482. doi:10.1007/s10461-020-02891-5
- Broverman, N. (2020). LGBTQ People Especially at Risk for COVID-19, Say 100+ Organizations, Advocate. Available at: <https://www.advocate.com/health/2020/3/11/lgbtq-people-especially-risk-covid-19-say-100-organizations> (Accessed August 28, 2020).
- Burdorf, A., Porru, F., and Rugulies, R. (2021). The COVID-19 Pandemic: One Year Later - an Occupational Perspective. *Scand. J. Work Environ. Health* 47 (4), 245–247. doi:10.5271/sjweh.3956

- Bwire, G. M. (2020). Coronavirus: Why Men Are More Vulnerable to Covid-19 Than Women? *SN Compr. Clin. Med.* 2, 874–876. doi:10.1007/s42399-020-00341-w
- Caceres, B. A., Brody, A., Luscombe, R. E., Primiano, J. E., Maruska, P., Sitts, E. M., et al. (2017). A Systematic Review of Cardiovascular Disease in Sexual Minorities. *Am. J. Public Health* 107 (4), e13–e21. doi:10.2105/AJPH.2016.303630
- Cahill, S. (2020). Coronavirus, COVID-19, and Considerations for People Living with HIV and LGBTQIA+ People. Available at: https://fenwayhealth.org/wp-content/uploads/C19MC-9_COVID-19and-LGBTQIA-and-People-Living-with-HIV-Brief_final2_links.pdf (Accessed August 28, 2020).
- Cahill, S., Grasso, C., Keuroghlian, A., Sciortino, C., and Mayer, K. (2020). Sexual and Gender Minority Health in the COVID-19 Pandemic: Why Data Collection and Combatting Discrimination Matter Now More Than Ever. *Am. J. Public Health* 110, 1360–1361. doi:10.2105/AJPH.2020.305829
- Casale, D., and Posel, D. (2020). Gender and the Early Effects of the COVID-19 Crisis in the Paid and Unpaid Economies in South Africa. Available at: <https://www.researchgate.net/publication/343008071> (Accessed November 12, 2020).
- Catalyst (2020). The Detrimental Impact of Covid-19 on Gender and Racial Equality: Quick Take. Available at: <https://www.catalyst.org/research/covid-effect-gender-racial-equality/> (Accessed May 12, 2021).
- Chandra, J. (2020). 'Covid-19 Lockdown | Rise in Domestic Violence, Police Apathy: NCW', *the Hindu*, 2 April. Available at: <https://www.thehindu.com/news/national/covid-19-lockdown-spike-in-domestic-violence-says-ncw/article31238659.ece>.
- Connell, R. (2005). *Masculinities*. University of California Press. Available at: doi:10.1787/9789264017450-en <https://www.ucpress.edu/book/9780520246980/masculinities> (Accessed May 12, 2021)
- Costello, C. G. (2020). "Beyond Binary Sex and Gender Ideology," in *The Oxford Handbook of the Sociology of Body and Embodiment*. Oxford University Press, 198–220. doi:10.1093/oxfordhb/9780190842475.013.14
- Costoya, V., Echeverría, L., Edo, M., Rocha, A., and Thailinger, A. (2020). "The Impact of COVID-19 in the Allocation of Time within Couples," in *Evidence for Argentina*. Buenos Aires: Working Paper 145, Working Papers 145 Universidad de San Andres, Departamento de Economia. Available at: <https://ideas.repec.org/p/sad/wpaper/145.html> (Accessed November 12, 2020).
- DeMulder, J., Kraus-Perrotta, C., and Zaidi, H. (2020). Sexual and Gender Minority Adolescents Must Be Prioritized during the Global COVID-19 Public Health Response. *Sex. Reprod. Health Matters*, 28. 1804717. doi:10.1080/26410397.2020.1804717
- Dey, S., and Pandit, A. (2020). 38% of Health Staff Infected with COVID in India Are Women, Times of India. Available at: <https://timesofindia.indiatimes.com/india/38-of-health-staff-infected-with-covid-in-india-are-women/articleshow/78471302.cms> (Accessed November 11, 2020).
- Fawcett Society (2020). Exiting Lockdown: The Impact on Women. Available at: <https://www.fawcettsociety.org.uk/exiting-lockdown-the-impact-on-women-1>. doi:10.1515/9780691207773 (Accessed August 26, 2020).
- Flentje, A., Obedin-Maliver, J., Lubensky, M. E., Dastur, Z., Neilands, T., and Lunnn, M. R. (2020). Depression and Anxiety Changes Among Sexual and Gender Minority People Coinciding with Onset of COVID-19 Pandemic. *J. Gen. Intern. Med.* 35, 2788–2790. doi:10.1007/s11606-020-05970-4
- Franke, A. (2020). *The Job Loss Tsunami Will Set Back equality for Women*. London: The Telegraph. again.
- Gebhard, C., Regitz-Zagrosek, V., Neuhauser, H. K., Morgan, R., and Klein, S. L. (2020). Impact of Sex and Gender on COVID-19 Outcomes in Europe. *Biol. Sex. Differ.* 11 (1), 29. doi:10.1186/s13293-020-00304-9
- Gibson, W. T., Evans, D., An, J., and Jones, S. (2020). 'ACE 2 Coding Variants: A Potential X-Linked Risk Factor for COVID-19 Disease', *bioRxiv*. Cold Spring: Cold Spring Harbor Laboratory, 2020. doi:10.1101/2020.04.05.026633
- Global Health 50/50 (2020). COVID-19 Sex-Disaggregated Data Tracker. Available at: <https://globalhealth5050.org/covid19/> (Accessed April 6, 2020).
- Goel, I. (2020). *Impact of Covid-19 on Hijras, a Third-Gender Community in India*. New York: Society for Cultural Anthropology, Society for Cultural Anthropology. Available at: <https://culanth.org/fieldsights/impact-of-covid-19-on-hijras-a-third-gender-community-in-india> (Accessed August 28, 2020).
- Goldblatt, P., and Morrison, J. (2020). *Initial Assessment of London Bus Driver Mortality from COVID-19*. London. Available at: <http://www.instituteofhealthequity.org/resources-reports/london-bus-drivers-review/london-bus-drivers-review.pdf>.
- Griffith, D. M. (2012). An Intersectional Approach to Men's Health. *J. Men's Health* 9 (2), 106–112. No longer published by Elsevier. doi:10.1016/j.jomh.2012.03.003
- Griffith, D. M. (2016). Biopsychosocial Approaches to Men's Health Disparities Research and Policy. *Behav. Med.* 42 (3), 211–215. doi:10.1080/08964289.2016.1194158
- Griffith, D. M., Ellison, J. M., and Semlow, A. R. (2020a). The COVID-19 Elephant and the Blind Men of Race, Place and Gender, Gender and COVID-19. Available at: <https://www.genderandcovid-19.org/uncategorized/the-covid-19-elephant-and-the-blind-men-of-race-place-and-gender/> (Accessed November 16, 2020).
- Griffith, D. M., Sharma, G., Holliday, C. S., Enyia, O. K., Valliere, M., Semlow, A. R., et al. (2020b). Men and COVID-19: A Biopsychosocial Approach to Understanding Sex Differences in Mortality and Recommendations for Practice and Policy Interventions. *Prev. Chronic Dis.* 17, E63. doi:10.5888/pcd17.200247
- Griffith, D. M. (2020). "Achieving Men's Health Equity," in *Health Equity: A Solutions-Focused Approach*. Editors K. B. Smalley, J. C. Warren, and M. I. Fernández (New York, NY: Springer), 197–215.
- Hart, C. G., Saperstein, A., Magliozzi, D., and Westbrook, L. (2019). Gender and Health: Beyond Binary Categorical Measurement. *J. Health Soc. Behav.* 60 (1), 101–118. doi:10.1177/0022146519825749
- Heilman, B., and Barker, G. (2020). Masculine Norms and Violence: Making the Connections. Available at: <https://promundoglobal.org/wp-content/uploads/2018/04/Masculine-Norms-and-Violence-Making-the-Connection-20180424.pdf> doi:10.1515/9780804775786 (Accessed November 12, 2020).
- Heise, L., Greene, M. E., Oppen, N., Stavropoulou, M., Harper, C., Nascimento, M., et al. (2019). Gender Inequality and Restrictive Gender Norms: Framing the Challenges to Health. *The Lancet* 393 (10189), 2440–2454. doi:10.1016/S0140-6736(19)30652-X
- Islam, N., Khunti, K., Dambha-Miller, H., Kawachi, I., and Marmot, M. (2020). COVID-19 Mortality: a Complex Interplay of Sex, Gender and Ethnicity. *Eur. J. Public Health* 30, 847–848. doi:10.1093/eurpub/ckaa150
- Joel, D. (2021). Beyond the Binary: Rethinking Sex and the Brain. *Neurosci. Biobehav. Rev.* 122, 165–175. doi:10.1016/j.neubiorev.2020.11.018
- Jorge, J. C., Valerio-Pérez, L., Esteban, C., and Rivera-Lassen, A. I. (2019). Intersex Care in the United States and International Standards of Human Rights. *Glob. Public Health* 16, 679–691. doi:10.1080/17441692.2019.1706759
- Khan, A. R., Ratele, K., and Arendse, N. (2020). Men, Suicide, and Covid-19: Critical Masculinity Analyses and Interventions. *Postdigit Sci. Educ.* 2, 651–656. doi:10.1007/s42438-020-00152-1
- Klein, S. L., and Morgan, R. (2020). The Impact of Sex and Gender on Immunotherapy Outcomes. *Biol. Sex. Differ.* 11 (1), 24. doi:10.1186/s13293-020-00301-y
- Lai, X., Wang, M., Qin, C., Tan, L., Ran, L., Chen, D., et al. (2020). Coronavirus Disease 2019 (COVID-2019) Infection Among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China. *JAMA Netw. Open* 3(5), e209666. doi:10.1001/jamanetworkopen.2020.9666
- Law, T. (2021). 'Why Men Are Falling behind in COVID-19 Vaccination', Time, 4 May. Available at: <https://time.com/6045671/covid-19-vaccine-men/> (Accessed May 12, 2021).
- Lee, E., and Frayn, E. (2008). *The "Feminisation" of Health*. London: A sociology of health, 115–133.
- Li, Y., Jerkic, M., Slutsky, A. S., and Zhang, H. (2020). Molecular Mechanisms of Sex Bias Differences in COVID-19 Mortality. *Crit. Care. BioMed Central* 24, 405. doi:10.1186/s13054-020-03118-8
- Liszewski, W., Peebles, J. K., Yeung, H., and Arron, S. (2018). Persons of Nonbinary Gender - Awareness, Visibility, and Health Disparities. *N. Engl. J. Med.* 379 (25), 2391–2393. doi:10.1056/nejmp1812005
- Liu, J. B., Yu, Z. P., Zhao, W. Z., Lin, S. Y., Wang, E. L., Zhang, Y., et al. (2010). Isolation and Identification of Angiotensin-Converting Enzyme Inhibitory Peptides from Egg White Protein Hydrolysates. *Food Chem.* 122 (4), 1159–1163.

- Lucas Ramón MendosILGA World (2019). *State-Sponsored Homophobia Report 2019: Global Legislation Overview Update*. Geneva. Available at: <https://ilga.org/state-sponsored-homophobia-report-2019-global-legislation-overview> (Accessed August 28, 2020).
- Margolis, H. (2020). 'England Leads Way in UK after U-Turn on COVID-19 Abortion Access. Rest of UK, Europe Should Follow', *Human Rights Watch*, 31 March. Available at: <https://www.hrw.org/news/2020/03/31/england-leads-way-uk-after-u-turn-covid-19-abortion-access>.
- Mauvais-Jarvis, F., Klein, S. L., and Levin, E. R. (2020). Estradiol, Progesterone, Immunomodulation, and COVID-19 Outcomes, 161, 161. doi:10.1210/endo/bqaa127
- Meads, C., Martin, A., Grierson, J., and Varney, J. (2018). Systematic Review and Meta-Analysis of Diabetes Mellitus, Cardiovascular and Respiratory Condition Epidemiology in Sexual Minority Women. *BMJ Open* 8(4), e020776. doi:10.1136/bmjopen-2017-020776
- Milhaud, N. (2020). Stranded in Hong Kong: The Plight of Domestic Workers during COVID-19, Arian. Available at: <https://www.arianalife.com/topics/community/stranded-in-hong-kong-domestic-workers-covid-19/> (Accessed November 13, 2020).
- Movember (2020). New Movember Research Looks into How Men Are Coping during COVID-19: A Chat with a Friend Could Really Help, According to 1 in 2 Men. Available at: https://ca.movember.com/story/view/id/12249?utm_campaign=20200717_EDM_Impact_July&utm_medium=email&utm_source=Eloqua&elqTrackId=284d4a7a11bb437d81a257d9a986572f&elq=767747e8a50a46938477e06e269c1fe9&elqaid=2920&elqat=1&elqCampaignId=1380#Footnote (Accessed 28 August 2020).
- Office for National Statistics (2020). Coronavirus (COVID-19) Related Deaths by Ethnic Group, England and Wales, Office for National Statistics. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/coronavirusrelateddeathsbyethnicgroupenglandandwales/2march2020to10april2020> (Accessed November 13, 2020).
- Perez-Brumer, A., and Silva-Santisteban, A. (2020). COVID-19 Policies Can Perpetuate Violence against Transgender Communities: Insights from Peru. *AIDS Behav.* 24 (9), 2477–2479. Nature Publishing Group. doi:10.1007/s10461-020-02889-z
- Peterman, A., Potts, A., O'Donnell, M., Thompson, K., Shah, N., Oertelt-Prigione, S., et al. (2020). Pandemics and Violence against Women and Children. Available at: <https://www.cgdev.org/publication/pandemics-and-violence-against-women-and-children> (Accessed April 10, 2020).
- Public Health England (2020). Disparities in the Risk and Outcomes of COVID-19. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf.
- Purdy, C. (2020). Opinion: How Will COVID-19 Affect Global Access to Contraceptives — and what Can We Do about it? | Devex, Devex. Available at: <https://www.devex.com/news/opinion-how-will-covid-19-affect-global-access-to-contraceptives-and-what-can-we-do-about-it-96745> (Accessed September 8, 2020).
- Qian, Y., and Fuller, S. (2020). COVID-19 and the Gender Employment Gap Among Parents of Young Children. *Can. Public Pol.* 46 (S2), S89–S101. University of Toronto Press. doi:10.3138/cpp.2020-077
- Rao, A., Rucinski, K., Jarrett, B. A., Ackerman, B., Wallach, S., Marcus, J., et al. (2021). Perceived Interruptions to HIV Prevention and Treatment Services Associated with COVID-19 for Gay, Bisexual, and Other Men Who Have Sex with Men in 20 Countries. *Ovid Tech. (Wolters Kluwer Health)* 87 (1), 644–651. doi:10.1097/qai.0000000000002620
- Reeves, A., McKee, M., Gunnell, D., Chang, S.-S., Basu, S., Barr, B., et al. (2015). Economic Shocks, Resilience, and Male Suicides in the Great Recession: Cross-National Analysis of 20 EU Countries. *Eur. J. Public Health* 25 (3), 404–409. doi:10.1093/eurpub/cku168
- Reid, G. (2020). A Global Report Card on LGBTQ+ Rights for IDAHOBIT | Human Rights Watch, the Advocate. Available at: <https://www.hrw.org/news/2020/05/18/global-report-card-lgbtq-rights-idahobit> (Accessed August 28, 2020).
- Restar, A. J., Jin, H., Jarrett, B., Adamson, T., Baral, S. D., Howell, S., et al. (2021). Characterising the Impact of COVID-19 Environment on Mental Health, Gender Affirming Services and Socioeconomic Loss in a Global Sample of Transgender and Non-binary People: A Structural Equation Modelling. *BMJ Glob. Health* 6 (3), e004424. doi:10.1136/bmjgh-2020-004424
- Reuters (2020). 'Another Pandemic': Domestic Abuse Calls Spike in Latin America during Coronavirus Lockdown', 11 April. Available at: <https://www.nbcnews.com/news/latino/another-pandemic-domestic-abuse-calls-spike-latin-america-during-coronavirus-n1193281> (Accessed August 26, 2020).
- Rushovich, T., Boulicault, M., Chen, J. T., Danielsen, A. C., Tarrant, A., Richardson, S. S., et al. (2021). Sex Disparities in COVID-19 Mortality Vary across US Racial Groups. *J. Gen. Intern. Med.*, 1–6. doi:10.1007/s11606-021-06699-4
- Sanchez, T. H., Zlotorzynska, M., Rai, M., and Baral, S. D. (2020). Characterizing the Impact of COVID-19 on Men Who Have Sex with Men across the United States in April, 2020. *AIDS Behav.* 24 (7), 2024–2032. Nature Publishing Group. doi:10.1007/s10461-020-02894-2
- Santos, A. L. (2014). Beyond Binarism? Intersex as an Epistemological and Political Challenge*. *rcsar* 6 (6), 123–140. doi:10.4000/rcsar.558
- Santos, G.-M., Ackerman, B., Rao, A., Wallach, S., Ayala, G., Lamontage, E., et al. (2020). Economic, Mental Health, HIV Prevention and HIV Treatment Impacts of COVID-19 and the COVID-19 Response on a Global Sample of Cisgender Gay Men and Other Men Who Have Sex with Men. *AIDS Behav.* 25, 311–321. Nature Publishing Group. doi:10.1007/s10461-020-02969-0
- Save the Children (2020). COVID-19 Places Half a Million More Girls at Risk of Child Marriage in 2020, Save the Children. Available at: <https://www.savethechildren.net/news/covid-19-places-half-million-more-girls-risk-child-marriage-2020> (Accessed November 13, 2020).
- Scandurra, C., Mezza, F., Maldonado, N. M., Bottone, M., Bochicchio, V., Valerio, P., et al. (2019). Health of Non-binary and Genderqueer People: A Systematic Review. *Front. Psychol.* 10, 1453, 2019. Frontiers Media S.A. doi:10.3389/fpsyg.2019.01453
- Shi, D., Wu, W., Wang, Q., Xu, K., Xie, J., Wu, J., et al. (2020). Clinical Characteristics and Factors Associated with Long-Term Viral Excretion in Patients with Severe Acute Respiratory Syndrome Coronavirus 2 Infection: a Single-Center 28-Day Study. *J. Infect. Dis. NLM (Medline)* 222 (6), 910–918. doi:10.1093/infdis/jiaa388
- Smith, J., Griffith, D., White, A., Baker, P., Watkins, D., Drummond, M., et al. (2020). COVID-19, Equity and Men's Health. *Ijmsch* 3 (1), e48–e64. doi:10.22374/ijmsch.v3i1.42
- Souyris, M., Cenac, C., Azar, P., Daviaud, D., Canivet, A., Grunenwald, S., et al. (2018). TLR7escapes X Chromosome Inactivation in Immune Cells. *Sci. Immunol.* 3 (19), eaap8855. doi:10.1126/sciimmunol.aap8855
- Springer, K. W., Hankivsky, O., and Bates, L. M. (2012a). Gender and Health: Relational, Intersectional, and Biosocial Approaches. *Soc. Sci. Med.* 74 (11), 1661–1666. doi:10.1016/j.socscimed.2012.03.001
- Springer, K. W., Mager Stellman, J., and Jordan-Young, R. M. (2012b). Beyond a Catalogue of Differences: A Theoretical Frame and Good Practice Guidelines for Researching Sex/gender in Human Health. *Soc. Sci. Med.* 74 (11), 1817–1824. doi:10.1016/j.socscimed.2011.05.033
- Stevis-Gridneff, M., Gupta, A. H., and Pronczuk, M. (2020). *Coronavirus Created an Obstacle Course for Safe Abortions*. New York Times: June, 14.
- Stonewall (2020). Out of the Margins: LBT + Exclusion through the Lens of the SDGs. Available at: <https://outofthemargins.org.uk/wp-content/uploads/2020/05/Out-of-the-Margins-report-2020.pdf> (Accessed August 28, 2020).
- Streed, C. G., and Siegel, J. (2020). An Update on Gender Affirming Care during the COVID-19 Pandemic - HRC, Human Rights Watch. Available at: <https://www.hrc.org/news/an-update-on-gender-affirming-care-during-the-covid-19-pandemic> (Accessed August 28, 2020).
- The Lancet HIV, H. I. V. (2020). Lockdown Fears for Key Populations. *Lancet HIV* 7 (6), e373. doi:10.1016/S2352-3018(20)30143-0
- Trans PULSE Canada (2020). COVID-19 Testing and Diagnosis Among Transgender and Non-binary People in Canada. Available at: <https://transpulsecanada.ca/results/report-covid-19-testing-and-diagnosis-among-transgender-and-non-binary-people-in-canada/> (Accessed May 12, 2021).
- UNAIDS (2020a). The Cost of Inaction: COVID-19-Related Service Disruptions Could Cause Hundreds of Thousands of Extra Deaths from HIV. Available at: <https://www.who.int/news-room/detail/11-05-2020-the-cost-of-inaction-covid-19-related-service-disruptions-could-cause-hundreds-of-thousands-of-extra-deaths-from-hiv> (Accessed August 28, 2020).
- UNAIDS (2020b). Worldwide, More Than Half of New HIV Infections Now Among Key Populations and Their Sexual Partners | UNAIDS. Available at: https://www.unaids.org/en/resources/presscentre/featurestories/2019/november/20191105_key-populations (Accessed August 28, 2020).
- UN Women (2020). COVID-19 and Ending Violence against Women and Girls. Available at: <https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/issue-brief-covid-19-and-ending-violence-against-women-and-girls-en.pdf?la=en&vs=5006>.

- Varanka, J. J. (2008). Mainstreaming Men into Gender Sensitive Health Policies. *J. Men's Health* 5, 189–191. doi:10.1016/j.jomh.2008.07.004
- Wang, Y., Pan, B., Liu, Y., Wilson, A., Ou, J., and Chen, R. (2020). Health Care and Mental Health Challenges for Transgender Individuals during the COVID-19 Pandemic. *Lancet Diabetes Endocrinol.* 8 (7), 564–565. doi:10.1016/S2213-8587(20)30182-0
- Wenham, C., Smith, J., Davies, S. E., Feng, H., Grépin, K. A., Harman, S., et al. (2020a). Women Are Most Affected by Pandemics - Lessons from Past Outbreaks. *Nature* 583 (7815), 194–198. doi:10.1038/d41586-020-02006-z
- Wenham, C., Smith, J., and Morgan, R. (2020b). COVID-19: the Gendered Impacts of the Outbreak. *The Lancet* 395 (10227), 846–848. doi:10.1016/S0140-6736(20)30526-2
- West, C., and Zimmerman, D. H. (1987). Doing Gender. *Gend. Soc.* 1 (2), 125–151. doi:10.1177/0891243287001002002 Available at: <https://www.jstor.org/stable/189945?seq=1> (Accessed May 12, 2021)
- White, A., and Kirby, M. (2020). COVID-19: Biological Factors in Men's Vulnerability. *Trends Urol. Men Health* 11 (4), 7. doi:10.1002/tre.757
- White, A. (2020). Men and COVID-19: the Aftermath. *Postgrad. Med.* 132, 18–27. doi:10.1080/00325481.2020.1823760
- White, A., and Richardson, N. (2011). Gendered Epidemiology: Making Men's Health Visible in Epidemiological Research. *Public Health* 125 (7), 407–410. doi:10.1016/j.puhe.2011.04.012
- Whittington, C., Hadfield, K., and Calderón, C. (2020). *The Lives and Livelihoods of Many in the LGBTQ Community Are At-Risk amidst COVID-19 Crisis*.
- WHO (2020a). 10 Key Issues in Ensuring a Gender Balance in the Global Health Workforce. Available at: <https://www.who.int/news-room/feature-stories/detail/10-key-issues-in-ensuring-gender-equity-in-the-global-health-workforce> (Accessed August 26, 2020).
- WHO (2020b). Gender and COVID-19. Available at: <https://apps.who.int/iris/rest/bitstreams/1277843/retrieve>.
- WHO (2020c). Gender and Health. Available at: <https://www.who.int/health-topics/gender>.
- Xu, K., Chen, Y., Yuan, J., Yi, P., Ding, C., Wu, W., et al. (2020). "Factors Associated with Prolonged Viral RNA Shedding in Patients with Coronavirus Disease 2019 (COVID-19)," in *Clinical Infectious Diseases* (Oxford University Press), 71, 799–806. doi:10.1093/cid/ciaa351
- Ye, Q., Wang, B., and Mao, J. (2020). The Pathogenesis and Treatment of the 'Cytokine Storm' in COVID-19. *J. Infect.* 80 (6), 607–613. doi:10.1016/j.jinf.2020.03.037
- Zheng, S., Fan, J., Yu, F., Feng, B., Lou, B., Zou, Q., et al. (2020). Viral Load Dynamics and Disease Severity in Patients Infected with SARS-CoV-2 in Zhejiang Province, China, January–March 2020: Retrospective Cohort Study. *Bmj* 369, m1443. doi:10.1136/bmj.m1443

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Political Narratives and the US Partisan Gender Gap

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Social scientists have devoted considerable research effort to investigate the determinants of the Partisan Gender Gap (PGG), whereby US women (men) tend to exhibit more liberal (conservative) political preferences over time. Results of a survey experiment run during the COVID-19 emergency and involving 3,086 US residents show that exposing subjects to alternative narratives on the causes of the pandemic increases the PGG: relative to a baseline treatment in which no narrative manipulation is implemented, exposing subjects to either the *Lab narrative* (claiming that COVID-19 was caused by a lab accident in Wuhan) or the *Nature narrative* (according to which COVID-19 originated in the wildlife) makes women more liberal. The polarization effect documented in our experiment is magnified by the political orientation of participants' state of residence: the largest PGG effect is between men residing in Republican-leaning states and women living in Democratic-leaning states.

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INTRODUCTION

Political polarization is a central question in the United States as it can affect the design and implementation of various (social) policies, as well as on the general functioning of democracy (Bail et al., 2018). Political polarization is mainly attributed to the partisan identification of US citizens (Bail et al., 2018; Peterson and Iyengar, 2020), as it is a much stronger predictor of the policy preferences of Americans than any other socio-demographic variable (Dimock et al., 2014).¹

Regarding partisan identification, the *partisan gender gap* (PGG)—i.e., the tendency of females to be more Democratic than males—is an important feature of the US political landscape. To this date, the PGG has been investigated mainly through socio-economic determinants, such as

¹In general, we can define partisanship as "an individual's adherence to a particular political party or platform" (Klar, 2014, p. 687). Two essential features of partisanship are that it tends to remain highly stable over time and influences individual perceptions of political cues (Bartels, 2002), where political cues are explicit or implicit signals indicating which ideological group supports a specific stance.

gender differences in policy preferences (Shapiro and Mahajan, 1986; Kaufmann and Petrocik, 1999),² socio-demographic conditions such as being single or divorced (Edlund and Pande, 2002),³ feminism (Conover, 1988), cultural values (Kaufmann, 2002), and economic autonomy (Huddy et al., 2008). More recently, Clark (2017) and Gillion et al. (2020) have shown that at least part of the PGG is the consequence of an ideological sorting mechanism. According to Gillion et al. (2020), men and women initially selected the party that matched their policy preferences, then this pre-existing sorting fueled the PGG over time, leading to a gap not fully explained by differences in policy opinions.

In this paper, first, we go beyond socio-economic determinants and investigate the impact of political narratives on the PGG (in the United States), which to the best of our knowledge is an understudied question in the literature. Indeed, in the social science literature there is an increasing interest in understanding how narratives form and influence opinions and behaviors (Morson and Schapiro, 2017; Shiller, 2017, 2019), and our work represents a contribution to this stream. Formally, we test the following hypothesis: because political narratives make the partisan affiliation salient (contain partisan cues), and given the existing gender gap in partisanship, we expect that political narratives will increase political polarization between men and women (i.e., the PGG widens). Second, we investigate the mechanisms through which the political narratives affect the PGG. We identify three potential mechanisms (one rational and two behavioral) through which the political narratives can affect the PGG.

As for the rational (or Bayesian) explanations, recent theoretical and experimental contributions show that individuals receiving the same informative signal on an unknown state of the world may rationally develop polarized beliefs on the same state if they start from heterogeneous priors or have differing private information (Andreoni and Mylovannov, 2012; Baliga et al., 2013; Fryer et al., 2019; Loh and Phelan, 2019; Eliaz and Spiegler, 2020). For example, Andreoni and Mylovannov (2012) consider a model in which information has a private and a public dimension, and both dimensions are important for identifying the state of nature. In this context, the heterogeneous beliefs about the state of the world determined by private information may influence the interpretation of public information and may cause ex-post polarization. Eliaz and Spiegler (2020) instead present a model of competing narratives in a Bayesian framework and represent narratives as causal relations that map actions into consequences. They provide a theoretical foundation for the emergence of false narratives that maximize anticipatory utility by providing easy

solutions to complex issues. However, these narratives necessarily also require the co-existence of rational (or “correct”) versions of the facts in order to thrive, suggesting that polarization of opinions is an equilibrium feature. These models are consistent with empirical evidence showing that the exposure of contending factions to the same objective empirical evidence can lead to social positions that are politically polarized (Lord et al., 1979). Thus, even if individuals disregard political cues and adopt “accuracy-driven reasoning,” in the sense that they make use of cognitive resources to accurately evaluate information (Kunda, 1990; Gilens, 2001; Howell and West, 2009), if gender determines distinct initial views of the world (i.e., beliefs on the state of the world), narratives may rationally lead males and females to update these positions in opposite directions.

As for behavioral mechanisms, on the one hand, “directional-motivated reasoning” postulates that partisans tend to base their reasoning on biased sources of information, which leads to inaccurate, desired beliefs reducing cognitive dissonance (Taber and Lodge, 2006; Gaines et al., 2007; Kraft et al., 2015; Miller et al., 2016; Flynn et al., 2017; Peterson and Iyengar, 2020). On the other hand, the “cheerleading effect” posits that when individuals are asked to express their opinions about facts that contrast their political view, they simply ignore these facts and prefer expressing their general affinity toward a specific party or ideology. In this case, partisans are well-informed, but they prefer to express opinions that are in line with their political identity and can contradict the information they have (Bullock et al., 2015; Miller and Conover, 2015; Prior et al., 2015; Schaffner and Luks, 2018; Bullock and Lenz, 2019). For example, Schaffner and Luks (2018) identify the existence of a cheerleading behavior among partisans who express a controversy on the number of people at the 2017 presidential inauguration of Donald Trump and those who participated at Barack Obama’s inauguration in 2009. Despite the existence of clear aerial photographs demonstrating that many more people attended Obama’s ceremony, a high percentage of Trump voters sustained the opposite.

To study the impact of political narratives on the PGG and the underlying mechanisms behind this effect, we focused on the COVID-19 pandemic and administered a survey experiment in the United States. Given that, since the onset of COVID-19, there is no consensus on its origin, alternative, sometimes competing, narratives about what caused the pandemic have emerged. The main treatments of our survey experiment are built upon two prominent alternative explanations on the origin of the COVID-19 pandemic and are consistent with the concept of narrative outlined by Crow and Jones (2018) and Eliaz and Spiegler (2020). Indeed, each version of the facts represents a “causal model that maps actions into consequences” and contains a cue or a reminder of an existing wider representation of reality that is already part of the public debate. More specifically, the *Lab* narrative, suggests that the pandemic originated as a result of human error and scientific misconduct in laboratories in Wuhan, while the *Nature* narrative describes the biological and genetic origin of the disease without explicitly attributing its cause to human actions. These two narratives have become part of the recent political debate in the United States since the Trump administration sustained the *Lab* narrative on several

²According to Shapiro and Mahajan (1986), men exhibit a higher degree of conservatism than women in policy issues such as criminal justice, national defense, law enforcement, and the welfare state. In line with these results, Kaufmann and Petrocik (1999) find that men prefer lower welfare spending than women.

³Using a panel data approach, Edlund and Pande (2002) explain the fact that in the last decades, more women than men voted for the Democratic party with the decline in marriage. Edlund and Pande argue that divorce makes women economically vulnerable, shaping their political preferences in favor of liberal positions that are typically associated with higher spending in the welfare state. Other studies reaching similar conclusions are Box-Steffensmeier et al. (2004) and Iversen and Rosenbluth (2006).

occasions.⁴ To contrast the diffusion of this narrative, Chinese political representatives and the World Health Organization (WHO) supported the idea that COVID-19 was the result of a natural phenomenon.⁵ Because these narratives entered a political dispute, they both contain political cues that associate them to a specific political party. For instance, a survey conducted in the US from March 10–16, 2020 (Schaeffer, 2020) showed that liberals were more likely than conservatives to state that COVID-19 originated in wildlife (64 vs. 37%). In contrast, conservatives were more likely than liberals to believe that COVID-19 originated in a lab (37 vs. 15%).

These narratives also result in divergent opinions regarding vital policy issues during the post-COVID recovery (Antinyan et al., 2021b). More specifically, individuals in Republican-leaning states voice less favorable opinions about trade openness and the relevance of climate change relative to individuals living in Democratic-leaning states when exposed to the *Lab* narrative.

Regarding the design of the survey experiment, the study participants—individuals residing in the US—were randomly split into three distinct groups: a baseline group involving no narrative manipulation and two treatment groups that were either exposed to the *Lab* or the *Nature* narratives. After the participants had been exposed to the treatment manipulations, we elicited their political preferences. A quick note about the mechanisms through which political narratives affect PGG is worth noting. Unfortunately, our experimental design does not allow us to separate “accuracy-driven reasoning” from “directional-motivated reasoning” since we do not elicit participants’ pre-treatment political views. Thus, we use “reasoning effect” to indicate the effects of both the “accuracy-driven reasoning” and “directional-motivated reasoning” on PGG. This means that, in the rest of the paper, we differentiate between the “cheerleading effect” and “reasoning effect.” Nonetheless, although we cannot distinguish ex-ante between the two types of reasoning, we will argue why our experimental results do not support the hypothesis of a gender-specific directionally motivated logic.

The results of our experimental exercise can be summarized as follows. The narratives about the origin of the COVID-19 pandemic increase the PGG. More specifically, relative to a baseline treatment in which no narrative manipulation is implemented, exposing subjects to either the *Lab narrative* or the *Nature narrative* make females more liberal and men more conservative. The PGG effect is amplified by the political orientation of participants’ state of residence: the largest gender gap is between men residing in Republican-leaning states

and women living in Democratic-leaning states. This result is consistent with the studies arguing that the social context influences how individuals react to political messages and process political information [see, e.g., Martin and Yurukoglu (2017) and Gentzkow et al. (2019)]. Regarding the mechanisms, the cheerleading behavior seems to be the main channel through which narratives contribute to the widening of the PGG. While the literature discusses that the “reasoning effect” and the “cheerleading effect” are not mutually exclusive concepts (Peterson and Iyengar, 2020), we illustrate the prevalence of the latter over the former for the PGG.

The rest of the paper is structured as follows. Section Experimental Design and Data details the experimental design and the data. Section Methodology and Results discusses the empirical methodology and the results. Section Conclusions concludes the paper.

EXPERIMENTAL DESIGN AND DATA

Experimental Design

The survey experiment was run on May 7–8, 2020, through Prolific (Palan and Schitter, 2018), and only US citizens residing in the US were allowed to participate in the study. Three main reasons motivate these participation restrictions. First, citizens are those that have the right to vote, and therefore, it is crucial to understand how political narratives influence the electorate. Second, these restrictions were intended to limit the effects exerted by unobservable social and cultural characteristics of participants. Third, the restrictions reasonably assured that all participants were physically located in the US and were exposed to the same societal, political, and media attention on the COVID-19 pandemic at the time of the experiment.

The survey experiment included three treatments: a baseline *No narrative* treatment and two narrative-manipulated treatments: *Lab narrative* and *Nature narrative*. In all treatments, the questionnaire (see **Part E** of the Supplementary Information) included several consecutive screens, and each screen contained a single question. After confirming their answer to a question, subjects proceeded to the next screen without having the possibility of moving back to revise previous responses.

The questionnaire administered in the *No narrative* treatment included three main blocks of questions. The first block contained a number of questions to elicit participants’ opinions on three relevant policy domains: climate change, foreign trade, and the role of science. The analysis of the answers to these questions (and how they are affected by the narrative manipulations) represents the main research question undertaken in Antinyan et al. (2021b).

The second block contained questions about the potential causes of the COVID-19 pandemic. We used the point allocation method and requested the participants to distribute 100 points across the following four possible causes of the pandemic:

- i. the virus originated from an accident in a lab;
- ii. the virus originated in nature as a result of natural processes;
- iii. the virus is a weapon the countries use against each other;
- iv. other reasons.

⁴Dan Mangan and Berkeley Lovelace Jr., “Trump suspects coronavirus outbreak came from China lab, doesn’t cite evidence,” CNBC, www.cnbc.com/2020/04/30/coronavirus-trump-suspects-covid-19-came-from-china-lab.html (accessed April 30, 2020).

⁵Cecelia Smith-Schoenwalder, “WHO Assures That Coronavirus Is Natural Amid Trump Attacks,” US News, www.usnews.com/news/world-report/articles/2020-05-01/who-assures-that-coronavirus-is-natural-amid-trump-attacks (accessed May 1, 2020). Meg Kelly and Sarah Cahlan, “Was the new coronavirus accidentally released from a Wuhan lab? It’s doubtful,” The Washington Post, www.washingtonpost.com/politics/2020/05/01/was-new-coronavirus-accidentally-released-wuhan-lab-its-doubtful/ (accessed May 1, 2020).

With this question, we aimed at eliciting subjects' beliefs about the real cause of the pandemic: the higher the points allocated to a given cause, the more the subject's belief in the given explanation. The explanation claiming that the virus is a weapon used by some countries against others aimed to distinguish those who believe in a pure conspiracy theory from those who associate the COVID-19 with a lab accident deriving from a human error. If a subject allocated the highest number of points to the fourth explanation, she was requested to indicate the reason she believed had triggered the pandemic.

In the third block, subjects were asked their willingness to get vaccinated against viruses other than COVID-19, their state of residence as well as other socio-demographic questions, including gender, age, occupational and educational status, income situation, whether lockdown restrictions were active in the state where they were actually living, and how much time (in minutes) they spent watching, reading or listening to news about politics and current affairs on a typical day. More importantly, for the scope of the present paper, the third block contained a question asking subjects to report their political view on a 5-point scale, moving from very liberal to very conservative. The political preference question included in our survey experiment is widely used in the literature.

The main difference between the baseline treatment and the narrative-manipulated treatments concerned the fact that, in the latter, before proceeding with the questionnaire, participants were exposed to a specific narrative about the origin of COVID-19. In particular, subjects in the *Lab narrative* treatment were presented with two media extracts claiming that, despite the denials from Chinese authorities, the pandemic was caused by an accident in a laboratory near the wet market in Wuhan. Meanwhile, the two extracts in the *Nature narrative* treatment affirmed that COVID-19 initially originated in the wildlife and then was transmitted to humans presumably from bats and pangolins. Thus, while the *Lab narrative* associates the COVID-19 outbreak with scientific misconduct, the *Nature narrative* emphasizes the importance of science for determining the genetic characteristics of the virus. Furthermore, while the *Nature narrative* depicts the pandemic as a neutral and natural phenomenon, the laboratory narrative attributes the blame to Chinese institutions.

Two aspects of the narrative manipulations implemented in our experiment are worth noting. First, we made sure that each of the narratives was covered by both the democratic leaning and the republican leaning media. In this respect, participants in each of the narrative-manipulated treatments were presented with two extracts, both referring to the same story, but one based on Fox News and one on CNN sources.⁶ Despite the differences in the news networks, the extracts were similar with respect to the framing and wording, and participants were never

told the original source the extracts came from. Moreover, while keeping the original text in the extracts mostly unchanged, we simply removed the graphical elements and the precise references to scientific sources (journal articles and names of researchers) to keep the exposition of the two narratives as comparable as possible.

Second, both the stories about the COVID-19 origins circulated in the US debate and media networks before our experiment took place. For instance, on March 17, 2020, *Nature Medicine* published a scientific article affirming that COVID-19 originated in wildlife. The article represented a scientific reaction to President Trump's rhetoric about the COVID-19 outbreak. On the contrary, on April 15, 2020, Fox News released a report promoting the lab origin of COVID-19. The report gained a lot of media attention throughout the US and triggered a vivid debate in the next days.

To make sure that subjects in the *Lab narrative* and *Nature narrative* treatments fully read and understood the extracts they were exposed to, they were asked to sum up in no more than two sentences what caused the COVID-19 pandemic according to the displayed text. The survey experiment lasted for 5.45 min on average, and the participants were paid £0.84 (around \$1.1) for their participation.

Data

The final sample consists of 3,086 participants: 1,053 in the *No narrative* treatment, 1,016 in the *Lab narrative* treatment, and 1,017 in the *Nature narrative* treatment.⁷ Participants were randomly allocated to one of the three treatments and participated in the study only once. As shown by **Part A** of the Supplementary Information, the randomization successfully generated balanced subsamples in the three treatments according to the main socio-demographic dimensions. More importantly, for the scope of the paper, in all treatments, participants were equally split between males and females, and the percentage of women was well-balanced across treatments.

Table 1 presents the main descriptive statistics for respondents' socio-demographic characteristics by distinguishing between men and women. The last two columns report the results of a balance test that uses the standardized difference between means and the variance ratio to compare the distributions of men and women's characteristics. Although there is no clear threshold of these two statistics to define imbalance, Rubin (2001) suggests a cut-off in the standardized difference of 0.25 and a variance ratio between 0.5 and 2.⁸ In general, we may say that standardized

⁶Three (out of four) of the extracts were taken directly from the websites of the two media outlets, while the *Nature narrative* associated with a conservative media network was taken from the Daily Caller, a source that is, however, directly connected to Fox News (the owner of Daily Caller was Tucker Carlson at the time the survey experiment was carried out, one of the most influent anchormen of Fox News).

⁷Out of the initial 3,091 participants, we excluded five participants who completed the questionnaire but either refused to provide demographic information or gave insensate responses: two subjects refused to provide their age, whereas three persons reported inexistent states of residence. The attrition bias referring to those that entered the survey and quit before the end of the questionnaire is 2.71 percent (i.e., 84 questionnaires out of 3,091). Because the tasks are usually short and the subjects get paid for their participation, the attrition rate in Prolific is usually rather low (Palan and Schitter, 2018).

⁸Normand et al. (2001) consider a standardized difference greater than 0.10 as indicative of imbalance. Because the standardized difference is a version of Cohen's d statistic for effect size (Cohen, 1988), a difference of 0.2 represents a "small" discrepancy.

TABLE 1 | Summary statistics for socio-demographic characteristics.

	Male (N = 1,509)		Women (N = 1,577)		Balance	
	Mean	Variance	Mean	Variance	Std-diff	Var-ratio
Age	33.976	154.700	35.221	175.766	-0.097	0.880
Income	6.155	3.231	5.982	3.281	0.096	0.985
Republican state (rep)	0.338	0.224	0.354	0.229	-0.033	0.979
COVID-19	0.099	0.016	0.094	0.014	0.039	1.099
Lockdown	0.782	0.171	0.774	0.175	0.019	0.975
Lower than high school	0.008	0.008	0.008	0.008	0.004	1.045
High school	0.346	0.226	0.342	0.225	0.007	1.005
Bachelor's degree	0.455	0.248	0.469	0.249	-0.028	0.996
Master's degree	0.140	0.121	0.139	0.120	0.005	1.010
Doctoral degree	0.050	0.048	0.042	0.040	0.041	1.193
Employed	0.577	0.244	0.467	0.249	0.221	0.981
Self-employed	0.102	0.092	0.124	0.108	-0.068	0.846
Student	0.161	0.135	0.164	0.137	-0.009	0.984
Unemployed	0.129	0.112	0.190	0.154	-0.167	0.729
Other	0.032	0.031	0.056	0.053	-0.117	0.585
Metro county	0.867	0.115	0.837	0.136	0.086	0.843
Republican county	1.353	0.229	1.403	0.241	-0.102	0.950
Marriage rate	6.095	4.209	6.162	5.099	-0.031	0.825

This table reports the main descriptive statistics for men and women's socio-demographic characteristics. The last two column provides two distributional tests aiming to check whether the two groups are balanced in terms of these characteristics. Std-diff is the standardized difference between the means, while Var-ratio is the corresponding variance ratio [see Linden and Samuels (2013)].

TABLE 2 | Expected outcomes.

Treatment	Gender	State	Expected outcome
Baseline	Female	Dem	$\alpha + \phi' \tilde{X}_i$
Baseline	Female	Rep	$\alpha + \gamma + \phi' \tilde{X}_i$
Baseline	Male	Dem	$\alpha + \beta + \phi' \tilde{X}_i$
Baseline	Male	Rep	$\alpha + \beta + \gamma + \phi' \tilde{X}_i$
Narrative	Female	Dem	$\alpha + \delta + \phi' \tilde{X}_i$
Narrative	Female	Rep	$\alpha + \gamma + \delta + \rho + \phi' \tilde{X}_i$
Narrative	Male	Dem	$\alpha + \beta + \delta + \mu + \phi' \tilde{X}_i$
Narrative	Male	Rep	$\alpha + \beta + \gamma + \delta + \mu + \rho + \phi' \tilde{X}_i$

differences (variance ratios) should be as close to zero (one) as possible.

The average age of men is 33.976 years, while for women, this average is 35.221 years. However, no significant differences emerge in terms of age between the two groups. Even the distribution of self-reported income is similar between men and women. Here, participants were asked to indicate their income status using a scale on which 1 was the lowest income group and 10 the highest income group in the United States. This variable is particularly important to control for the economic factors mentioned in the Introduction that can potentially affect women's preferences toward a larger welfare state (note that one of the main

explanations of the PGG relies on preferences about the welfare state).⁹

No difference between men and women emerges in terms of variable *rep*: a dummy which equals 1 if the respondent resides in a Republican-leaning state and 0 otherwise. We classified states using the average party affiliation of each state's residents throughout 2018.¹⁰ The variable COVID-19 represents the COVID-19 incidence rate measured as the ratio between the cumulated number of COVID-19 cases officially confirmed in each state till the day before the survey experiment and the corresponding population (USA Facts, 2020). Approximately 78 percent of men and women reported to live in a location subject to lockdown restrictions at the time of the survey. This variable captures subjects' perception to live under restrictions and thus their political view. Nonetheless, to check the robustness of our

⁹One can argue that a self-reported status is less reliable than an objective measure of income. However, as shown in Karadja et al. (2017), individual preferences for redistributive policies depend more on the self-perceived relative status than on effective income. Moreover, different groups of individuals might be differently equipped to provide their income based on a specific time horizon (e.g., annual, monthly, weekly, etc.). In contrast, a ten-point scale does not depend on any given periodicity. Finally, people are sensitive about disclosing their income, while a scale can make people feel more comfortable about sharing information.

¹⁰Data comes from Jones (2019). Two important features characterize Jones' data: they include nonvoters' political position, and all measures refer to the same period. We consider as Republicans those states with a fraction of affiliations greater or equal to the fraction of Democrats. In Table C3 of the Supplementary Information, we conduct a robustness check, separating blue/red states from those that changed their political orientation in the 2020 US Presidential Elections. Nonetheless, our results continue to hold.

results, in **Part C** of the Supplementary Information, we repeat our main analysis by replacing individual perception with official information on state restrictions.

Men and women are also homogeneous in terms of educational levels. Indeed, there are no significant discrepancies between the two groups across the four classes of educational attainment: lower than high school, high school, bachelor's degree, master's degree, and doctoral degree. In contrast, small

differences between the two sexes arise when we look at the occupational status. In particular, men are more likely to be employed and less likely to be unemployed than women. In order to control for the socio-political environment in which subjects live, we supplement data with information on whether they reside in metropolitan areas characterized by more than 250,000 inhabitants and in republican counties. We identified counties' political orientation using the average vote share for the

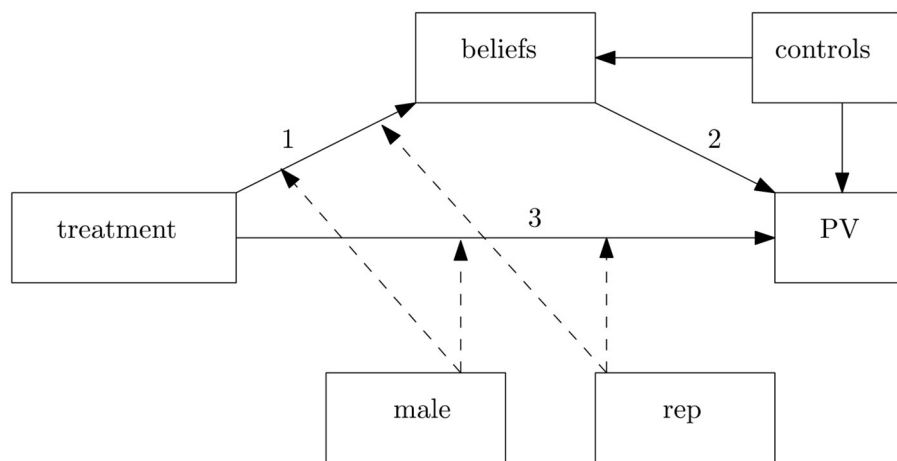


FIGURE 1 | Path diagram for SEM decomposition. This diagram indicates how narratives, moderators (male and rep), and control variables enter our structural equation model (SEM). Solid lines denote the estimated direct relationship between two variables, whereas the dashed lines indicate the presence of interaction effects. Edges 1 and 2 characterize the indirect (reasoning) effect of narratives on political views (PV). In contrast, edge 3 represents the direct (cheerleading) effect of narratives on PV.

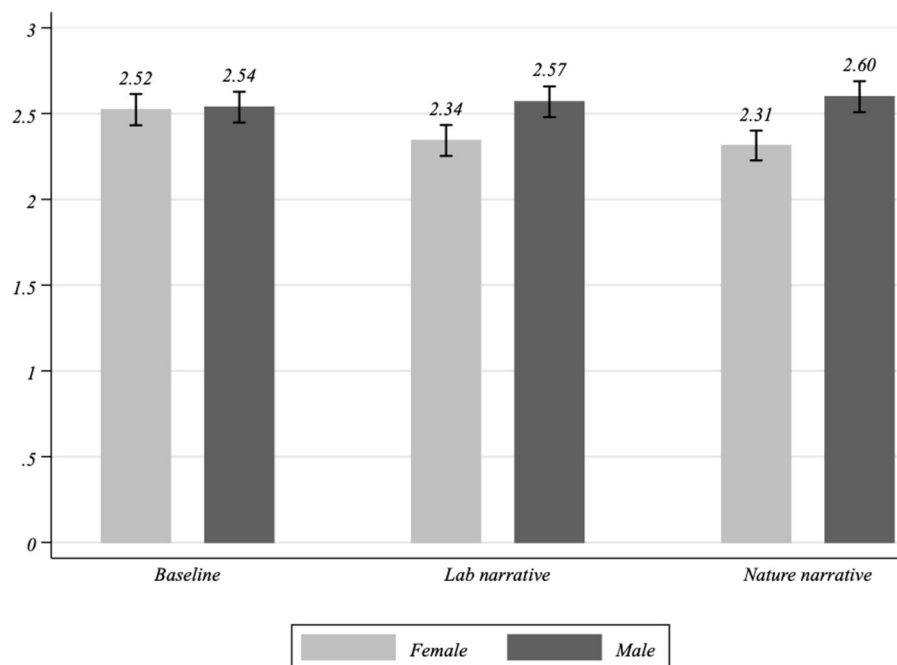


FIGURE 2 | Political views by gender and treatment. Histograms indicate the unconditional average political view of men and women subject to different treatments. The corresponding 95% confidence intervals are represented with capped spikes.

democratic or republican candidate in the last five presidential elections run before the experiment.¹¹ Finally, we also included the state marriage rates per 1,000 total population provided by the National Center for Health Statistics (NCHS).¹² Although we already control for individual income that has been associated with relative preferences for the welfare state and hence the PGG, the inclusion of the state marriage rates allows us to control for other social determinants of women's conditions such as more favorable state legislation or better economic opportunities.

METHODOLOGY AND RESULTS

Methodology

This study investigates whether narratives on COVID-19 origins affect the Partisan Gender Gap. Since the dependent variable classifies individual political preferences into five classes of conservatism, we consider both a linear specification and an ordered probit model.¹³ The five classes used to measure individual preferences are: 1 = very liberal, 2 = liberal, 3 = moderate, 4 = conservative, 5 = very conservative.

Denoting with $T = B, L, N$ the *Baseline* treatment, *Lab narrative*, and *Nature narrative*, respectively, we start by running the following OLS regression:

$$PV_i = \alpha + \beta \cdot male_i + \gamma \cdot rep_i + \delta \cdot T_i + \mu \cdot T_i \cdot male_i + \rho \cdot T_i \cdot rep_i + \phi' X_i + \varepsilon_i, \quad (1)$$

where PV_i is the political view of individual i , T_i is the treatment individual i was assigned to (the *Baseline* treatment is the omitted group), $male_i$ is a dummy variable taking value 1 if the respondent declares to be a man and zero otherwise, rep_i is a dummy taking value 1 if the respondent lives in a Republican-oriented state and zero otherwise, X_i is a set of control variables describing individual socio-demographic characteristics, and ε_i is the error term. The inference is based on heteroskedasticity-robust standard errors. Because Antinyan et al. (2021a) found that the state political orientation moderates the effect of narratives on political preferences, we estimate Equation (1) with and without the following constraint: $\rho = 0$ for any treatment.¹⁴

Table 2 summarizes the expected outcomes from Equation (1) for respondents with the various combinations of treatment, gender, and state political orientation (the residual variation term is omitted).

¹¹To distinguish between metro and non-metro counties, we used the "2013 Rural-Urban Continuum Codes" provided by the U.S. Department of Agriculture (available at <https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx>, accessed 15 June 2020). Data on presidential elections come from the "County Presidential Election Returns 2000-2016" provided by the MIT Election Data and Science Lab in 2018 (available at <https://electionlab.mit.edu/data>, accessed 15 June 2020).

¹²Data on marriage rates are available at <https://www.cdc.gov/nchs/fastats/marriage-divorce.htm> (accessed 10 April 2021).

¹³We also carry out an ordered logit analysis and a Brant test for the parallel odds assumption in Part C of the Supplementary Information.

¹⁴We use an F -test (Wald- χ^2 test in case of ordered probit models) to check whether this restriction is appropriate as well as to verify the opportunity to include a three-way interaction term among treatment, gender, and state political orientation.

From Table 2, we can easily derive the average treatment effect of treatment T on the Partisan Gender Gap:

$$\Delta PGG \equiv \left(\overline{PV}|_{T=L,N,male=1} - \overline{PV}|_{T=L,N,male=0} \right) - \left(\overline{PV}|_{T=B,male=1} - \overline{PV}|_{T=B,male=0} \right) = \mu. \quad (2)$$

Thus, a positive value of μ indicates that, compared to the baseline group, narrative $T=L, N$ enlarges the PGG, whereas a negative value would denote a shrinking effect. Moreover, Equation (1) allows us to distinguish the political view of men and women living in Democratic- and Republican-leaning states.

Because of the discrete nature of our dependent variable, we also estimate an ordered probit model. Formally, we estimate the

TABLE 3 | Political view (OLS and ordered probit).

	OLS		Ordered probit	
	(1)	(2)	(3)	(4)
Lab narrative	-0.154** (0.064)	-0.241*** (0.071)	-0.169** (0.067)	-0.257*** (0.075)
Nature narrative	-0.165*** (0.062)	-0.229*** (0.070)	-0.176*** (0.066)	-0.242*** (0.074)
Lab narrative*male	0.183** (0.090)	0.186** (0.090)	0.201** (0.093)	0.204** (0.093)
Nature narrative*male	0.232*** (0.089)	0.235*** (0.089)	0.248*** (0.093)	0.251*** (0.093)
Male	0.045 (0.063)	0.042 (0.063)	0.044 (0.065)	0.041 (0.065)
Rep	0.092** (0.045)	-0.042 (0.070)	0.091** (0.046)	-0.046 (0.072)
Lab narrative*rep		0.242** (0.097)		0.243** (0.100)
Nature narrative*rep		0.171* (0.095)		0.177* (0.098)
Constant	2.124*** (0.183)	2.196*** (0.185)		
Additional controls	Yes	Yes	Yes	Yes
Observations	3,086	3,086	3,086	3,086
R ² and Pseudo-R ²	0.061	0.063	0.021	0.022
Log-likelihood			-4290.107	-4286.770
F-statistics/Wald χ^2 for nested models	10.97	2.60	183.46	4.38
DF	18	2	18	2
P-value (for nested models)	0.000	0.074	0.000	0.112

Coefficients of Equations (1) and (3). Additional controls include respondent's education level, an indicator variable for individuals living under lockdown restrictions, a dummy for those who live in metro areas of more than 250,000 population, a dummy for respondents living in Republican-leaning counties, a self-reported assessment of personal income, respondent's age, and employment status. Finally, we also included the COVID-19 incidence rate recorded in the respondent's state till the day before the interview and the state marriage rate. The complete set of estimates is available in the Part F of the Supplementary Information. Robust standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

probability of declaring a political view equal to k as follows:

$$\Pr[PV_i = k] = F(z_k - \mathbf{W}_i \mathbf{w}) - F(z_{k-1} - \mathbf{W}_i \mathbf{w}), \quad (3)$$

where $\mathbf{W}_i \mathbf{w}$ is the right-hand side of Equation (1) with the exclusion of the error term, $F(\bullet)$ is the standard normal cumulative distribution function, and z_k is the cut point of class k .

The last part of the analysis exploits the question regarding respondents' beliefs on COVID-19 causes. Following Antinyan et al. (2021a), we use a Structural Equation Model (SEM) to decompose our estimates into two components: the reasoning effect and the cheerleading effect. The reasoning effect is the part of the total effect passing through individual beliefs about COVID-19 causes. In contrast, the cheerleading effect is the part of the total effect unexplained by these beliefs. **Figure 1** shows the path diagram associated with our SEM. Here, we can identify two distinct channels linking our treatments with political view (PV). The first channel represents the reasoning effect and includes links 1 and 2. According to this channel, narratives can influence personal opinions about what generated the COVID-19 (link 1), and these beliefs may affect individual preferences (link 2). Because we observe only the post-treatment political view, we cannot say whether narratives lead to politically biased or unbiased reasoning, so we cannot distinguish between accurate or directionally motivated reasoning. However, if this channel yields statistically significant results, we may conclude that narratives influence political views through a cognitive process. In contrast, the second channel is not mediated by beliefs (link 3) and represents a pure cheerleading effect. Notice that,

in line with Equation (1), we allow the *male* and *rep* dummy to moderate both channels (see the dashed links in **Figure 1**).

The path diagram represented in **Figure 1** can be expressed in terms of structural equations as follows:

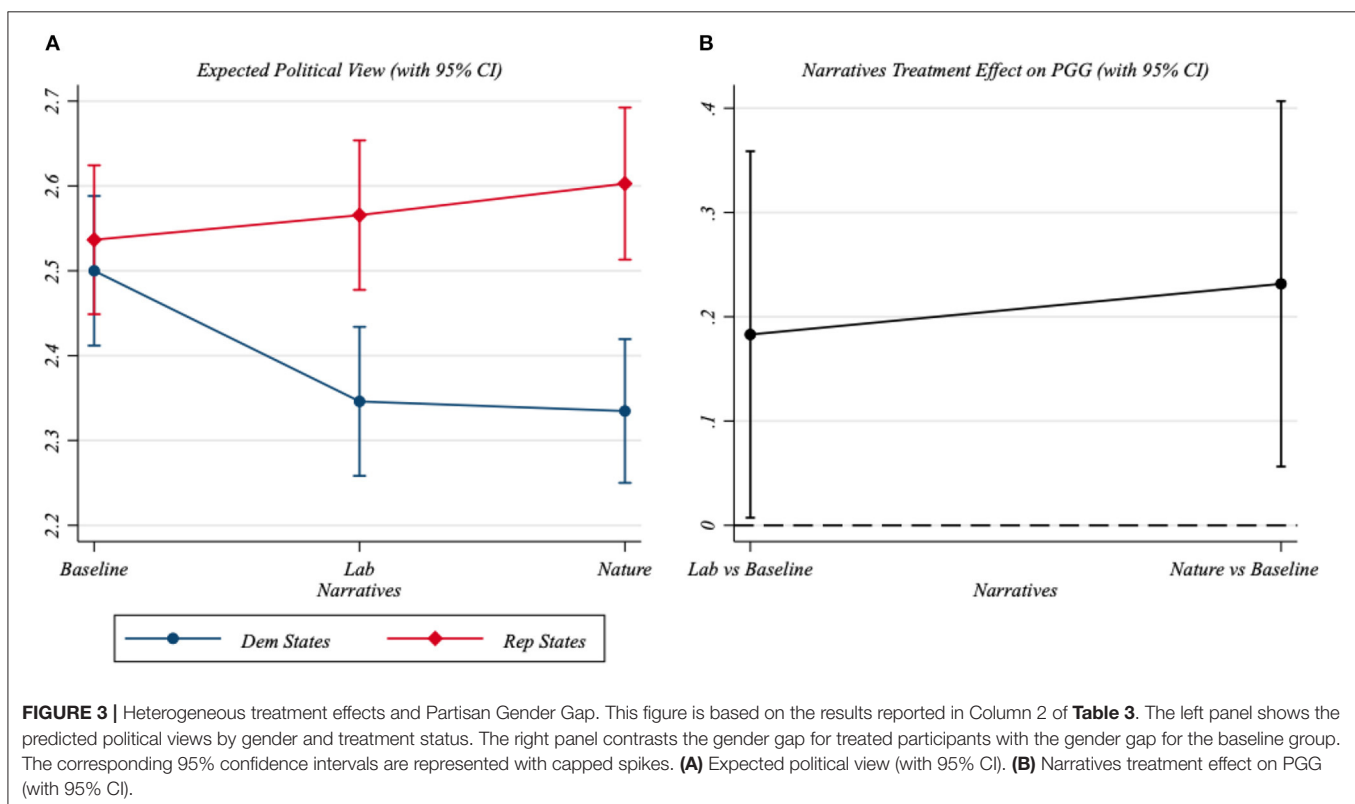
$$B_i^c = a + b \cdot \text{male}_i + q \cdot \text{rep}_i + d \cdot T_i + m \cdot T_i \cdot \text{male}_i + r \cdot T_i \cdot \text{rep}_i + p' X_i + e_i, \quad (4)$$

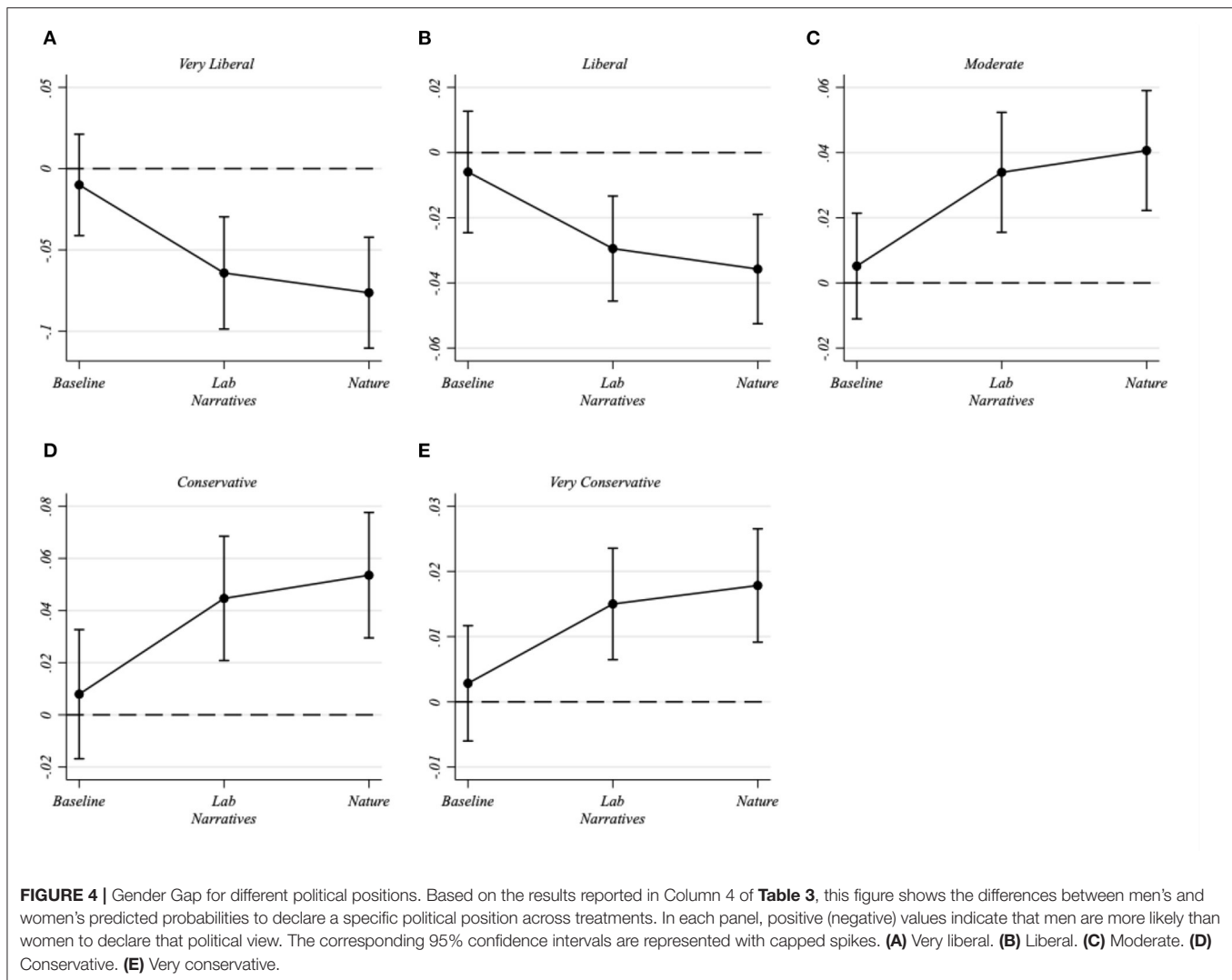
and

$$PV_i = \alpha + \beta \cdot \text{male}_i + \gamma \cdot \text{rep}_i + \delta \cdot T_i + \mu \cdot T_i \cdot \text{male}_i + \rho \cdot T_i \cdot \text{rep}_i + \phi' X_i + \sum_c \sigma_c \cdot B_i^c + \varepsilon_i, \quad (5)$$

where B_i^c is the number of points that subject i assigned to cause c and represents his/her beliefs. Using the terminology adopted in mediation analysis, we can refer to Equation (4) as “mediation equation,” whereas Equation (5) is typically called “outcome equation.” Since our survey considered different potential causes of COVID-19, each cause will have its mediation equation. Because beliefs about COVID-19 origins (i.e., mediators) are correlated, we allow residuals of the mediators to be correlated.

To measure the indirect effect of narratives (as well as of any other covariate) on subjects' political view, we must multiply the coefficients estimated in Equation (4) by the coefficient of beliefs estimated in Equation (5) (i.e., σ_c for any hypothesized cause c) and taking their sum. In other words, for treated subjects, the treatment effect passing through individual beliefs will be given





by $\sum_c \sigma_c \cdot d$. In this way, we capture any rational or motivated reasoning effect of a narrative passing through individual beliefs on COVID-19 causes (links 1 and 2 in **Figure 1**). Analogously, the indirect effect of any other control variable such as rep_i or X_i will be given by $\sum_c \sigma_c \cdot q$ or $\sum_c \sigma_c \cdot p$. In contrast, the coefficients in Equation (5) measure the direct impact of explanatory variables on political views and capture the cheerleading effect, that is, the effect that is not mediated by any rational or motivated reasoning on COVID-19 causes (link 3 in **Figure 1**). We use the delta method to compute the standard errors of both the cheerleading and the reasoning effect.¹⁵

Results

Figure 2 displays the average political view declared by men and women across different treatment groups. Whereas there are no differences between male and female preferences in

the baseline group, significant differences seem to emerge for men and women treated with the two narratives. In particular, treated women declare more liberal views, whereas treated men report more conservative positions. We used a Kruskal-Wallis test to support visual interpretation. According to this test, the difference between genders is statistically insignificant in the baseline group [$\chi^2(1)$ is 0.295 with $p = 0.587$]. In contrast, a Partisan Gender Gap seems to appear when subjects are treated with narratives ($\chi^2(1)$ is 11.628 with $p = 0.001$ for the *Lab narrative*, and $\chi^2(1)$ 21.419 with $p = 0.000$ for the *Nature narrative*).

Table 3 reports our main results. Columns 1 and 2 show the OLS estimates of Equation (1), while Columns 3 and 4 provide the corresponding Ordered Probit estimates. In Columns 1 and 3, we interacted the factor variable indicating the treatment group with the *male* dummy, assuming $\rho = 0$ for any narrative. The positive coefficients of the interaction terms (i.e., *Lab narrative*male* and *Nature narrative*male*) indicate that the distance between men's political positions and women's political

¹⁵See MacKinnon et al. (2007) for further methodological details on mediation analysis.

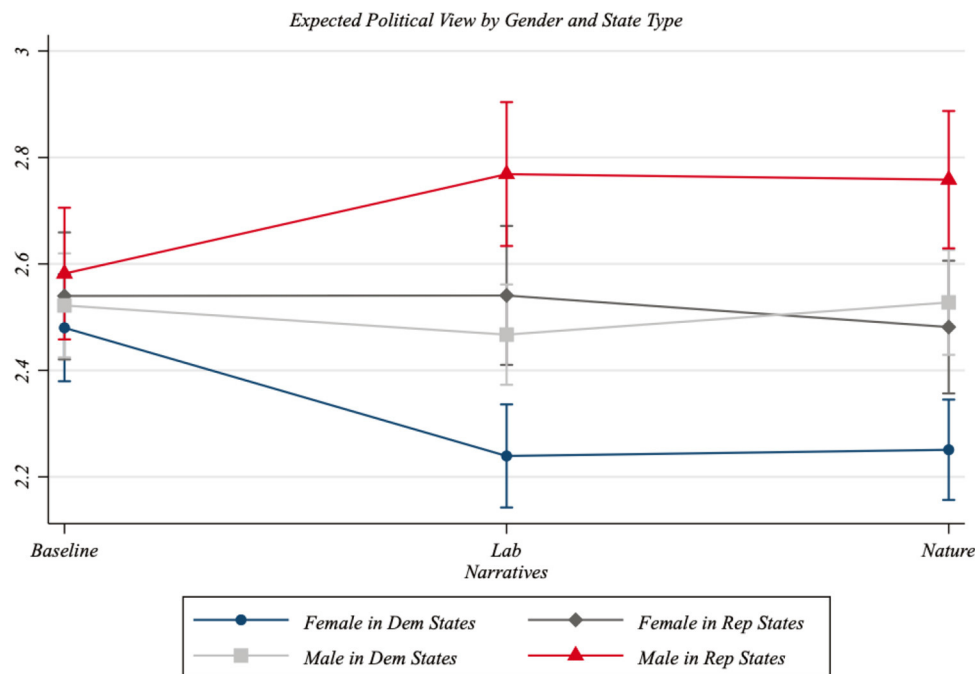


FIGURE 5 | Partisan Gender Gap and state type. Based on the results reported in Column 2 of **Table 3**, this figure shows the predicted political views by gender and treatment status, distinguishing between individuals living in Republican-leaning states and those living in Democratic-leaning states. The corresponding 95% confidence intervals are represented with capped spikes.

positions widens once subjects are treated with one of the two narratives. In other words, whereas the treated women tend to declare more liberal positions compared to the control treatment, the treated men do not change their political position compared to the control which enlarges the PGG. This evidence is in line with **Figure 2**.

In Columns 2 and 4, we also interact the treatment indicator with the dummy variable indicating Republican-leaning states. This allows us to take into account the fact that narratives on COVID-19 origins cause political polarization between subjects living in Democratic-leaning and Republican-leaning states (Antinyan et al., 2021a). The F -test and Wald- χ^2 test reported at the end of Columns 2 and 4, respectively, indicate that the inclusion of this second interaction term slightly improves the model specification. As before, coefficient μ is positive for both narratives, which implies that treated subjects continue to exhibit a PGG.¹⁶ Because PV has a standard deviation of 1.04, the interpretation of OLS coefficients reported in **Table 3** and of our results in general are rather straightforward. In particular, a single exposure to the Lab narrative induces a PGG of 17.9 percentage points of standard deviation (i.e., 0.186/1.04), whereas a single

exposure to the Lab narrative induces a PGG of 22.6 percentage points of standard deviation (i.e., 0.235/1.04).

Notice that, when controlling for socio-demographic characteristics (such as income, education, and social context in which participants live) that have been used to explain the PGG (Kaufmann, 2002; Huddy et al., 2008), we find no difference in political positions between women and men assigned to the baseline group.¹⁷ Interestingly, we would expect to observe PGG in the baseline group, nonetheless its absence can be due to the characteristics of the subject pool that participates in the on-line experiment. Indeed, while online experiments permit us to recruit a broader population than classical lab experiments with students, internet and platform users can still be different from the population at large (Palan and Schitter, 2018; Coppock, 2019). Please note that the absence of the PGG in the baseline group, does not harm the internal validity of the study, since the randomization is successful and the subjects in the three treatment arms possess similar characteristics. Thus, the increase of the PGG in the treatment groups can be attributed to the narratives the subjects are exposed to with very high confidence. Commenting on the external validity of the results, we think that the political narratives studied can make the PGG even wider

¹⁶We have also considered a three-way interaction model in which narratives are interacted with state political orientation and gender. However, with a p -value of 0.321 and 0.391, respectively, the F -test and Wald- χ^2 test for nested specifications reveal that a three-way interaction model does not significantly improve the reduced model estimated in Columns 2 and 4. Therefore, we opted for more parsimonious specifications, such as those reported in **Table 2**.

¹⁷The coefficients of control variables indicate that individual income, education, and county-level political orientation influence political preferences (see **Table F1** of the Supplementary Information). This implies that, in a more heterogeneous population, such factors might also cause a PGG in the baseline group that is not related to narratives.

at the population level, where socio-demographic differences between men and women exist.

Figure 3 provides a graphical representation of results reported in Column 2 of **Table 3**. In particular, panel A displays the expected political view (with the 95% CI) of men and women separately. Notice that, whereas no significant differences emerge between men and women in the baseline group, the distance between men and women's positions enlarges when respondents are treated with one of the two narratives. More specifically, treated women tend to declare more liberal views. Panel B reports the difference between the PGG for treated subjects and the PGG for subjects in the baseline group. This figure shows that the Partisan Gender Gap in the treated groups is significantly higher than the gender gap in the baseline group.

Result 1: Political narratives on the origins of COVID-19 increase the PGG by pushing women toward more liberal positions.

Using the Ordered Probit estimates reported in Column 4 of **Table 3**, **Figure 4** illustrates the probability gap between men and women expressing a specific political position across different treatments (i.e., the difference between the probability that men have a political view equal to k and the probability that women have the same view). Panels A and B reveal that, in the treatment groups, women are more likely than men to declare liberal and very liberal preferences compared to the baseline group. For instance, the probability that women treated with the Lab narrative express very liberal positions is more than 5 percentage points higher than the probability that men exposed to the same treatment declare very liberal positions (Panel A). In contrast, treated men are more likely than treated women to express moderate, conservative, or very conservative positions (panels C, D, and E). By looking at Panel D, we may notice that the probability that men exposed to the Lab (Nature) narrative declare a conservative view is about 4 (6) percent higher than the probability that women treated with the same narrative express the same position.

Column 2 of **Table 3** also allows us to distinguish the PGG across state types. Therefore, we also computed the expected political view of men and women living in Republican- and Democratic-leaning states separately. **Figure 5** indicates that the largest PGG is between men residing in Republican-leaning states and women living in Democratic-leaning states. Indeed, adding the 17.9% points of PV standard deviation due to the Lab narrative's PGG effect to the 23.2% points associated with state differences, we obtain a distance between men residing in Republican-leaning states and women living in Democratic-leaning states of more than 40 standard deviation points.

Result 2: State political differences magnify the effect of narratives regarding the origins of COVID-19 on the gender gap in political views.

In **Table 4**, we decompose the total effects reported in Column 2 of **Table 3** into the cheerleading and the reasoning effect.¹⁸ According to our results, women exhibit both components

TABLE 4 | Political view (decomposition).

	Cheerleading (1)	Reasoning (2)	Total (3)
Nature hypothesis			−0.005*** (0.001)
Accident hypothesis			0.010*** (0.001)
Weapon hypothesis			0.007*** (0.001)
Lab narrative	−0.360*** (0.065)	0.119*** (0.030)	−0.241*** (0.071)
Nature narrative	−0.137** (0.064)	−0.092*** (0.030)	−0.229*** (0.070)
Lab narrative*male	0.194** (0.081)	−0.008 (0.037)	0.186** (0.089)
Nature narrative*male	0.197** (0.081)	0.038 (0.037)	0.235*** (0.089)
Male	0.084 (0.057)	−0.042 (0.026)	0.042 (0.063)
Rep	−0.035 (0.062)	−0.007 (0.028)	−0.042 (0.068)
Lab narrative*rep	0.199** (0.085)	0.043 (0.039)	0.242*** (0.093)
Nature narrative*rep	0.182** (0.085)	−0.011 (0.039)	0.171* (0.093)
Additional controls	Yes	Yes	Yes
Observations	3,086	3,086	3,086
R ²	0.224		0.166

*This table reports the cheerleading and reasoning effects estimated through the structural equation model described by Equations (4) and (5). Column 1 provides the cheerleading effect (i.e., each covariate's direct effect on individual political views). These coefficients correspond to the estimates of Equation (5). For each covariate, Column 2 reports the reasoning effect (i.e., the effect of a covariate on political view passing through individual beliefs on COVID-19 causes). These effects are computed by multiplying the coefficient in Equation (4) with the estimated coefficients of COVID-19 causes in Equation (5). Column 3 gives the total effect of two components (i.e., the sum of direct and indirect effects). The other remarks about the additional controls of **Table 3** apply. Standard errors are in parentheses and covariance among equations is allowed.*

*Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

(see the coefficients of *Lab narrative* and *Nature narrative*). In the *Lab narrative* case, these two components have opposite effects, and the cheerleading effect dominates the reasoning one. In the *Nature narrative* case, both the cheerleading and the reasoning effects push women toward more liberal positions. Notice that, although we cannot distinguish between accuracy-driven and directionally motivated reasoning, we can conclude that treated subjects' reasoning is not directionally motivated. Indeed, independently of whether partisans react to political cues with directionally motivated reasoning or a cheerleading behavior, these two effects should always exhibit the same sign, causing more political polarization. Therefore, given that men and women do not differ in terms of reasoning, we can indirectly infer that both sexes adopt an accuracy driven logic, but this logic is masked by a cheerleading behavior.

¹⁸**Table 3** only shows the estimates of Equation (5). The coefficients of the mediation equations, represented by Equation (4), are in **Table B1** of the Supplementary Information.

By looking at the coefficients of *Lab narrative*male* and *Nature narrative*male*, we can say that men exhibit a lower cheerleading component, while the reasoning effect remains unchanged.

Finally, in line with Antinyan et al. (2021a), we found that subjects residing in Republican-leaning states react to our narratives with a cheerleading behavior that pushes them to declare more conservative positions (see the coefficients of *Lab narrative*rep* and *Nature narrative*rep*).

Result 3: The PGG arising from exposing subjects to narratives on COVID-19 origins is the consequence of a cheerleading behavior.

CONCLUSIONS

In this paper, we explored how men and women respond differently to political narratives. In particular, we examined the effect of narratives on the origins of COVID-19 on the US Partisan Gender Gap, that is, the increasing political gap between males and females. To do this, we randomly assigned subjects to three different treatments: a non-narrative treatment (the baseline), a treatment ascribing the cause of the COVID-19 to a human error that occurred in a Chinese lab (*Lab narrative*), and a treatment suggesting that COVID-19 is a natural phenomenon originating from wildlife (*Nature narrative*). These two narratives were already circulating in the US before our experiment, so subjects had the opportunity to locate them within the political debate. Indeed, the *Lab narrative* has been supported by Trump's administration on several occasions, whereas the *Nature narrative* represented the main opposing narrative to Trump's rhetoric. This means that both stories were potentially associated with some political cues.

We found that these cues were strong enough to push women toward more liberal positions, enhancing the Partisan Gender Gap. Both narratives are particularly effective in activating women living in Democratic-leaning states and men residing in Republican-leaning states. Compared to the baseline group, the former tended to declare more liberal positions, whereas the latter responded by adopting a more conservative view. Finally, we investigate whether the polarizing effect of narratives passes through reasoning or is the consequence of a pure cheerleading behavior. We find that reason plays the same role in both sexes; thus, the Partisan Gender Gap increases because of cheerleading

behaviors. In other words, males and females react to narratives on COVID-19 causes reinforcing or reaffirming their political identity, mainly when this identity is supported by the socio-political context in which they live.

These results suggest that attaching political cues to pieces of information that could otherwise be decision-relevant, may favor partisan affiliation to become the salient dimension, amplifying the partisan gender gap.

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 Ethical Committee of the University of Venice Ca' Foscari. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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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.2021.675684/full#supplementary-material>

REFERENCES

- Andreoni, J., and Mylovannov, T. (2012). Diverging opinions. *Am. Econ. J. Microecon.* 4, 209–232. doi: 10.1257/mic.4.1.209
- Antinyan, A., Bassetti, T., Corazzini, L., and Pavesi, F. (2021a). *Narratives on COVID-19 Origins and Voter Polarization*. Venice: Mimeo.
- Antinyan, A., Bassetti, T., Corazzini, L., and Pavesi, F. (2021b). *Narratives on COVID-19 and Policy Opinions: A Survey Experiment. Working Paper No. 04/WP/2021, ISSN 1827-3580*. Venice: Ca' Foscari University of Venice, Department of Economics. doi: 10.2139/ssrn.3764436
- Bail, C. A., Argyle, L. P., Brown, T. W., Bumpus, J. P., Chen, H., Hunzaker, M. F., et al. (2018). Exposure to opposing views on social media can increase political polarization. *Proc. Natl. Acad. Sci. U. S. A.* 115, 9216–9221. doi: 10.1073/pnas.1804840115
- Baliga, S., Hanany, E., and Klibanoff, P. (2013). Polarization and ambiguity. *Am. Econ. Rev.* 103, 3071–3083. doi: 10.1257/aer.103.7.3071
- Bartels, L. M. (2002). Beyond the running tally: partisan bias in political perceptions. *Polit. Behav.* 24, 117–150. doi: 10.1023/A:1021226224601
- Box-Steffensmeier, J. M., De Boef, S., and Lin, T.-M. (2004). The dynamics of the Partisan Gender Gap. *Am. Polit. Sci. Rev.* 98, 515–528. doi: 10.1017/S0003055404001315
- Bullock, J., Gerber, A., Hill, S., and Huber, G. (2015). Partisan bias in factual beliefs about politics. *Quart. J. Polit. Sci.* 10, 519–578. doi: 10.1561/100.00014074
- Bullock, J., and Lenz, G. (2019). Partisan bias in surveys. *Ann. Rev. Polit. Sci.* 22, 325–342. doi: 10.1146/annurev-polisci-051117-050904
- Clark, A. K. (2017). Updating the gender gap(s): a multilevel approach to what underpins changing cultural attitudes. *Polit. Gender* 13, 26–56. doi: 10.1017/S1743923X16000520

- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge.
- Conover, P. J. (1988). Feminists and the gender gap. *J. Polit.* 50, 985–1010. doi: 10.2307/2131388
- Coppock, A. (2019). Generalizing from survey experiments conducted on Mechanical Turk: a replication approach. *Polit. Sci. Res. Methods* 7, 613–628. doi: 10.1017/psrm.2018.10
- Crow, D., and Jones, M. (2018). Narratives as tools for influencing policy change. *Policy Polit.* 46, 217–234. doi: 10.1332/030557318X15230061022899
- Dimock, M., Kiley, J., Keeter, S., and Doherty, C. (2014). *Political Polarization in the American Public: How Increasing Ideological Uniformity and Partisan Antipathy Affect Politics, Compromise, and Everyday Life*. Washington, DC: Pew Research Center.
- Edlund, L., and Pande, R. (2002). Why have women become left-wing? The political gender gap and the decline in marriage. *Quart. J. Econ.* 117, 917–961. doi: 10.1162/003355302760193922
- Eliasz, K., and Spiegler, R. (2020). A model of competing narratives. *Am. Econ. Rev.* 110, 3786–3816. doi: 10.1257/aer.20191099
- Flynn, D. J., Nyhan, B., and Reifler, J. (2017). The nature and origins of misperceptions: understanding false and unsupported beliefs about politics. *Polit. Psychol.* 38, 127–150. doi: 10.1111/pops.12394
- Fryer, R. G. Jr., Harms, P., and Jackson, M. O. (2019). Updating beliefs when evidence is open to interpretation: implications for bias and polarization. *J. Eur. Econ. Assoc.* 17, 1470–1501. doi: 10.1093/jea/evy025
- Gaines, B. J., Kuklinski, J. H., Quirk, P. J., Peyton, B., and Verkuilen, J. (2007). Same facts, different interpretations: partisan motivation and opinion on Iraq. *J. Polit.* 69, 957–974. doi: 10.1111/j.1468-2508.2007.00601.x
- Gentzkow, M., Shapiro, J. M., and Taddy, M. (2019). Measuring group differences in high-dimensional choices: method and application to congressional speech. *Econometrica* 87, 1307–1340. doi: 10.3982/ECTA16566
- Gilens, M. (2001). Political ignorance and collective policy preferences. *Am. Polit. Sci. Rev.* 95, 379–396. doi: 10.1017/S0003055401002222
- Gillion, D. Q., Ladd, J. M., and Meredith, M. (2020). Party polarization, ideological sorting and the emergence of the US Partisan Gender Gap. *Br. J. Polit. Sci.* 50, 1217–1243. doi: 10.1017/S0007123418000285
- Howell, W. G., and West, M. R. (2009). Educating the public: how information affects Americans' support for school spending and charter schools. *Education Next* 9, 40–48.
- Huddy, L., Cassese, E., and Lizotte, M.-K. (2008). "Gender, public opinion, and political reasoning," in *Political Women and American Democracy*, eds C. Wolbrecht, K. Beckwith, and L. Baldez (New York, NY: Cambridge University Press), 31–49. doi: 10.1017/CBO9780511790621.005
- Iversen, T., and Rosenbluth, F. (2006). The political economy of gender: explaining cross-national variation in the gender division of labor and the gender voting gap. *Am. J. Polit. Sci.* 50, 1–19. doi: 10.1111/j.1540-5907.2006.00166.x
- Jones, J. (2019). *Democratic States Exceed Republican States by Four in 2018*. Gallup, 22 February. Available online at: <https://news.gallup.com/poll/247025/democratic-states-exceed-republican-states-four-2018.aspx> (accessed May 9, 2020).
- Karadja, M., Mollerstrom, J., and Seim, D. (2017). Richer (and holier) than thou? The effect of relative income improvements on demand for redistribution. *Rev. Econ. Statist.* 99, 201–212. doi: 10.1162/REST_a_00623
- Kaufmann, K. M. (2002). Culture wars, secular realignment, and the gender gap in party identification. *Polit. Behav.* 24, 283–307. doi: 10.1023/A:1021824624892
- Kaufmann, K. M., and Petrocik, J. R. (1999). The changing politics of American men: understanding the sources of the gender gap. *Am. J. Polit. Sci.* 43, 864–887. doi: 10.2307/2991838
- Klar, S. (2014). Partisanship in a social setting. *Am. J. Polit. Sci.* 58, 687–704. doi: 10.1111/ajps.12087
- Kraft, P. W., Lodge, M., and Taber, C. S. (2015). Why people "don't trust the evidence" motivated reasoning and scientific beliefs. *ANNALS Am. Acad. Polit. Soc. Sci.* 658, 121–133. doi: 10.1177/0002716214554758
- Kunda, Z. (1990). The case for motivated reasoning. *Psychol. Bull.* 108, 480–498. doi: 10.1037/0033-2909.108.3.480
- Linden, A., and Samuels, S. J. (2013). Using balance statistics to determine the optimal number of controls in matching studies. *J. Eval. Clin. Practice* 19, 968–975. doi: 10.1111/jep.12072
- Loh, I., and Phelan, G. (2019). Dimensionality and disagreement: asymptotic belief divergence in response to common information. *Int. Econ. Rev.* 60, 1861–1876. doi: 10.1111/iere.12406
- Lord, C. G., Ross, L., and Lepper, M. R. (1979). Biased assimilation and attitude polarization: the effects of prior theories on subsequently considered evidence. *J. Personal. Soc. Psychol.* 37, 2098–2109. doi: 10.1037/0022-3514.37.11.2098
- MacKinnon, D. P., Fairchild, A. J., and Fritz, M. S. (2007). Mediation analysis. *Ann. Rev. Psychol.* 58, 593–614. doi: 10.1146/annurev.psych.58.110405.085542
- Martin, G. J., and Yurukoglu, A. (2017). Bias in cable news: persuasion and polarization. *Am. Econ. Rev.* 107, 2565–2599. doi: 10.1257/aer.20160812
- Miller, J. M., Saunders, K. L., and Farhart, C. E. (2016). Conspiracy endorsement as motivated reasoning: the moderating roles of political knowledge and trust. *Am. J. Polit. Sci.* 60, 824–844. doi: 10.1111/ajps.12234
- Miller, P. R., and Conover, P. J. (2015). Red and blue states of mind: Partisan hostility and voting in the United States. *Polit. Res. Quart.* 68, 225–239. doi: 10.1177/1065912915577208
- Morson, G. S., and Schapiro, M. (2017). *Cents and Sensibility: What Economics Can Learn from the Humanities*. Princeton, NJ: Princeton University Press. doi: 10.1515/9781400884841
- Normand, S. L. T., Landrum, M. B., Guadagnoli, E., Ayanian, J. Z., Ryan, T. J., Cleary, P. D., et al. (2001). Validating recommendations for coronary angiography following an acute myocardial infarction in the elderly: a matched analysis using propensity scores. *J. Clin. Epidemiol.* 54, 387–398. doi: 10.1016/S0895-4356(00)00321-8
- Palan, S., and Schitter, C. (2018). Prolific.ac—A subject pool for online experiments. *J. Behav. Exp. Fin.* 17, 22–27. doi: 10.1016/j.jbef.2017.12.004
- Peterson, E., and Iyengar, S. (2020). Partisan gaps in political information and information-seeking behavior: motivated reasoning or cheerleading? *Am. J. Polit. Sci.* 2020:pnm7h. doi: 10.31235/osf.io/pnm7h
- Prior, M., Sood, G., and Khanna, K. (2015). You cannot be serious: the impact of accuracy incentives on partisan bias in reports of economic perceptions. *Quart. J. Polit. Sci.* 10, 489–518. doi: 10.1561/100.00014127
- Rubin, D. B. (2001). Using propensity scores to help design observational studies: application to the tobacco litigation. *Health Services Outcomes Res. Methodol.* 2, 169–188. doi: 10.1023/A:1020363010465
- Schaeffer, K. (2020). *Nearly Three-in-Ten Americans Believe COVID-19 Was Made in a Lab*. Pew Research Centre. Available online at: <https://www.pewresearch.org/fact-tank/2020/04/08/nearly-three-in-ten-americans-believe-covid-19-was-made-in-a-lab> (accessed May 13, 2020).
- Schaffner, B. F., and Luks, S. (2018). Misinformation or expressive responding? What an inauguration crowd can tell us about the source of political misinformation in surveys. *Publ. Opin. Quart.* 82, 135–147. doi: 10.1093/poq/nfx042
- Shapiro, R. Y., and Mahajan, H. (1986). Gender differences in policy preferences: a summary of trends from the 1960s to the 1980s. *Publ. Opin. Quart.* 50, 42–61. doi: 10.1086/268958
- Shiller, R. J. (2017). Narrative economics. *Am. Econ. Rev.* 107, 967–1004. doi: 10.1257/aer.107.4.967
- Shiller, R. J. (2019). *Narrative Economics: How Stories Go Viral and Drive Major Economic Events*. Princeton, CA: Princeton University Press. doi: 10.1515/9780691189970
- Taber, C. S., and Lodge, M. (2006). Motivated skepticism in the evaluation of political beliefs. *Am. J. Polit. Sci.* 50, 755–769. doi: 10.1111/j.1540-5907.2006.00214.x
- USA Facts (2020). *US Coronavirus Cases and Deaths. Track COVID-19 Data Daily by State and County*. Available online at: <https://usafacts.org/visualizations/coronavirus-covid-19-spread-map> (accessed May 15, 2020).

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Life With Corona: Increased Gender Differences in Aggression and Depression Symptoms Due to the COVID-19 Pandemic Burden in Germany

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Gender differences (GD) in mental health have come under renewed scrutiny during the COVID-19 pandemic. While rapidly emerging evidence indicates a deterioration of mental health in general, it remains unknown whether the pandemic will have an impact on GD in mental health. To this end, we investigate the association of the pandemic and its countermeasures affecting everyday life, labor, and households with changes in GD in aggression, anxiety, depression, and the somatic symptom burden. We analyze cross-sectional data from 10,979 individuals who live in Germany and who responded to the online survey “Life with Corona” between October 1, 2020 and February 28, 2021. We estimate interaction effects from generalized linear models. The analyses reveal no pre-existing GD in aggression but exposure to COVID-19 and COVID-19 countermeasures is associated with sharper increases in aggression in men than in women. GD in anxiety decreased among participants with children in the household (with men becoming more anxious). We also observe pre-existing and increasing GD with regards to the severity of depression, with women presenting a larger increase in symptoms during the hard lockdown or with increasing stringency. In contrast to anxiety, GD in depression increased among participants who lived without children (women > men), but decreased for individuals who lived with children; here, men converged to the levels of depression presented by women. Finally, GD in somatic symptoms decreased during the hard lockdown (but not with higher stringency), with men showing a sharper increase in symptoms, especially when they lived with children or alone. Taken together, the findings indicate an increase in GD in mental health as the pandemic unfolded in Germany, with rising female vulnerability to depression and increasing male aggression. The combination of these two trends further suggests a worrying mental health situation for singles and families. Our results have important policy implications for the German

health system and public health policy. This public health challenge requires addressing the rising burden of pandemic-related mental health challenges and the distribution of this burden between women and men, within families and for individuals who live alone.

Keywords: aggression, anxiety, depression, somatization, mental health, COVID-19 pandemic, gender differences

INTRODUCTION

More than 1 year has passed since the beginning of the COVID-19 pandemic and evidence on its profound psychological impacts is emerging rapidly from around the world (Wang C. et al., 2020; Williams et al., 2020). So far, the life-threatening and traumatic nature of the pandemic, as well as the increased stress load imposed by measures to contain the SARS-CoV-2 virus, the coronavirus causing COVID-19 (hereafter referred to as “the coronavirus”), are causing a deterioration in mental health (Xiang et al., 2020). Recent studies document higher levels of stress and anxiety, loneliness and insomnia, somatization, and depressive symptoms, as well as symptoms of post-traumatic stress (Ko et al., 2020; Ran et al., 2020; Shelef and Zalsman, 2020). A meta-study (Wu et al., 2021) conducted in May 2020 evaluated over 10 studies on anxiety and depression since the onset of the COVID-19 pandemic and found prevalence rates of over 30%. Accordingly, recent meta-analyses estimated the prevalence of depression in the general population during the pandemic at 25% (95% confidence interval: 18–33%) (Bueno-Notivol et al., 2021) and 33.7% (95% confidence interval: 27.5–40.6) (Salari et al., 2020); pre-pandemic prevalence rates between 1994 and 2014 across 30 communities averaged at 12.9% (95% confidence interval: 11.1–15.1%) and data from Global Burden of Disease showed a proportion of 3.4% in 2017 (Ritchie and Roser, 2018).

Given the gender-specific challenges associated with the pandemic, the latter may also impact mental health differently by gender. Gender, beyond the biological definition of sex, refers to socially allocated roles, behaviors, identities, and expectations. In the literature, gendered behavior is understood as a cultural phenomenon rather than merely biological, given its highly relational nature (Flanagan, 2012). Gender differences (GD) in mental health outcomes have been established previously. Anxiety and mood disorders have been shown to be more prevalent among women than men (Rosenfield and Mouzon, 2013), while externalizing behavior or aggression and substance use disorders are more prevalent among men than women (Seedat et al., 2009; Boyd et al., 2015). To varying extents, these differences are assumed to be the result of sex-specific genetic (Kang et al., 2020), epigenetic (Hodes et al., 2017), neural (Stewart et al., 2010), reproductive (Li and Graham, 2017), and social factors, e.g., social roles and gender norms (Alon et al., 2020). It is widely acknowledged that gender is experienced not just individually but also socially. These social roles were found to partially explain GD in the perception of psychological distress (Simon, 1995), and GD in mental health is one of the facets where they manifest themselves. As the pandemic imposes different stressors on individuals with different (gendered) roles due to, for example, unemployment, home schooling, and working from home, differences in the impact of psychological distress on mental health may emerge. However, to date, we have limited

evidence about the pandemic-related stressors that affect gender roles differentially, and how they impact GD in mental health.

In summary, the aim of this paper is to address knowledge gaps about GDs of mental health outcomes that emerged with the COVID-19 pandemic. Specifically, we analyze GD in aggression, anxiety, and depression symptoms, as well as the somatic symptom burden for adult men and women in Germany during the winter period of 2020/2021. For the purpose of the current study, we categorize gender as male, female or other and analyze data on the binary spectrum. This is undoubtedly a coarse categorization, since growing empirical evidence affirms that gender is a non-binary construct. Recent awareness of gender diversity draws attention to the experience and rights of transgenders and individuals who perceive their gender identity as neither entirely male nor female (Ainsworth, 2015; Cameron and Stinson, 2019). In the methods and limitations sections, we describe why we chose the binary construct to answer our research questions, although we agree that research should move toward more gender inclusivity. To examine the impact of the COVID-19 pandemic, we specify three sets of analyses: first, the nature and intensity of containment measures imposed in Germany, comparing outcomes during *light* vs. *hard lockdowns* and across stringency levels of measures to contain the virus using the Oxford Stringency Index; second, exposure to the coronavirus by testing positive for the virus, knowing someone who died due to the pandemic and suffering income losses during the pandemic; third, household characteristics—being the main provider, living vs. not living with children, and living alone vs. with others in interaction with the stringency index.

GD in Aggression

Aggression can be defined as any behavior intended to cause harm in others motivated either reactively, thus occurring as a response to a perceived threat, or instrumentally/proactively (Anderson and Bushman, 2002). Increasing evidence points to the rewarding and thus self-perpetuating nature of aggression (Nell, 2006; Elbert et al., 2010, 2018; Koebach and Elbert, 2015; Golden and Shaham, 2018; Golden et al., 2019; Koebach et al., 2021). In recent aggression models, aggressive behavior is described as a consequence of situational (e.g., stress, frustration, discomfort, threatening stimuli) and personal factors (e.g., traits, attitudes, gender, trauma history), as well as internal states (e.g., cognition, affect, and arousal; e.g., Anderson and Bushman, 2002; Bushman, 2016; Elbert et al., 2018). In contrast, anger is considered a social emotion manifesting as a state or trait (Spielberger et al., 1983, 1995), and predisposing for an aggressive action in response to a (perceived) threat (Bettencourt et al., 2006). Inherent to the survival mode (Chemtob et al., 1997; Novaco and Chemtob, 1998) and with its property to suppress fear (Foa et al., 1995; Feeny et al., 2000), it is highly

prevalent in trauma-exposed individuals (for review see Orth and Wieland, 2006). Within this framework, aversive situations such as the COVID-19 pandemic and its circumstances, e.g., confinement or economic hardship, may impose an increased level of threat, frustration and discomfort. We theorize that COVID-19-related stressors stimulate cognitive, emotional, and physiological reactions that are associated with threat, and thus trigger fight-or-flight tendencies that lead to a higher level of anger and reactive physical aggression (Gelles, 1993; Allen et al., 2018; Elbert et al., 2018).

In line with this hypothesis, Ye et al. (2021) found an increase of online aggressive behavior associated with fear about contagion with COVID-19. In 2016, during an epidemic of the Middle East Respiratory Syndrome (MERS), Jeong et al. (2016) examined the effects of a 2-week isolation period on anger and anxiety, and found about 16% of participants experienced anger when isolated due to MERS virus exposure. Several health experts and scientists have also observed increasing rates of family violence during the COVID-19 pandemic, particularly in situations of more stringent quarantines (Fraser, 2020; Perez-Vincent et al., 2020; Telles et al., 2020; Ebert and Steinert, 2021). In a recent meta-analysis, Piquero et al. (2021) found strong evidence for a moderate increase in domestic violence as a result of the pandemic based on 18 studies from the United States ($n = 12$), Mexico ($n = 1$), Argentina ($n = 1$), India ($n = 1$), Australia ($n = 1$), and Europe ($n = 2$). A study in Germany estimated the prevalence of violence against women and children during the pandemic, reporting 3.1% of women suffered verbal and physical conflict during the previous month; 7.8% reported emotional abuse; 3.1% felt threatened by their partner; and 6.7% reported child corporal punishment (Ebert and Steinert, 2021). The authors concluded that the risk of violence was more than double in households in quarantine, compared with households not in quarantine. Accordingly, Leslie and Wilson (2020) reported an increase of 7.5% of police calls in the United States due to an incident of intimate partner violence (IPV) during the first months of the pandemic. With regard to crime rates, evidence shows an overall decline in almost all types of crime during lockdowns, with exception to homicides and cyber crime (Halford et al., 2020; Hodgkinson and Andresen, 2020; Buil-Gil et al., 2021; Scott and Gross, 2021; Sutherland et al., 2021). A study from Australia recently showed that this effect might reverse once the measures are lifted (Andresen and Hodgkinson, 2020), but longer-term developments in crime indices remain to be explored. Thus, the literature suggests a shift of violence from the streets into the homes.

Traditionally, boys and men have been considered more aggressive than girls and women (Leslie and Wilson, 2020). However, more recent approaches claim gender-specific types of aggression with men being directly aggressive and women indirectly (e.g., spreading rumors) have come to the fore (Lagerspetz et al., 1988). This is also reflected in how women respond to anger: while it is recognized that men and women generally display comparable levels of anger (Deffenbacher et al., 1996), men tend to externalize their aggressive feelings more (Archer, 2004; Björkqvist, 2018), while women may respond to provocation with more anxiety and fear (Björkqvist, 2018). In a large sample from Denmark (>10,000 participants), found that

hospitalization due to interpersonal violence predicted criminal behavior in men and self-harm in women. Moreover, about 80% of all global homicides are perpetrated by men (Global Study on Homicide, 2019). Yet, there are conditions when GD in aggression disappear. In a meta-analysis, Knight et al. (2002) found that GD in aggression was most pronounced when the context allowed for variance in emotional arousal (rather than secure or highly arousing situations). This is also in line with findings from war-affected men and women who both presented similar levels of appetitive aggression after involvement to similar levels of trauma and violent fighting (Augsburger et al., 2015; Meyer-Parlapanis et al., 2016). GD in aggression have been argued to be associated with biological (e.g., Turanovic et al., 2017; Denson et al., 2018; Ling et al., 2019), psychological (e.g., as sequelae of trauma) and social factors (e.g., social learning, etc.). Further, researchers plausibly theorize that GD in aggression are the result of sexual selection throughout evolution (Archer and Webb, 2006; Elbert et al., 2018). Indirect/female forms of aggression are psychologically not less harmful (see Eisenberger and Lieberman, 2004; Eisenberger, 2012; Norman et al., 2012; Arseneault, 2017; Começanha et al., 2017; on social pain), but physical aggression and crime on average present higher societal costs and escalate more often into extreme forms requiring hospital admission, psychological treatment, restorative justice, isolation of perpetrators/imprisonment, etc. (Forum on Global Violence Prevention, 2011). Building on these findings, we focus in this paper on GD in anger and physical aggression, and postulate that, in Germany, men may respond with more anger and physical aggression to the stress caused by the pandemic.

GD in Anxiety

Symptoms of Generalized Anxiety Disorder (GAD) include restlessness, fatigue, excessive anxiety and worry, impaired concentration, and difficulty sleeping. About 5–6% of the population is estimated to present the full clinical diagnosis of GAD (Kessler et al., 1994). The COVID-19 pandemic has increased fear of acute threat of infection and death, which has been magnified by secondary stressors, e.g., social distancing, lockdowns, economic insecurity and unemployment. As a result, the incidence rates of anxiety have increased since the start of the pandemic (Alonzi et al., 2020; Bäuerle et al., 2020a; Canet-Juric et al., 2020; Kazmi, 2020; Mazza et al., 2020; Olaseni, 2020; Ozamiz-Etxebarria, 2020; Ausín et al., 2021; Moore et al., 2021; Msherghi et al., 2021).

Furthermore, anxiety, GAD in particular, is about 2–3 times more prevalent in women than in men (Beesdo et al., 2010; McLean et al., 2011); for review see Jalnapurkar et al. (2018). Differential biological, psychological, and social functioning have been found to underlie GD in anxiety. A large body of evidence emphasizes specific effects of reproductive hormones (Altemus, 2006; Altemus et al., 2014), e.g., estrogen that modulates brain regions relevant to the extinction of fear (Garcia et al., 2018), or testosterone which has anxiolytic effects (McHenry et al., 2014). Differential vulnerability to trauma and exposure to everyday stressors may further increase GD in anxiety (Donner and Lowry, 2013; Durbano, 2015). Gender theories emphasizes the identification of sex roles as factors determining GD in anxiety (Altemus, 2006; Altemus et al., 2014), namely when

discussing how etiological factors of anxiety and individual differences are moderated by socialization processes (social, cultural, and developmental) and gender-specific expectations (McLean and Anderson, 2009). Traditionally, gender role theory advocates that, in socialization processes, men and women are socially prescribed with certain behaviors, traits, and skills, with considerable evidence reporting that gender roles significantly influence symptoms of anxiety (Bem, 1981). For instance, expression of anxiety is inconsistent with male gender roles, and anxiety may therefore be less tolerated in men (Chambless and Mason, 1986; Ollendick et al., 2002). Indeed, the magnitude of GD depends on the type of anxiety (Bander and Betz, 1981; Moscovitch et al., 2005).

Since the beginning of the COVID-19 pandemic, several studies have discussed the increased vulnerability of women during the crisis, as women tend to work in jobs that require face-to-face interaction, depend on part-time employment, and manage both family and work (Olaseni, 2020; Sánchez-Teruel, 2021). Szabo et al. (2020) investigated stress levels in 1,552 Hungarians during the first month of the COVID-19 crisis and found that women were more worried than men (Szabo et al., 2020) about the consequences of the pandemic. Frederiksen and Gomez (2020) found that women tend to be worried more about someone in their family getting infected by COVID-19 and about income decrease (50% vs. 42%). Losada-Baltar et al. (2020) showed that feelings of loneliness and psychological distress were higher in women in Spain. Higher stress levels in women during the early stage of the pandemic were also found in China (Yan et al., 2021). However, these studies are not able to identify the effect of the pandemic on GD in anxiety. So far, only the study of Ausín et al. (2021) investigated gender-specific consequences in mental health due to the pandemic, in the period immediately after the declaration of the state of emergency in Spain. We extend this analysis to another setting (Germany), focus on longer-term effects, and consider various pandemic-related stressors.

GD in Depression

Depression refers to symptoms like depressed mood, loss of interest and pleasure, negative feelings and thoughts, and problems with sleeping and concentration, amongst others. Clinically relevant levels require these symptoms to persist for at least half a day and more than half of the days in a given time frame. Major depression is amongst the most prevalent mental disorders and a complex biopsychosocial interaction underlies the development of symptoms. In the advent of experimental psychology, Seligman (1972) introduced the concept of learned helplessness as he found that dogs exposed to electric shocks in an inescapable situation would later fail to escape electric shocks even when escape was possible (Overmier and Seligman, 1967). In humans, it was found that the attributional style (internal, global, and stable) is critical to whether subjects are able to cope with stressful situations (Abramson et al., 1978; Alloy, 1982; Raps et al., 1982). This model presents a prominent environmental theory for depression and its treatment in behavioral therapy at present (Rubenstein et al., 2016), besides other approaches that focus on traumatic or chronic environmental stressors (McCullough, 2003; O'Leary and Cryan, 2013; Wiborg, 2013).

As with the electric shocks, the pandemic has been imposed on individuals as a sequence of inescapable and unavoidable adverse events emerging in the form of the threat of infection, lockdowns, economic crisis, and restrictions to individual freedoms. The ability of individuals to cope with these stressors is subject to personal characteristics. Studies comparing the prevalence of depressive symptoms before and after the start of the pandemic suggest an increase in depression since the pandemic. This has been in the order of around 10.1% (Bretschneider et al., 2017) before the pandemic and 14.3% during the pandemic (Bäuerle et al., 2020b) in Germany. An accumulation of depression symptoms was also reported in the United States, with a threefold increase during COVID-19 pandemic (Ettman et al., 2020).

Concerning the GD of depression during the pandemic, two studies from China found that women showed higher prevalence of depression during the crisis (Wang C. et al., 2020; Zhang and Ma, 2020). In a large online survey from Italy ($N > 18,000$), Rossi et al. (2020) found women were more likely to display higher levels of depression. GD in depression represent a major health disparity, as women suffer about twice as frequently from major depression than men (Weissman and Klerman, 1977; Salk et al., 2017). Hammarström et al. (2009) conducted a literature review on explanatory models for GD in depression. The authors found that the majority of studies focused on a biomedical explanation (Hammarström et al., 2009), followed by sociocultural and psychological models that were superior on intersectionality and multifactoriality. Converging evidence of recent studies emphasize the interaction of environmental stress (e.g., childhood adversity, physical, sexual or emotional abuse, or neglect) and biological vulnerability (e.g., due to sex hormones, inflammation, etc.; for review see ref). Interestingly, studies consistently report narrowing GD in depression when accompanied by changes in traditional gender roles (Wickramaratne et al., 1989; Joyce et al., 1990; Seedat et al., 2009).

Given the higher depression rates in women before and during the pandemic, studies that emphasize GD in depression fail to reflect whether this is exaggerated due to the pandemic. Only Ausín et al. (2021) investigated the change in GD in depression due to the pandemic in Spain but did not find any evidence. To extend their findings, we investigate the differential impact of the pandemic, its countermeasures and related stressors, as well as household characteristics as moderators in Germany.

GD in Somatization

Somatic symptoms are common in medical, psychiatric, and social conditions, and are associated with higher levels of stress, decreased quality of life, and an increased use of health structures (Kroenke et al., 1990, 1997, 2010; Simon et al., 1999; Barsky et al., 2005; Rief et al., 2005; Fink et al., 2007; Kohlmann et al., 2013). This outcome has been subject to limited research in gender studies and during the pandemic. However, the few studies carried out suggest that COVID-19 may have considerable and gendered effects on somatization. Women and men reportedly experience somatic symptoms differently. Women tend to report somatic symptoms more frequently than men and experience them more intensively (Barsky et al., 2001). The reasons presented for these differences vary widely across

studies, since the same sensation may be differently described and labeled by women and men. Pennebaker and Roberts (1992) suggested that women use both situational information (external) and somatic (internal) signs to describe symptoms, while men rely more on internal signs. Again, gender roles may enforce GD in somatization. According to Ehlers (1993), women receive more positive reinforcement for expressing somatic symptoms than men, which may reinforce self-focus and partially explain GD in somatization, while men might suppress those symptoms more often, since they feel more discouraged from expressing them (Watt et al., 1998). Unlike mental health problems, somatic symptoms may not trigger stigmatization to the same extent, and we include them in this study as a global health indicator. Taking this into account, we seek to clarify GD in somatization associated with the COVID-19 pandemic and determine if these differences increased before and after the introduction of stricter measures to control the spread of the virus.

MATERIALS AND METHODS

Setting

Similar to other countries, the German federal and state governments, as well as local authorities, responded to the COVID-19 crisis by imposing countermeasures that included closures of schools and non-essential services, travel restrictions, mandatory self-isolation for travelers, and prohibition of gatherings. The second round of the Life with Corona (LwC) survey (see below) was launched during what was referred to as a light lockdown in October 2020: restaurants and cafés could only sell takeaway food and a maximum of ten people from two households were allowed to meet (religious congregations and street protests were subject to exemptions). As infection rates increased, measures were increased to a hard lockdown: private meetings were limited to five persons from two households and there were major closures of services such as schools and kindergartens, retail stores, personal care units (hairdressers, beauty salons, and similars), restaurants (with takeaway allowed), pubs, and cultural facilities. The hard lockdown lasted from December 16, 2020 until March 1, 2021, when some minor relaxations were introduced, reinstating a form of light lockdown.

Procedure

Life with Corona is a global online survey operated by an international academic consortium. LwC was implemented to gain a better understanding of how individuals experience and cope with the COVID-19 pandemic and its countermeasures. It was launched on March 23, 2020 (first round) and revised on October 1, 2020 (second round). The survey targets adult populations (>17 years inclusion criterion) across the globe and collects data on several topics, including individual exposure to COVID-19, compliance with recommended and mandated behaviors, food security, attitudes, life satisfaction, somatic and mental health, and the sociodemographic characteristics of the respondents (age, gender, marital status, household composition, location, and living conditions). The questions about recollection of events extend to a maximum of 14 days for the mental health variables. The LwC survey can be answered in 27 languages and

is promoted by local and international partners and social media. Informed consent is obtained at the beginning of the survey. The study received ethical approval by UNU-WIDER (reference number: 202009/01). More details on LwC can be retrieved online at www.lifewithcorona.org. In this paper, we use data from the second round of the survey (October 1, 2020 until February 28, 2021) from individuals who reported they live in Germany.

Participants

Between October 1, 2020, and February 28, 2021, a total of 10,979 individuals (7,426 female; 67.6%) living in Germany completed the LwC online survey. 76.9% of answers related to the period of the hard lockdown (which started on December 16, 2020). On average, participants were 50.62 years old ($SD = 16.16$; range = 18–91), had 14.09 ($SD = 3.99$) years of formal education, and lived in a household composed of 3.03 ($SD = 28.31$) members. The majority of participants were either single (64.6%) or lived in a stable relationship (partner/married, 29.1%), and 52.9% lived in an urban area.

Measures

In this subsection, we describe the data we collected and how we use them to measure the four types of GD described above.

Demographic Characteristics

Demographic information was collected at the beginning of the online survey, including age, years of formal education, marital status, location of residence, household composition, and gender.

Gender

To assess gender, we asked the participants to choose between categories of *male*, *female*, and *other*. For the analysis, we excluded participants who responded *other* due to a low response rate (only 14 participants, or 0.13%).

Mental Health Measures

The selected measures follow an established approach in the literature, validated in many countries, which allows comparison of results across different settings (Löwe et al., 2010; Gierk et al., 2014; Webster et al., 2014; Hinz et al., 2017).

Aggression

We measure aggression by applying subscales of the short version of the Buss and Perry *Brief Aggression Questionnaire* (BAQ) (Bryant and Smith, 2001; Webster et al., 2014, 2015) for physical aggression (e.g., *I have threatened people I know; I have trouble controlling my temper; Given enough provocation, I may hit another person*) and anger (e.g., *I flare up quickly but get over it quickly; Sometimes I fly off the handle for no good reason; I have trouble controlling my temper*). The instrument consists of three items for each subscale rated from *very unlike me* (1) to *very like me* (5). We calculate a sum score with values ranging 0–24, with higher values indicating a more pronounced inclination to aggression. The instrument has been applied in a wide variety of cultures (Diamond and Magaletta, 2006; Vitoratou et al., 2009; Abd-El-Fattah, 2013; Zimonyi et al., 2021), including Germany (von Collani and Werner, 2005). Webster et al. (2015) found high test–retest reliability among the four subscales indicating it measures a stable trait. Note that the instrument does not

measure violent behavior but has been shown to be associated with delinquent behavior (Jurczyk and Lalak, 2020), reactive aggressive behavior in a laboratory experiment (Fahlgren et al., 2021), and aggressive acts (Archer and Webb, 2006).

Anxiety

We measure anxiety with subscales from the seven-item *Generalized Anxiety Disorder* scale (GAD-7) (Spitzer et al., 2006). GAD-7 has proven to be effective in assessing severity of anxiety, and it is brief and self-administered (Spitzer et al., 2006). Response options were *Not at all*; *Several Days*; *More than half days*; and *Nearly every day*, which were coded as 0, 1, 2, and 3, respectively, for each item: *Feeling nervous, anxious, or on edge*; *Not being able to stop or control worrying*; *Worrying too much about different things*; *Trouble relaxing*; *Being so restless that it's hard to sit still*; *Becoming easily annoyed or irritable*; and *Feeling afraid as if something awful might happen*. We calculate a sum score to indicate anxiety severity, with values ranging 0–27, with higher values indicating higher anxiety. This instrument has been validated for the German population, where anxiety was correlated with low quality of life, fatigue, low habitual optimism, physical complaints, sleep problems, low life satisfaction, low social support, low education, unemployment, and low income (Hinz et al., 2017). The instrument has also been successfully applied in online surveys before (Pieh et al., 2020; Rossi et al., 2020).

Depression

We measure the severity of depression using the depression module of the *Patient Health Questionnaire* (PHQ-9) (Kroenke and Spitzer, 2002). All nine items of the questionnaire include rating symptoms from 0 (*not at all*) to 3 (*nearly every day*), according to the presence of a certain symptom in the 2 weeks prior to completing the survey. Based on these questions, we calculate an individual sum score that indicates depression severity. The depression score takes values ranging 0–27, with higher values indicating higher depression. The instrument has been validated for the German population (Löwe et al., 2010) and has successfully been applied as an online measure in recent studies (Pieh et al., 2020; Rossi et al., 2020).

Somatic symptom burden

We measure subjective severity of somatic symptoms based on the 8-item self-reported *Somatic Symptom Scale-8* (SSS8) (Gierk et al., 2014), which asks about fever, cough, diarrhea, headache, and other somatic symptoms during the 14 days before taking the survey. We calculate a sum score to indicate the symptomatic burden, taking values ranging 0–27, with higher values indicating a higher symptomatic burden. The high reliability and validity of the instrument has been demonstrated in a large sample not only in Germany (Gierk et al., 2014), but also elsewhere, including in self-administered online surveys (Matsudaira et al., 2017).

COVID-19 Countermeasures

To account for public policies enacted to contain the spread of the virus and the levels of life disruption that people could have experienced during the time of the study, we use the following two measures:

Lockdown

To contain the COVID-19 pandemic, public life in Germany was largely shut down on December 16, 2020. One week before Christmas, the hard lockdown period was implemented as the number of deaths and infections from the coronavirus reached record levels. The stringency index during the hard lockdown period reached its highest levels 83–85 (see below). For our first set of analyses, we compare the group of people that responded to the questionnaire before December 16, 2020, the start of the hard lockdown, with those that responded after that date.

Stringency index

The Oxford Coronavirus Government Response Tracker (OxCGRT) project (Hale et al., 2021) provides a “Stringency Index,” which indicates the strictness of public policies implemented to contain the spread of the virus. The index is calculated based on nine metrics: 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 restrictions. The resulting index is a continuous variable at the day-country level. It ranges from 1 to 100, with higher values indicating harder restrictions. We use the values of the stringency index for the time period covered in our data set, which range from 50 to 85.

COVID-19 Exposure

We measure COVID-19 exposure via three proxy variables, building on the measurement of shock exposure in surveys (Brück et al., 2016):

Testing positive for COVID-19

In the LwC survey, we asked participants if they had had an antibody coronavirus test, and whether it was positive or not.

Knowing someone who died

We asked survey participants whether they personally knew someone who had died from the coronavirus, or from other causes due to medical complications arising from the COVID-19 crisis.

Income decrease

We also asked participants if and how their monthly net income had changed since the start of the COVID-19 crisis. We group our respondents based on whether they had suffered an income loss or not.

Household Characteristics

We use the following three measures of household characteristics and composition:

Main provider

We identify those participants by asking who is the main provider of income in their household. We code the variable “yes” for participants who responded that they are the main providers and “no” if they responded that it is someone else or that they share this role with their partner.

Living with children

Based on information provided on other household members' age, we group respondents into two groups: those who indicated

they live in a household with children (household members below the age of 18) and those who do not.

Living alone

Based on information provided on the number of household members, we group respondents into two groups: those who indicated they live alone and those who do not.

Statistical Models

We use generalized linear models (GLMs) to study GD in mental health outcomes (aggression, anxiety, depression, and symptomization) and three sets of explanatory factors: COVID-19 countermeasures, COVID-19 exposure, and household characteristics. For each factor, we included various model terms that provide interactions between a given factor with gender (two-way interactions) or with gender and another factor (three-way interactions). All models include a vector of control variables [age, years of education, location (urban or rural), and household size]. Lastly, all responses are statistically weighted based on the gender, age, education, and income distribution of the German population.

To analyze the relationship of gender and COVID-19 countermeasures with mental health outcomes, we estimate the following equation:

$$H_{it} = \alpha + \beta_1 \text{Gender}_i + \beta_2 \text{Anti} - \text{Corona measure}_t + \beta_3 \text{Gender}_i * \text{Anti} - \text{Corona measure}_t + X_i + \varepsilon_{it} \quad (1)$$

where H_{it} refers to mental health outcome of individual i who answered the survey at date t ; Gender_i is a dummy that equals one if the respondent was male; $\text{Anti} - \text{Corona measure}_t$ refers to (a) the hard lockdown indicator or (b) the stringency index; X_i is the vector of individual-level time-invariant control variables, and ε_{it} is the idiosyncratic error term. The main coefficient of interest is β_3 , which estimates how strongly the association of a COVID-19 countermeasure with a mental health outcome varies with gender.

To analyze the relationship of gender and COVID-19 exposure with mental health outcomes, we estimate the following equation:

$$H_i = \alpha + \beta_1 \text{Gender}_i + \beta_2 \text{Corona exposure}_i + \beta_3 \text{Gender}_i * \text{Corona exposure}_i + X_i + \varepsilon_i \quad (2)$$

where Corona exposure is one of three separate dummy variables that indicate whether the individual (a) had had a positive result on a COVID-19 test, (b) knew someone who had died of COVID-19, or (c) had suffered an income decrease since the start of the pandemic. The main coefficient of interest is β_3 , which estimates how strongly the association of a COVID-19 exposure measure with a mental health outcome varies with gender.

To analyze how household characteristics shape the relationship of gender and anti-COVID-19 policy stringency with mental health outcomes, we estimate the following equation:

$$H_{it} = \alpha + \beta_1 \text{Gender}_i + \beta_2 \text{Household characteristic}_i + \beta_3 \text{Stringency index}_t + \beta_4 \text{Gender}_i * \text{Household characteristic}_i + \beta_5 \text{Gender}_i * \text{Stringency index}_t + \beta_6 \text{Household characteristics}_i *$$

$$\text{Stringency index}_t + \beta_7 \text{Gender}_i * \text{Household characteristic}_i * \text{Stringency index}_t + X_i + \varepsilon_{it}$$

where $\text{Household characteristic}$ is one of three separate dummy variables that indicate whether the individual reported (1) being the main provider of income in her household, (2) living with children, or (3) living alone. The main coefficient of interest is β_7 , which estimates how strongly the interactive effect of a household characteristic with the stringency measures varies with gender. We conduct all tests on a significance level of at least 90%.

RESULTS

Descriptives

Table 1 presents summary statistics of all variables used in the study, differentiated by gender.

Mental Health

The overall sum score is 5.61 (SD = 5.56) for aggression, 4.33 (SD = 4.83) for anxiety, 2.41 (SD = 3.18) for depression, and 4.92 (SD = 4.31) for somatic symptoms. T -tests of the difference in mean scores by gender indicate that women reported significantly higher levels for depression, anxiety, and the somatic symptom burden scores ($p < 0.001$), whereas men reported statistically higher levels of aggression ($p < 0.001$). Distributions by gender are presented in **Figure 1**.

Stringency

We do not find gender-based differences in the probability of responding before or after the lockdown and the average stringency score participants experienced was 77.04 (SD = 11.3).

COVID-19 Exposure

Regarding COVID-19 exposure, only 1% of the sample reported having tested positive for the coronavirus, but 13.9% knew someone who had died from COVID-19 or other causes arising from the pandemic. 23.4% of individuals had suffered an income decrease since the start of the pandemic. While there is no significant difference in the probability of reporting a positive test between genders, we find women were significantly more likely to know someone who had died of coronavirus (14.6% vs. 13.1%, $p < 0.001$), and more likely to suffer an income decrease (22.5% vs. 24.4%, $p < 0.001$).

Household Characteristics

With reference to household characteristics, 53.4% of the participants reported being the main income providers in their household, 22.9% of the participants live with children, and 24.8% live alone. We find women were significantly less likely to be main income providers compared to men (45.3% vs. 62.6%, $p < 0.001$); were more likely to live with children (23.5% vs. 22.2%); and were more likely to live alone (26.0% vs. 23.4%) (see **Table 1**).

Notably, we find variables associated with COVID-19 and household characteristics to be significantly associated with depression, anxiety, the somatic symptom burden, and aggression independently of gender (see **Supplementary Material 1**).

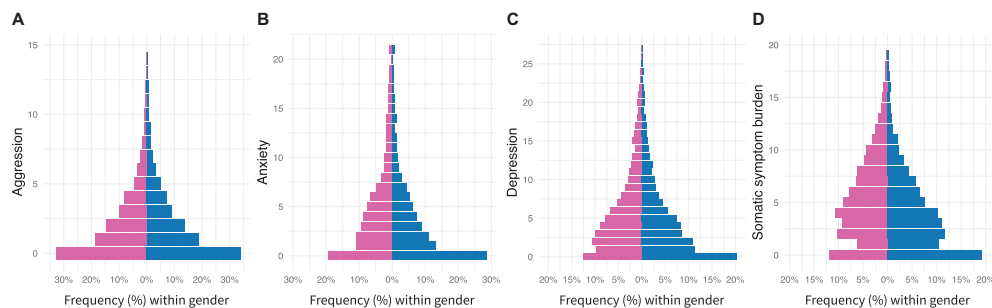


FIGURE 1 | Differences between men ($n = 3553$) and women ($n = 7426$) at mental health measures: **(A)** aggression, **(B)** anxiety, **(C)** depression, and **(D)** somatic symptom burden. Gender is color-coded (blue for men). Bars represent relative percentages within gender.

TABLE 1 | Summary statistics of all variables used in the study differentiated by gender.

Variable	(1) Female	(2) Male	(3) Total	t-test Difference
	Mean/SD	Mean/SD	Mean/SD	(1)-(2)
Depression	6.043 (5.676)	5.122 (5.387)	5.612 (5.562)	0.920***
Anxiety	4.841 (5.030)	3.767 (4.527)	4.338 (4.831)	1.074***
Somatic symptom burden	5.535 (4.466)	4.228 (4.021)	4.923 (4.313)	1.306***
Aggression	2.324 (3.011)	2.517 (3.376)	2.414 (3.189)	-0.193***
Lockdown	0.764 (0.425)	0.775 (0.418)	0.769 (0.421)	-0.011
Stringency	76.969 (11.266)	77.117 (11.337)	77.038 (11.299)	-0.148
COVID-19 test positive	0.011 (0.105)	0.009 (0.096)	0.010 (0.101)	0.002
Know someone who died	0.146 (0.353)	0.131 (0.338)	0.139 (0.346)	0.015**
Income decrease	0.225 (0.417)	0.244 (0.429)	0.234 (0.423)	-0.019**
Main provider: me	0.453 (0.498)	0.626 (0.484)	0.534 (0.499)	-0.173***
Lives with children	0.235 (0.424)	0.222 (0.415)	0.229 (0.420)	0.013*
Lives alone	0.260 (0.439)	0.234 (0.423)	0.248 (0.432)	0.027***
N	7426	3553	10979	

The value displayed for t-tests are the differences in the means across the groups.

***, **, and * indicate significance at the 1, 5, and 10 percent critical level. Data is weighted.

GD in Aggression

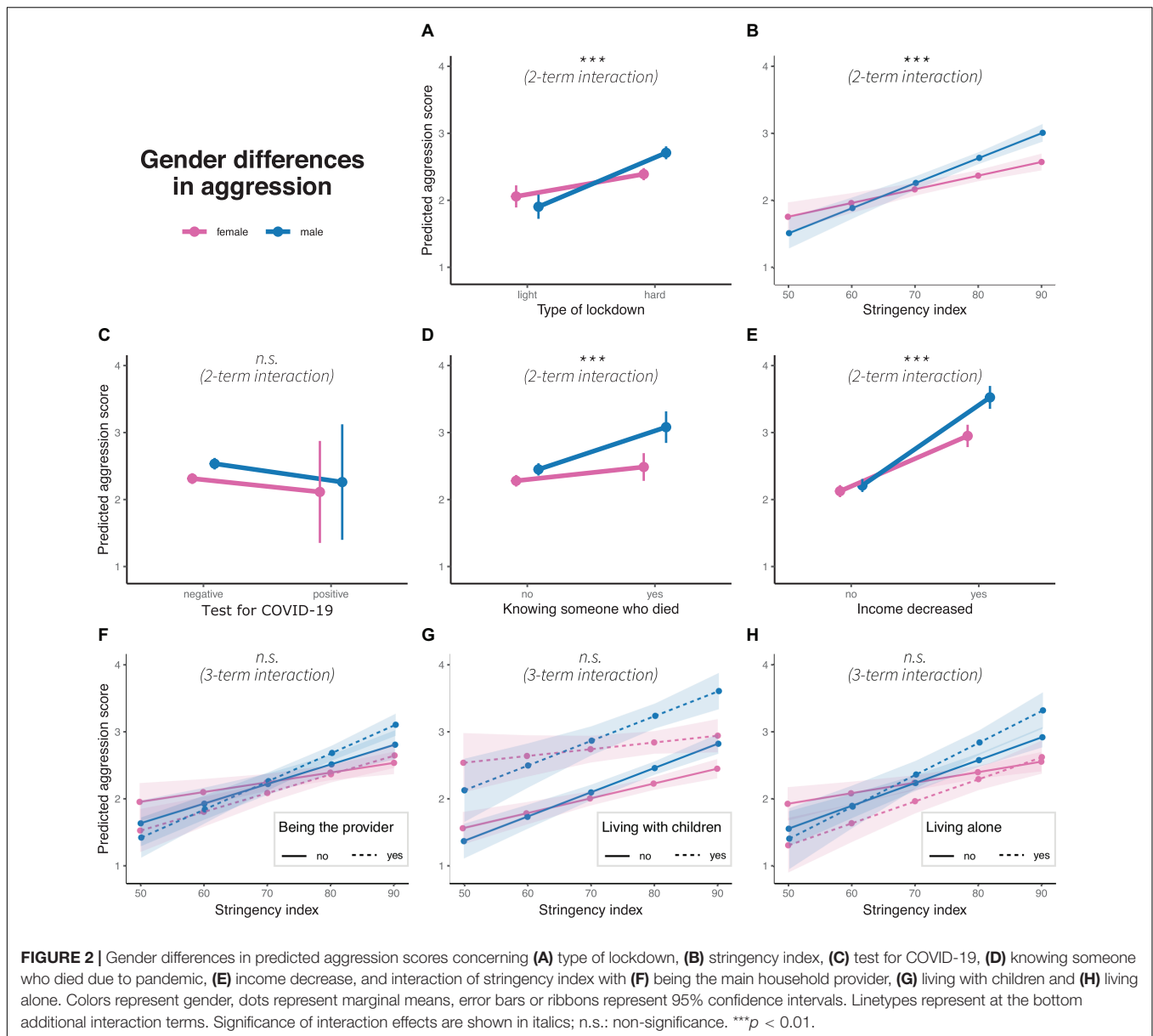
Generalized linear models are significant for the predictions of all aggression models (light vs. hard lockdown: $R^2 = 0.036$, $F(1, 10977) = 59.28$, $p < 0.01$, stringency: $R^2 = 0.038$, $F(1, 10977) = 61.35$, $p < 0.01$, positive COVID-19 test: $R^2 = 0.028$, $F(1, 10977) = 44.82$, $p = 0.01$), knowing someone who died due to COVID-19: $R^2 = 0.03$, $F(1, 10977) = 48.98$, $p < 0.01$), income decrease: $R^2 = 0.045$, $F(1, 10977) = 74.42$, $p < 0.01$, being the main provider in the household $R^2 = 0.039$, $F(1, 10977) = 40.32$, $p < 0.01$, living with children: $R^2 = 0.041$, $F(1, 10977) = 42.66$, $p < 0.01$, and living alone: $R^2 = 0.039$, $F(1, 10977) = 40.61$, $p < 0.01$). The positive and significant two-term interactions for light vs. hard lockdown ($\beta = 0.47$, $p < 0.01$), stringency ($\beta = 0.02$, $p < 0.01$), knowing someone who died ($\beta = 0.46$, $p < 0.01$), and income decrease ($\beta = 0.52$, $p < 0.01$) indicate increasing GD in aggression, with men consistently presenting a stronger increase in aggression than women. Two- and three-term interactions for the other variables are not significant (Figure 2). Notably, we do not find GD in aggression before the lockdown ($\beta = -0.15$, $p < 0.21$).

GD in Anxiety

Generalized linear models are also significant for all anxiety models (light vs. hard lockdown: $R^2 = 0.053$, $F(1, 10977) = 87.34$, $p < 0.01$, stringency: $R^2 = 0.054$, $F(1, 10977) = 90.33$, $p < 0.01$, positive COVID-19 test: $R^2 = 0.045$, $F(1, 10977) = 73.98$, $p = 0.01$, knowing someone who died due to COVID-19: $R^2 = 0.047$, $F(1, 10977) = 77.92$, $p < 0.01$, income decrease: $R^2 = 0.086$, $F(1, 10977) = 147.1$, $p > 0.01$, being the main provider in the household: $R^2 = 0.058$, $F(1, 10977) = 61.50$, $p < 0.01$, living with children: $R^2 = 0.055$, $F(1, 10977) = 58.32$, $p < 0.01$), and living alone: $R^2 = 0.059$, $F(1, 10977) = 62.94$, $p < 0.01$. The positive and significant three-term interaction for living with children ($\beta = 0.49$, $p < 0.01$) indicates that GD decreases when living with children and increases when living without children (see Figure 3). Other interaction terms are not significant (see Supplementary Material).

GD in Depression

Generalized linear models for depression models are significant for all variables (light vs. hard lockdown: $R^2 = 0.054$, $F(1, 10977) = 90.11$, $p < 0.01$), stringency: $R^2 = 0.056$, $F(1,$



10977) = 93.46, $p < 0.01$, positive COVID-19 test: $R^2 = 0.045$, $F(1, 10977) = 74.09$, $p = 0.01$, knowing someone who died due to COVID-19: $R^2 = 0.046$, $F(1, 10977) = 75.60$, $p < 0.01$, income decrease: $R^2 = 0.083$, $F(1, 10977) = 141.9$, $p > 0.01$, being the main provider in the household: $R^2 = 0.065$, $F(1, 10977) = 69.77$, $p < 0.01$, living with children: $R^2 = 0.058$, $F(1, 10977) = 61.54$, $p < 0.01$, and living alone: $R^2 = 0.074$, $F(1, 10977) = 79.39$, $p < 0.01$. Two-term interactions are significant for light vs. hard lockdown ($\beta = -0.44$, $p < 0.1$) and for stringency ($\beta = -0.02$, $p < 0.1$), both presenting increasing GD with tighter measures to control the pandemic. Three-term interactions are significant for living with children ($\beta = 0.49$, $p < 0.05$). Similar to anxiety, GD increases for individuals who do not live with children and decreases for those who live with children (see

Figure 4). Other interaction terms are not significant (see Supplementary Material 2).

GD in Somatization

Generalized linear models are also significant for the predictions of the somatic symptom burden (light vs. hard lockdown: $R^2 = 0.033$, $F(1, 10977) = 52.67$, $p < 0.01$), stringency: $R^2 = 0.033$, $F(1, 10977) = 52.66$, $p < 0.01$, positive COVID-19 test: $R^2 = 0.035$, $F(1, 10977) = 56.79$, $p = 0.01$, knowing someone who died due to COVID-19: $R^2 = 0.034$, $F(1, 10977) = 54.43$, $p < 0.01$, income decrease: $R^2 = 0.034$, $F(1, 10977) = 55.2$, $p < 0.01$), being the main provider in the household: $R^2 = 0.034$, $F(1, 10977) = 34.61$, $p < 0.01$, living with children: $R^2 = 0.034$, $F(1, 10977) = 34.97$, $p < 0.01$, and living alone: $R^2 = 0.036$, $F(1, 10977) = 37.48$, $p < 0.01$. Two-term interactions are significant for light vs. hard

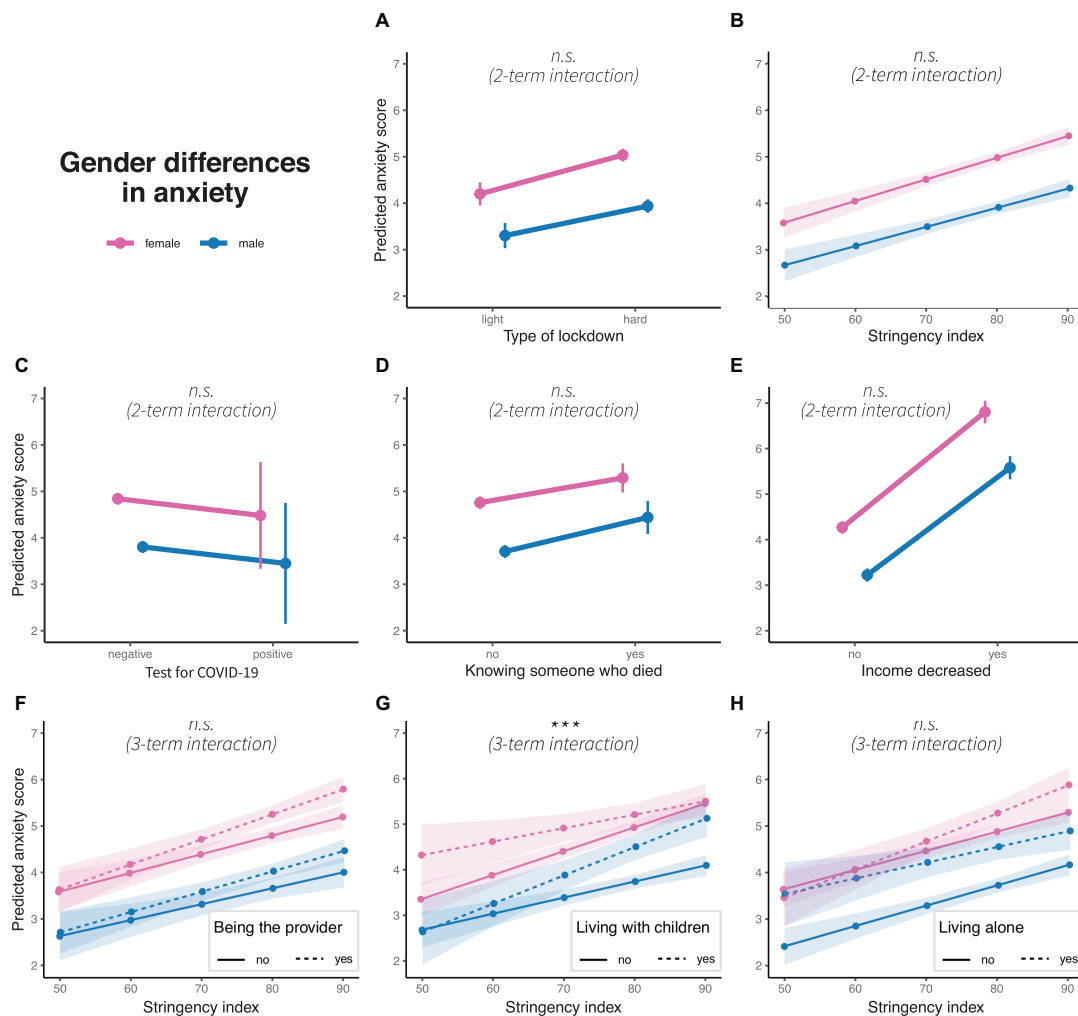


FIGURE 3 | Gender differences in predicted anxiety scores concerning (A) type of lockdown, (B) stringency index, (C) test for COVID-19, (D) knowing someone who died due to pandemic, (E) income decrease, and interaction of stringency index with (F) being the main household provider, (G) living with children and (H) living alone. Colors represent gender, dots represent marginal means, error bars or ribbons represent 95% confidence intervals. Linetypes represent at the bottom additional interaction terms. Significance of interaction effects are shown in italics; n.s.: non-significance. *** $p < 0.01$.

lockdown ($\beta = 0.33$, $p < 0.01$) and income decrease ($\beta = 0.40$, $p < 0.05$); both factors decrease GD. Three-term interaction is significant for living with children ($\beta = -0.03$, $p < 0.1$), with an increasing somatic symptom burden with increasing stringency for men living without children and a decreasing somatic symptom burden with rising stringency measures for men living with children (see Figure 5).

DISCUSSION

In this study, we show that GD in aggression and depression increased as a consequence of stricter COVID-19 countermeasures in Germany. While, contrary to widespread findings, men and women did not differ in their aggressiveness during the light lockdown period or when stringency was low, we find significant differences in aggressiveness during the hard lockdown and when stringency was higher. Women

presented more severe depression symptoms than men, and these symptoms increased more in women than in men in periods of stricter measures. In addition, we find GD in anxiety and somatization but the results do not indicate that these increased due to COVID-19 exposure, COVID-19 countermeasures or household characteristics. We find that somatic symptom burdens increased more in men than in women during the hard lockdown, resulting in a reduction in GD. In periods of higher stringency, we find living with children to decrease GD for depression and anxiety, and to increase GD in the somatic symptom burden. GD for the group who lived without children increased with higher stringency for depression and anxiety, but GD only emerged as stringency increased. We discuss the results below in more detail for each of the four main outcomes.

Aggression

As the stringency of the lockdown increased, men developed higher levels of aggression than women. Moreover, GD

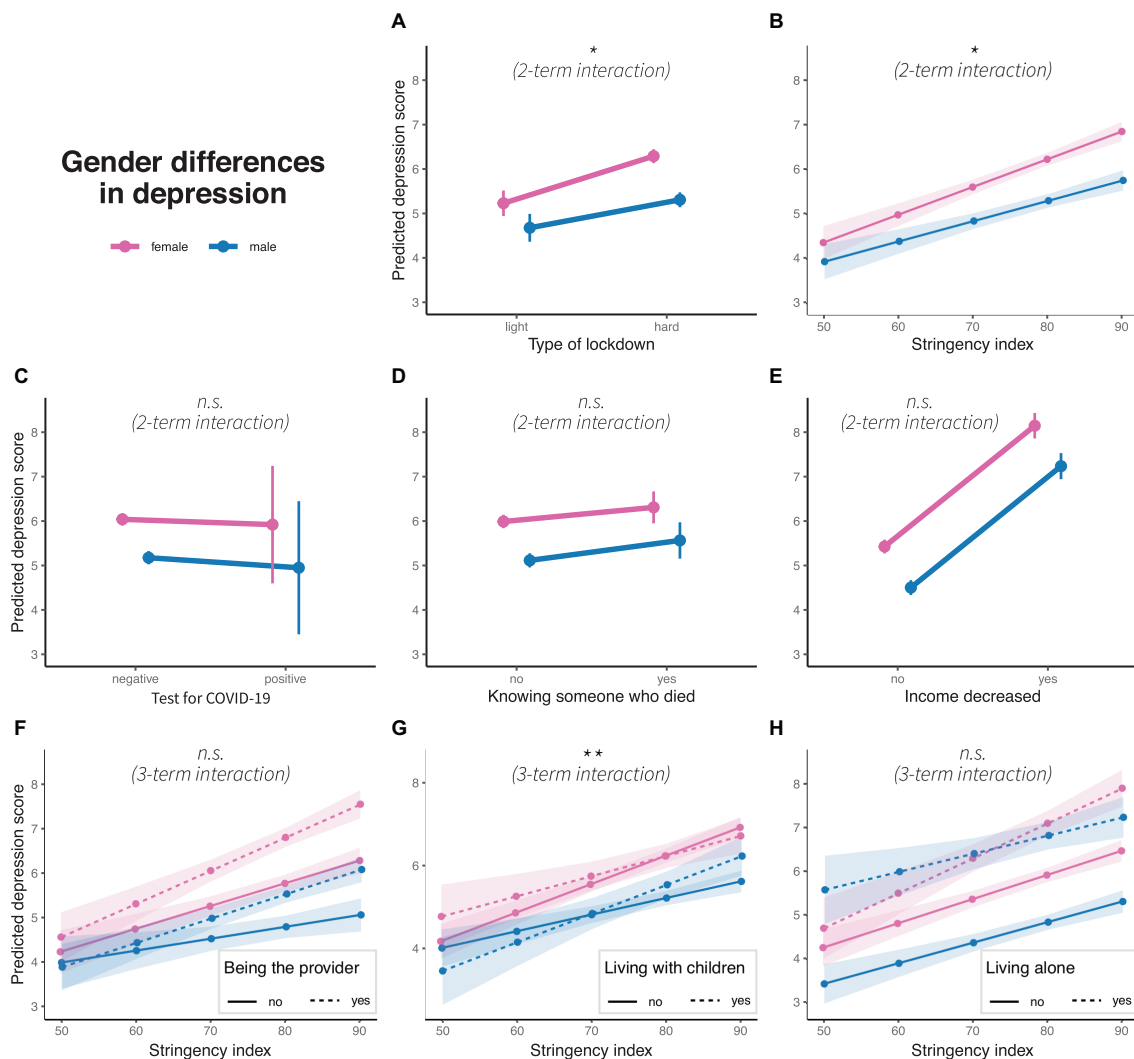


FIGURE 4 | Gender differences in predicted depression scores concerning (A) type of lockdown, (B) stringency index, (C) test for COVID-19, (D) knowing someone who died due to pandemic, (E) income decrease, and interaction of stringency index with (F) being the main household provider, (G) living with children and (H) living alone. Colors represent gender, dots represent marginal means, error bars or ribbons represent 95% confidence intervals. Linetypes represent at the bottom additional interaction terms. Significance of interaction effects are shown in italics; n.s.: non-significance. * $p < 0.1$ and ** $p < 0.05$.

in aggression further emerged when suffering an income decrease during the pandemic (men > women) and when participants knew someone who had died due to the pandemic (men > women). GD in aggression are not significant at baseline and for household characteristics (being the main provider, living with children, living alone). While previous studies have established strong evidence for an increase of domestic and cyberviolence during the pandemic (Fraser, 2020; Perez-Vincent et al., 2020; Ebert and Steinert, 2021), we show that the pandemic facilitates the development of aggression particularly in men. Previous studies have found robust correlations of the applied aggression questionnaire with act-based violence (Archer and Webb, 2006; Jurczyk and Lalak, 2020), and emerging evidence in neuroscience points to the rewarding properties and self-perpetuating nature of violent acts (Nell, 2006; Elbert et al., 2010;

Golden and Shaham, 2018; Golden et al., 2019). Additionally, gendered expectations regarding stress response further maintain GD in aggression. Our study therefore suggests that violence perpetrated by men surges during the pandemic due to the accumulating stressors and gendered expectations. Based on the emerging evidence in regard to the rewarding properties of violence, heightened levels of aggression may remain after the pandemic and the relaxation of lockdown measures. Especially online aggression, such as cyberbullying, violent video games, or the consumption/publication of other violent online material, may be novel arenas that require attention. Violent behaviors impose high costs on society in regard to executive and justice measures, psychotherapy for victims and perpetrators, and prevention programs. At the same time they might also affect public thinking and opinion when ignored

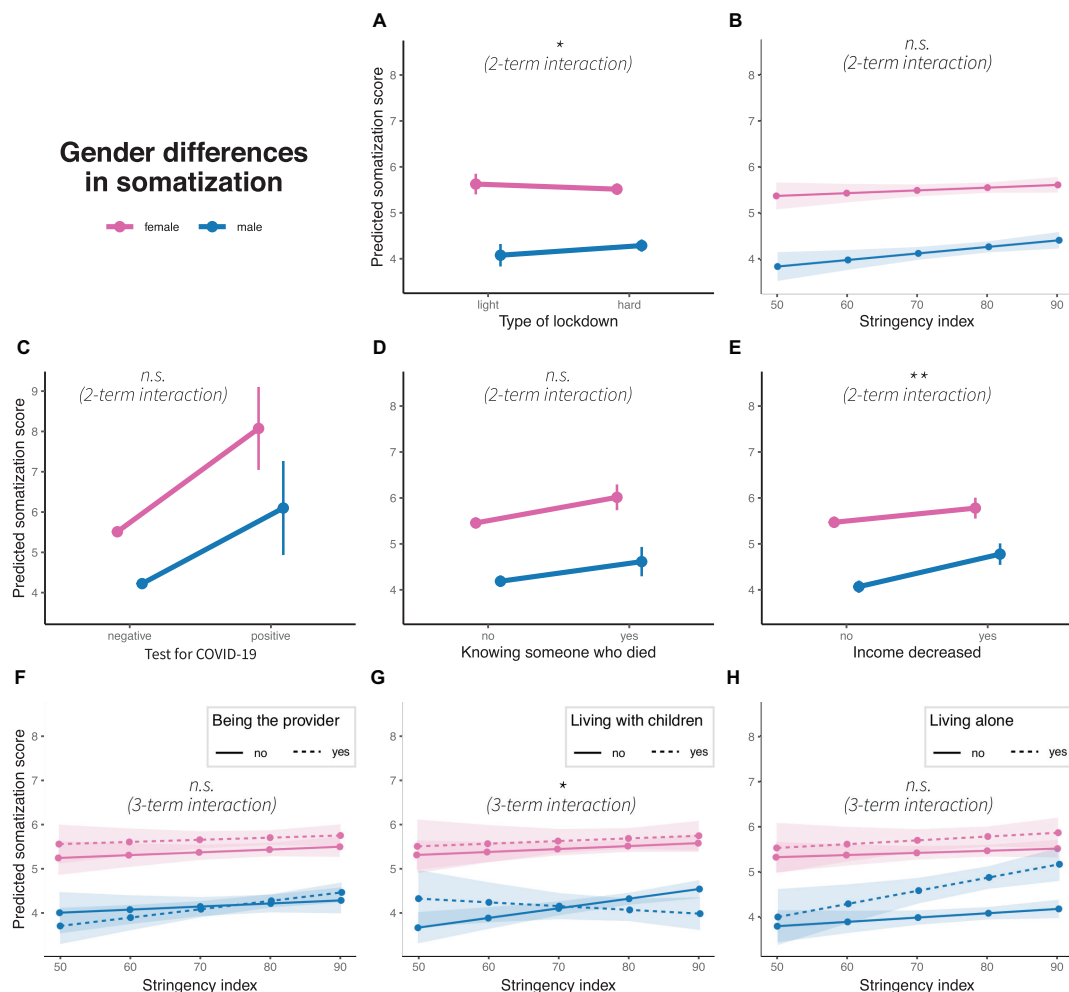


FIGURE 5 | Gender differences in predicted somatic symptom burden scores concerning (A) type of lockdown, (B) stringency index, (C) test for COVID-19, (D) knowing someone who died due to pandemic, (E) income decrease, and interaction of stringency index with (F) being the main household provider, (G) living with children and (H) living alone. Colors represent gender, dots represent marginal means, error bars or ribbons represent 95% confidence intervals. Linetypes represent at the bottom additional interaction terms. Significance of interaction effects are shown in italics; n.s.: non-significance. * $p < 0.1$ and ** $p < 0.05$.

(Forum on Global Violence Prevention, 2011). More research is needed to understand the magnitude of this specific consequence of the pandemic, firstly, on the individuals who experience more anger and the urge to become physically aggressive and, secondly, on the individuals who share their lives with them at work, in their family, and on social media.

Anxiety

While our study replicates that women present more anxiety symptoms (e.g., Asher et al., 2017), we only find GD developing differently for men and women who lived with vs. without children. Here, the GD in individuals who lived with children are significant when stringency was low, but disappear—with men developing similarly high levels of depression as women—when they lived with children. In contrast, GD are not significant when stringency was low, but increase for men and women who lived without children with more stringent measures. Other interaction terms that we test are not significant. The latter is in

line with the study of Ausín et al. (2021) from Spain. Following the rationale in the introduction, we would have expected women to be biologically more prone to develop, socially more prepared to express and in terms of gender roles more vulnerable to present higher levels of anxiety. This is not supported by our results, except for women who live without children, as they present a steeper increase of anxiety than men who live without children. In contrast, men who live with children seem to adopt “female levels of anxiety.” We did not expect this. What happens to the fathers who live with children during heightened stringency levels? One explanation may be that men faced high pressure both at work and as providers while having to arrange work from home or sharing responsibility for their children with their partner. There might also be a gender gap in the extent to which it is accepted for men to fail on tasks due to childcare. In turn, this could have allowed some relief to women who were not able to perform due to homeschooling and quarantines. Higher levels of empathy devoted to women might have facilitated this development.

However, men and women respond equally to the crisis in terms of anxiety in general, though both showing an increase.

Depression

The lockdown and higher stringency measures are associated with higher levels of depression (replicating e.g., ref) and an increased GD in depression. According to our expectations, women developed higher levels of depression during the hard lockdown or when stringency increased, respectively. The findings are partly in contrast to the study of Ausín et al. (2021) from Spain who found that GD in depression was not increasing there.

As for anxiety, when living with or without children we find a more complex pattern of GD: no significant differences during the low stringency period in individuals without children but a steeper increase for women than for men when stringency increased. For individuals who reported living with children, we find a trend toward assimilating levels of depression in men when stringency levels intensified. We also find similar levels of depression for men and women who lived alone. This contradicts previous theories concerning the consequences of combining multiple roles (spouse, parent, and worker) on mental health with a stronger impact on women than men (Simon, 1995). Our result indicates that men are strongly affected by stricter stringency when they live alone or with children. Moreover, this contrasts with previous studies that found having children to constitute a protective factor for mental ill-health for men only, with men who had two or more children presenting a lower risk of developing mental disorders when compared to men without children (Klose and Jacobi, 2004).

On the other hand, the result that GD in mental disorders increased for women is in line with other COVID-19 studies that reported a new gap in psychological distress emerging between women with children at school age and women without children (Zamarro and Prados, 2021). Similarly, Mazza et al. (2020) suggested that women who lived alone or had children with behavioral problems may present an increase of mental disorders, such as stress or depression. An emerging research gap that results from this study is in regard to men who develop more depression in their dual role as fathers at home with children and providers. Does sharing responsibility at work and in the household mean that the burden is doubled and that both partners have to carry their weight? Or can the burden actually be shared?

Hard lockdown and increasing stringency are associated with a steeper increase in depression for women than for men. One factor that may contribute to this are the heightened levels of domestic and gender-based violence (GBV) documented during the lockdowns. Indeed, this has previously been claimed to be a major health concern during the pandemic (Bradbury-Jones and Isham, 2020; Telles et al., 2020), who argued that the impact of the pandemic has fueled stress and tensions within families, with an increased and continuous risk of domestic violence and divorce cases (Chang, 2020; Peterman et al., 2020; Usher et al., 2020). Accordingly, several studies reported that the increase of domestic violence occurred especially during stricter lockdowns or states of emergency (Campbell, 2020; Usher et al., 2020), e.g., a

55% increase of calls made to a domestic violence hotline during the lockdown in Argentina (Perez-Vincent et al., 2020), or the reported increased risk of domestic violence during the pandemic in Germany (Ebert and Steinert, 2021).

Furthermore, evidence shows that family violence, including IPV, child abuse and elder abuse, increase during and after large-scale crises or disasters (Neria et al., 2008; Perez-Vincent et al., 2020; Peterman et al., 2020). Families from socially deprived settings and with low socioeconomic status (e.g., low educational levels or unemployment) are particularly at risk in Germany (Ravens-Sieberer et al., 2021). Women and children are most affected by these incidents globally and, although data is still scarce, the domestic violence rates appear to be rising rapidly (Perez-Vincent et al., 2020). Yet, children and adolescents in Germany do not seem to be as negatively affected as, for example, youth from Spain and Italy, where higher levels of stress on families were observed, with 85.7% of the parents reporting emotional and behavioral changes in their children (Orgilés et al., 2020); or in China, where one study reported 22.6% of students having depressive symptoms, which is higher than the 17.2% previously reported in studies on primary schools (Xie et al., 2020).

In addition to GBV, a combination of the biologically determined heightened susceptibility of women for depressive symptoms (e.g., Slavich and Sacher), combined with gender-specific roles that come with restrictions and opportunities (Seedat et al., 2009; Salk et al., 2017), may underlie the enforced GD during periods of high-stringency lockdown measures. However, it is unclear why lockdowns and stringency do not increase GD in anxiety but only in depression. Both syndromes are more pronounced in women than in men and related to adversity (Kuzminskaite et al., 2021). One explanation, yet speculative, could be that the pandemic imposes a situation with both an invisible or implicit threat and also highly incisive inescapable consequences, connected with the uncertainty regarding what the post-pandemic period will look like and when it will start.

To the best of our knowledge, there is no study that investigates characteristics of threats in association with specific symptoms of depression and anxiety. However, it is known that emotional abuse and neglect (especially during childhood) may lead to more pronounced symptoms of depression than post-traumatic stress or anxiety. Indeed, the pandemic has imposed strong restrictions on meeting family, friends, and other community members. Accordingly, living alone has been shown to be a consistent moderator of symptom severity, both in anxiety and depression. The social deprivation may therefore have had a stronger weight than the actual threat to physical integrity. From a sociological perspective, these results indicate that, when traditional resources of social cohesion are interrupted (real life sociality), a substantial part of resilience may be undermined.

But why is there a difference by gender? One explanation may be the gendered labor patterns in Germany which are outlined in detail below in the section “Moderating Social Factors Associated With the COVID-19 Pandemic.” In summary, it means that, on average, men engage more in paid work while

women remain occupied in informal care and part-time jobs—or poorly paid jobs, e.g., in supermarkets or as nurses. Since the German government avoided the wholesale closure of industries, men were less likely to be confined to their homes and thus able to socialize with their colleagues at work, whereas many retail businesses and the hospitality industry were shut. As female employment is relatively high in these sectors, more women were cut off from their social environments and isolated with their children at home.

Many of the children themselves had difficulties coping and developed abnormal behaviors (Wang G. et al., 2020), which impacted their parents (Calvano et al., 2021)—mothers and fathers alike—as indicated by our results. This is where the pandemic comes down to the concept of Seligman's learned helplessness from about four decades ago. Many people have realized that there is no escape from this crisis. Policies and stepped care mental health programs could provide relief and help people reestablish social activities, regain a feeling of autonomy (external rather than internal), reprocess and contextualize the most important events (that the pandemic was a special situation requiring special measures rather than a global plan to serve the self-interest of anyone), and to close off the period (to counteract the attribution that the pandemic is a permanent condition).

Somatization

The overall subjective burden of somatic symptoms was higher in women than in men. Yet, the hard lockdown period, an income decrease, and higher-stringency lockdown measures resulted, for participants who lived with children, in a steeper increase of somatic symptoms in men than in women (decreasing GD). Increased vulnerability of men in developing severe symptoms after a COVID-19 infection have been well established (Conti and Younes, 2020; Jin et al., 2020; Wenham, 2020). However, our study does not find a higher level of somatic symptoms in men for those who tested positive. On the other hand, our sample includes only a very small percentage of participants who tested positive for COVID-19. Given the potential long-term consequences of COVID-19 infections and the consistent association of the somatic symptoms with mental health problems, further research would be beneficial.

In the case of men who lived with children assimilating to the somatic symptom burden of women, it is noteworthy that the COVID-19 crisis does not actually seem to have increased GD in terms of levels of parental involvement in childcare. In Germany, for example, studies observed that both parents reported spending substantially more time with their children during the crisis than they did in the previous year (Kreyenfeld et al., 2020), and there are seemingly no elementary differences in established aggregate-level roles of division of labor in couples (Hank and Steinbach, 2020).

Moderating Social Factors Affected by the COVID-19 Pandemic

Paid and Non-paid Work

There is considerable evidence showing an overall magnifying of gender inequalities in paid and non-paid work during COVID-19

(Farré et al., 2020). Although women are as likely as men to have flexible jobs, women globally earn less than men and were already in a more vulnerable situation before the pandemic started (Carli, 2020). The pandemic increases this inequality, because women disproportionately occupy a share of jobs requiring face-to-face interactions, e.g., retail or personal care, meaning that the opportunities to work from home and the risk of unemployment are higher (Freund and Hamel, 2020). Moreover, an important share of women are essential workers (Boniol et al., 2019), e.g., healthcare workers, with an increased risk of infection from the coronavirus, putting them at a higher risk of stress and burnout (Carli, 2020).

Domestic Division of Labor

In many OECD countries, including Germany, the domestic division of labor still predominantly follows a traditional system (Zimmert, 2019). Despite recent policy reforms that have resulted in some increase in maternal full-time work and an increase in fathers taking parental leave, equally shared care work among both partners is still the exception, especially in West Germany (Hank and Steinbach, 2020; Kreyenfeld et al., 2020). The same is observed in the United Kingdom, with mothers spending less time in paid work but more time on household responsibilities (mothers combined paid work with other activities—mostly childcare—47% of their time, compared with 30% for fathers, a 2:1 ratio) (Andrew et al., 2020). Similar results are reported in Spain, with mothers spending on average 28 h a week on childcare compared with 19 h for fathers (Farré et al., 2020) see also (Czymara et al., 2021) for further discussion).

Informal Care

COVID-19 and its countermeasures have impacted women and men differently in terms of family dynamics and the intra-household allocation of paid and family care work, with consequences for both physical and mental health. Gender norms fundamentally shape women's and men's lives and this pandemic has remarkably increased the need for care inside homes, which has a particularly large impact on working mothers (Alon et al., 2020). Women underpin a greater share of informal care, providing on average 3.3 times more care than men at home (Addati and Cattaneo, 2018; Manzo and Minello, 2020), with the consequence of limiting their work and economic opportunities (Wenham, 2020). Comprehensively, social isolation was found to affect women in particular, considering that, for example, school closures forced more women than men to take time off for childcare, which might provide some insights into women's loneliness and depression (Chang, 2020). Thus, for the past three decades, studies have consistently reported that women are more likely to experience depression than men (Salk et al., 2017; Weissman and Klerman, 1977). However, as Brommelhoff et al. (2004) observes, reporting bias might also contribute to the higher rates of depression in women, since even when men and women present similar depression symptoms, women are tendentially more likely to be diagnosed with depression, which might underlie a gender bias. In line with this, Bluhm (2011) argues that depressed women do not tend to simply act out

passive behavior, but are more aware of their symptoms, despite the effects of their environment and their illness.

Insight and Implications

Our study highlights unresolved questions for research and policy. The first one regards aggression. How can increasing aggression in men be addressed effectively during and after the pandemic? Barriers to seek services as a victim, but also as a perpetrator, have to be distinguished into community and online programs. More research is necessary to estimate the demand during pandemics and adequately scale up these services. Furthermore, the focus in research and practice should shift toward prevention programs for perpetrators, since they may be at particular risk for developing a robust trait of (appetitive) aggression, antisocial personality disorder, or psychopathy (Powell et al., 1997; Cauffman et al., 1998; Fondacaro et al., 1999; Garieballa et al., 2006). Thus, screening for traumatic events should become a routine part of psychological treatment. Combined trauma therapy with extended group sessions allowing for skills training and help to abstain from aggression has shown promising results (Robjant et al., 2019; Koebach et al., 2021). In addition, systemic approaches help to de-escalate intrinsic family dynamics that lead to aggression and violence (e.g., Oka and Whiting, 2011). However, prevention should start with the adequate care of trauma-exposed children and youths, especially young men who learn to experience and control their aggression as part of their developmental milestones (Kröber, 2012).

Second, our data show that individuals living with children–male or female–present higher levels of depression and anxiety. Due to changes in the workplace and within families, more men will have to juggle paid work with housework. This will lead to higher stress loads and the question of how families can be protected. The increased stress load during the pandemic highlights the importance of well-functioning childcare services and schools, not only as a measure to raise and prepare the next generation for the workplace but also to facilitate mental health in society. Further research should explore the clinical relevance of the symptoms and whether gender assimilation in depression is maintained and how it develops after the pandemic. More research is needed to explore the specific challenges faced by men during the pandemic (see also Betron et al., 2020). It is also important to note that children growing up with a depressed parent have a higher risk of developing mental disorders themselves (Downey and Coyne, 1990).

Third, the higher levels of depression in women during crises lead to the question of whether depression in women can be prevented through gender equality programs. Programs to assist women to cope with the additional stress may be particularly important. In a large multinational study (Seedat et al., 2009) indeed found a decrease in GD in depression for countries with more gender equality. Given the hormonal aspects in the development of depression, this should nevertheless be complemented with early psychotherapeutic intervention. Mental health problems induced by the pandemic are likely to persist over time and mental health services should prepare for higher numbers of patients emerging after the COVID-19 pandemic. Currently, the demand for mental healthcare is rapidly

increasing, but affected individuals experience higher barriers to care due to lockdown measures being in place and services being overstretched. According to a WHO survey of 130 member states launched in mid-June 2020, the COVID-19 pandemic disrupted or halted critical mental healthcare in 93% of these countries, with approximately only 30% of mental health services for children, adolescents or older adults reporting no disruptions (WHO, 2020).

Fourth, depression and anxiety are higher in individuals who live alone, leading to the question how we can improve their resilience. Targeted regulations and interventions are necessary to shield this population from the negative mental health effects. Again, it will be an essential question how many suffer at a clinically relevant level and what the recovery rate is after the crisis. A model example is the project *Coping with Corona: Extended Psychosomatic care in Essen* (CoPE) developed to target, prevent and address the psychological burden of the pandemic, via a community-based intervention. CoPE aims at providing health support with psychoeducation, mindfulness and cognitive behavioral skills training. The intervention addresses day structuring, fears and worries, conflicts, stress management, sleep, and loneliness (Bäuerle et al., 2020c).

Fifth, despite the diversity in individual experiences, COVID-19 has affected everyone. Community intervention may therefore help a collective reprocessing of the pandemic and thus prevent further divisions in society. The key question is whether there is a desire and a political will to form a collective memory. The pandemic has led to divergent adverse, sometimes traumatic experiences of the crisis in terms of age/generation, gender, socioeconomic status, and work group (e.g., for medical doctors and nurses). Immediate responses tend to avoid and close with the past while ignoring the personal wounds and societal cleavages that were generated. In the long run, this may divide society. Therefore, a collective process to restore a shared understanding of the pandemic is necessary to rebuild a sense of togetherness and community. To this end, the narratives of subgroups who experienced marginalization and disadvantage due to policies related to the pandemic can be merged and developed to be presented to the affected community and facilitate a shared collective memory of the living generation (Koebach and Robjant, sub).

Strengths and Limitations

Our study has several strengths. First, it is one of the largest samples to date to examine GD in mental health burdens globally and in Germany during COVID-19. Second, besides mental health issues that were known to be more common in women, we also investigate aggression as an important mental health outcome. Third, LwC collects data in real time, reducing memory bias and allowing a valid comparison on the impact of the introduction or relaxation of COVID-19 countermeasures over time. Fourth, we collect nuanced information on what we call the exposure to COVID-19, which covers both respondents' own health experience of the pandemic, that of their social circle and an economic dimension. Finally, to our knowledge, there is no previous study that investigated gender effects in somatization dependent on the pandemic.

Nevertheless, our study also has some important limitations. First, the sampling technique we used to collect data is an online survey and we have to consider the possibility of selection bias, as suggested by the unbalanced gender ratio observed, e.g., when comparing cross-sectional data during the light and hard lockdown periods, which are based on answers by different individuals. Even though we statistically weighted sample responses based on population data on gender, age, level of education, and income, questions about representativeness and comparability over time may remain. Second, the responses were based on a self-administered online survey, which might create systematic differences in answers compared to answers from in-person interviews (though responses may suffer less from enumerator bias). Third, the variable whether the participant had previously contracted a COVID-19 infection is also a self-report rather than based on a test result. Fourth, we have limitations concerning sociodemographic data. since this is an international survey and the constructs of ethnicity and race are culturally specific, LwC does not include any questions on ethnicity or race. Also, LwC only includes a gender variable as: *male*, *female* or *other*, and does not include non-binary gender identity considerations. We acknowledge that a binary division of gender has been called into question and a more fluid and inclusive understanding of gender should be developed. Finally, our sample consisted of a very small part of individuals who tested positive for COVID-19 which restricts the relevance of the non-significant results and requires further investigation, possible using drawing on more data from the LwC survey or similar datasets.

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.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by UNU-WIDER (reference number: 202009/01). The patients/participants provided their written informed consent to participate in this study.

REFERENCES

- Abd-El-Fattah, S. M. (2013). A cross-cultural examination of the aggression questionnaire-short form among Egyptian and Omani adolescents. *J. Pers. Assessment* 95, 539–548. doi: 10.1080/00223891.2013.791828
- Abramson, L., Seligman, M., and Teasdale, J. (1978). Learned helplessness in humans: critique and reformulation. *J. Abnorm. Psychol.* 87, 49–74. doi: 10.1037/0021-843X.87.1.49
- Addati, L., and Cattaneo, U. (2018). *Care Work and Care Jobs For The Future Of Decent Work [Report]*. Available online at: http://www.ilo.org/global/publications/books/WCMS_633135/lang-en/index.htm (accessed May 15, 2021).
- Ainsworth, C. (2015). Sex redefined. *Nat. News* 518:288. doi: 10.1038/518288a

AUTHOR CONTRIBUTIONS

LA and AK made substantial contributions to the conception or design of the work and drafting the work. AH, TB, WS, and PJ made substantial contributions to the conception and design and were project leaders of Life with Corona (LwC). LA, AK, OD, and SC made substantial contributions to the analysis or interpretation of data for the work. LA, AK, OD, SC, AH, WS, HF, PJ, and TB made substantial contribution to the revision of the analysis and interpretation of data for the work and revising it critically for important intellectual content. LA, AK, OD, SC, AH, WS, HF, PJ, and TB provided approval for publication of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to accuracy of any part of the work are appropriately investigated and resolved. All the authors contributed and approved the submitted version of this article.

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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.2021.689396/full#supplementary-material>

- Allen, J. J., Anderson, C. A., and Bushman, B. J. (2018). The general aggression model. *Curr. Opin. Psychol.* 19, 75–80. doi: 10.1016/j.copsyc.2017.03.034
- Alloy, L. B. (1982). The role of perceptions and attributions for response-outcome noncontingency in learned helplessness: a commentary and discussion. *J. Pers.* 50, 443–479. doi: 10.1111/j.1467-6494.1982.tb00229.x
- Alon, T., Doepke, M., Olmstead-Rumsey, J., and Tertilt, M. (2020). *The Impact of COVID-19 on Gender Equality* (No. w26947; p. w26947). Cambridge, MA: National Bureau of Economic Research, doi: 10.3386/w26947
- Alonzi, S., La Torre, A., and Silverstein, M. W. (2020). The psychological impact of preexisting mental and physical health conditions during the COVID-19 pandemic. *Psychol. Trauma* 12, S236–S238. doi: 10.1037/tra0000840

- Altemus, M. (2006). Sex differences in depression and anxiety disorders: Potential biological determinants. *Hormones Behav.* 50, 534–538. doi: 10.1016/j.yhbeh.2006.06.031
- Altemus, M., Sarvaiya, N., and Epperson, C. N. (2014). Sex differences in anxiety and depression clinical perspectives. *Front. Neuroendocrinol.* 35:320–330. doi: 10.1016/j.yfrne.2014.05.004
- Anderson, C. A., and Bushman, B. J. (2002). Human aggression. *Annu. Rev. Psychol.* 53, 27–51. doi: 10.1146/annurev.psych.53.100901.135231
- Andresen, M. A., and Hodgkinson, T. (2020). Somehow I always end up alone: COVID-19, social isolation and crime in Queensland, Australia. *Crime Sci.* 9:25. doi: 10.1186/s40163-020-00135-4
- Andrew, A., Cattani, S., Dias, M. C., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). *How are Mothers and Fathers Balancing Work and Family under Lockdown?*. London: Institute for Fiscal Studies, doi: 10.1920/BN.IFS.2020.BN0290
- Archer, J. (2004). Sex differences in aggression in real-world settings: a meta-analytic review. *Rev. Gen. Psychol.* 8, 291–322. doi: 10.1037/1089-2680.8.4.291
- Archer, J., and Webb, I. A. (2006). The relation between scores on the Buss–Perry Aggression Questionnaire and aggressive acts, impulsiveness, competitiveness, dominance, and sexual jealousy. *Aggressive Behav.* 32, 464–473. doi: 10.1002/ab.20146
- Arseneault, L. (2017). The long-term impact of bullying victimization on mental health. *World Psychiatry* 16, 27–28. doi: 10.1002/wps.20399
- Asher, M., Asnaani, A., and Aderka, I. M. (2017). Gender differences in social anxiety disorder: a review. *Clin. Psychol. Rev.* 56, 1–12. doi: 10.1016/j.cpr.2017.05.004
- Augsburger, M., Meyer-Parlapanis, D., Bambonye, M., Elbert, T., and Crombach, A. (2015). Appetitive aggression and adverse childhood experiences shape violent behavior in females formerly associated with combat. *Front. Psychol.* 6:1756. doi: 10.3389/fpsyg.2015.01756
- Ausín, B., Gonzalez-Sanguino, C., Castellanos, M., and Munoz, M. (2021). Gender-related differences in the psychological impact of confinement as a consequence of COVID-19 in Spain. *J. Gender Stud.* 30, 29–38. doi: 10.1080/09589236.2020.1799768
- Bander, R. S., and Betz, N. E. (1981). The relationship of sex and sex role to trait and situationally specific anxiety types. *J. Res. Pers.* 15, 312–322. doi: 10.1016/0092-6566(81)90029-5
- Barsky, A. J., Orav, E. J., and Bates, D. W. (2005). Somatization increases medical utilization and costs independent of psychiatric and medical comorbidity. *Arch. Gen. Psychiatry* 62:903. doi: 10.1001/archpsyc.62.8.903
- Barsky, A. J., Peekna, H. M., and Borus, J. F. (2001). Somatic symptom reporting in women and Men. *J. Gen. Intern. Med.* 16, 266–275. doi: 10.1046/j.1525-1497.2001.00229.x
- Bäuerle, A., Graf, J., Jansen, C., Dörrie, N., Junne, F., Teufel, M., et al. (2020c). An e-mental health intervention to support burdened people in times of the COVID-19 pandemic: CoPE It. *J. Public Health.* 42, 647–648. doi: 10.1093/pubmed/fdaa058
- Bäuerle, A., Steinbach, J., Schweda, A., Beckord, J., Hetkamp, M., Weismüller, B., et al. (2020a). Mental health burden of the COVID-19 outbreak in Germany: predictors of mental health impairment. *J. Primary Care Commun. Health* 11:2150132720953682. doi: 10.1177/2150132720953682
- Bäuerle, A., Teufel, M., Musche, V., Weismüller, B., Kohler, H., Hetkamp, M., et al. (2020b). Increased generalized anxiety, depression and distress during the COVID-19 pandemic: a cross-sectional study in Germany. *J. Public Health* 42, 672–678. doi: 10.1093/pubmed/fdaa106
- Beesdo, K., Pine, D. S., Lieb, R., and Wittchen, H.-U. (2010). Incidence and risk patterns of anxiety and depressive disorders and categorization of generalized anxiety disorder. *Arch. Gen. Psychiatry* 67:47. doi: 10.1001/archgenpsychiatry.2009.177
- Bem, S. (1981). Gender schema theory: a cognitive account of sex typing. *Psychol. Rev.* 88, 354–364.
- Betron, M., Gottert, A., Pulerwitz, J., Shattuck, D., and Stevanovic-Fenn, N. (2020). Men and COVID-19: adding a gender lens. *Glob. Public Health* 15, 1090–1092. doi: 10.1080/17441692.2020.1769702
- Bettencourt, B., Talley, A., Benjamin, A. Jr., and Valentine, J. (2006). Personality and aggressive behavior under provoking and neutral conditions: a meta-analytic review. *Psychol. Bull.* 132, 751–777. doi: 10.1037/0033-2909.132.5.751
- Björkqvist, K. (2018). Gender differences in aggression. *Curr. Opin. Psychol.* 19, 39–42. doi: 10.1016/j.copsyc.2017.03.030
- Bluhm, R. (2011). Gender differences in depression: explanations from feminist ethics. *Int. J. Fem. Approaches Bioeth.* 4, 69–88. doi: 10.2979/intfemappbio.4.1.69
- Boniol, M., McIsaac, M., Xu, L., Wuliji, T., Diallo, K., and Campbell, J. (2019). *Gender Equity in the Health Workforce: Analysis of 104 Countries*, Vol. 8. Geneva: World Health Organization.
- Boyd, A., Van de Velde, S., Vilagut, G., de Graaf, R., O'Neill, S., Florescu, S., et al. (2015). Gender differences in mental disorders and suicidality in Europe: results from a large cross-sectional population-based study. *J. Affect. Disord.* 173, 245–254. doi: 10.1016/j.jad.2014.11.002
- Bradbury-Jones, C., and Isham, L. (2020). The pandemic paradox: the consequences of COVID-19 on domestic violence. *J. Clin. Nurs.* 29, 2047–2049. doi: 10.1111/jocn.15296
- Bretschneider, J., Kuhnert, R., and Hapke, U. (2017). Depressive symptoms among adults in Germany. *J. Health Monit.* 2, 77–83. doi: 10.17886/RKI-GBE-2017-070
- Brommelhoff, J. A., Conway, K., Merikangas, K., and Levy, B. R. (2004). Higher rates of depression in women: role of gender bias within the family. *J. Womens Health* 13, 69–76. doi: 10.1089/154099904322836474
- Brück, T., Justino, P., Verwimp, P., Avdeenko, A., and Tedesco, A. (2016). Measuring violent conflict in micro-level surveys: current practices and methodological challenges. *World Bank Res. Observer* 31, 29–58. doi: 10.1093/wbro/lkv011
- Bryant, F. B., and Smith, B. D. (2001). Refining the architecture of aggression: a measurement model for the buss–perry aggression questionnaire. *J. Res. Pers.* 35, 138–167. doi: 10.1006/jrpe.2000.2302
- Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., and Santabárbara, J. (2021). Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int. J. Clin. Health Psychol.* 21:100196. doi: 10.1016/j.ijchp.2020.07.007
- Buil-Gil, D., Miró-Llinares, F., Moneva, A., Kemp, S., and Díaz-Castaño, N. (2021). Cybercrime and shifts in opportunities during COVID-19: A preliminary analysis in the UK. *Eur. Soc.* 23(sup1), S47–S59. doi: 10.1080/14616696.2020.1804973
- Bushman, B. (2016). *Aggression and Violence – A social psychological perspective*. *Frontiers of Social Psychology*. New York, NY: Routledge.
- Calvano, C., Engelke, L., Di Bella, J., Kindermann, J., Renneberg, B., and Winter, S. M. (2021). Families in the COVID-19 pandemic: parental stress, parent mental health and the occurrence of adverse childhood experiences-results of a representative survey in Germany. *Eur. Child Adolesc. Psychiatry* 1–13. doi: 10.1007/s00787-021-01739-0
- Cameron, J. J., and Stinson, D. A. (2019). Gender (mis)measurement: Guidelines for respecting gender diversity in psychological research. *Soc. Pers. Psychol. Compass* 13:e12506. doi: 10.1111/spc3.12506
- Campbell, A. M. (2020). An increasing risk of family violence during the Covid-19 pandemic: Strengthening community collaborations to save lives. *Foren. Sci. Int. Rep.* 2:100089. doi: 10.1016/j.fsir.2020.100089
- Canet-Juric, L., Andrés, M. L., del Valle, M., López-Morales, H., Poó, F., Galli, J. I., et al. (2020). A Longitudinal Study On The Emotional Impact Cause By The COVID-19 pandemic quarantine on general population. *Front. Psychol.* 11:565688. doi: 10.3389/fpsyg.2020.565688
- Carli, L. L. (2020). Women, gender equality and COVID-19. *Gender Manag. Int. J.* 35, 647–655. doi: 10.1108/GM-07-2020-0236
- Cauffman, E., Feldman, S., Wetherman, J., and Steiner, H. (1998). Posttraumatic stress disorder among female juvenile offenders. *J. Am. Acad. Child Adolesc. Psychiatry* 37, 1209–1216. doi: 10.1097/00004583-199811000-00022
- Chambless, D. L., and Mason, J. (1986). Sex, sex-role stereotyping and agoraphobia. *Behav. Res. Ther.* 24, 231–235. doi: 10.1016/0005-7967(86)90098-7
- Chang, W.-H. (2020). Understanding the COVID-19 pandemic from a gender perspective. *Taiwan. J. Obstet. Gynecol.* 59, 801–807. doi: 10.1016/j.tjog.2020.09.004
- Chemtob, C., Novaco, R., Hamada, R., Gross, D., and Smith, G. (1997). Anger regulation deficits in combat-related posttraumatic stress disorder. *J. Traumatic Stress* 10, 17–36. doi: 10.1023/A:1024852228908

- Começanha, R., Basto-Pereira, M., and Maia, Â (2017). Clinically speaking, psychological abuse matters. *Compr. Psychiatry* 73, 120–126. doi: 10.1016/j.comppsy.2016.11.015
- Conti, P., and Younes, A. (2020). Coronavirus COV-19/SARS-CoV-2 affects women less than men: clinical response to viral infection. *J. Biol. Regul. Homeost. Agents* 34, 339–343. doi: 10.23812/Editorial-Conti-3
- Czymara, C. S., Langenkamp, A., and Cano, T. (2021). Cause for concerns: gender inequality in experiencing the COVID-19 lockdown in Germany. *Eur. Soc. 23(sup1)*, S68–S81. doi: 10.1080/14616696.2020.1808692
- Deffenbacher, J. L., Oetting, E. R., Lynch, R. S., and Morris, C. D. (1996). The expression of anger and its consequences. *Behav. Res. Ther.* 34, 575–590. doi: 10.1016/0005-7967(96)00018-6
- Denson, T. F., O'Dean, S. M., Blake, K. R., and Beames, J. R. (2018). Aggression in Women: behavior, brain and hormones. *Front. Behav. Neurosci.* 12:18. doi: 10.3389/fnbeh.2018.00081
- Diamond, P. M., and Magaletta, P. R. (2006). The short-form buss-perry aggression questionnaire (BPAQ-SF): a validation study with federal offenders. *Assessment* 13, 227–240. doi: 10.1177/1073191106287666
- Donner, N. C., and Lowry, C. A. (2013). Sex differences in anxiety and emotional behavior. *Pflügers Arch. Eur. J. Physiol.* 465, 601–626. doi: 10.1007/s00424-013-1271-7
- Downey, G., and Coyne, J. C. (1990). Children of depressed parents: an integrative review. *Psychol. Bull.* 108, 50–76. doi: 10.1037/0033-2909.108.1.50
- Durbano, F. (2015). *A Fresh Look at Anxiety Disorders*. Nordstedt: BoD – Books on Demand.
- Ebert, C., and Steinert, J. I. (2021). Prevalence and risk factors of violence against women and children during COVID-19 Germany. *Bull. World Health Organ.* 99, 429–438.
- Ehlers, A. (1993). Somatic symptoms and panic attacks: a retrospective study of learning experiences. *Behav. Res. Ther.* 31, 269–278. doi: 10.1016/0005-7967(93)90025-p
- Eisenberger, N. I. (2012). The pain of social disconnection: examining the shared neural underpinnings of physical and social pain. *Nat. Rev. Neurosci.* 13, 421–434. doi: 10.1038/nrn3231
- Eisenberger, N. I., and Lieberman, M. D. (2004). Why rejection hurts: a common neural alarm system for physical and social pain. *Trends Cogn. Sci.* 8, 294–300. doi: 10.1016/j.tics.2004.05.010
- Elbert, T., Schauer, M., and Moran, J. K. (2018). Two pedals drive the bi-cycle of violence: Reactive and appetitive aggression. *Curr. Opin. Psychol.* 19, 135–138. doi: 10.1016/j.copsyc.2017.03.016
- Elbert, T., Weierstall, R., and Schauer, M. (2010). Fascination violence: on mind and brain of man hunters. *Eur. Arch. Psychiatry Clin. Neurosci.* 260 Suppl 2, S100–S105. doi: 10.1007/s00406-010-0144-8
- Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw. Open* 3:e2019686. doi: 10.1001/jamanetworkopen.2020.19686
- Fahlgren, M. K., Cheung, J. C., Ciesinski, N. K., McCloskey, M. S., and Coccaro, E. F. (2021). Gender differences in the relationship between anger and aggressive behavior. *J. Interpers. Violence* 5:886260521991870. doi: 10.1177/0886260521991870
- Farré, L., Fawaz, Y., Gonzalez, L., and Graves, J. (2020). *How the COVID-19 Lockdown Affected Gender Inequality in Paid and Unpaid Work in Spain*. IZA Discussion Papers (No. 13434; IZA Discussion Papers). Bonn: Institute of Labor Economics (IZA).
- Feeny, N. C., Zoellner, L. A., and Foa, E. B. (2000). Anger, dissociation, and posttraumatic stress disorder among female assault victims. *J. Traumatic Stress* 13, 89–100. doi: 10.1023/A:1007725015225
- Fink, P., Toft, T., Hansen, M. S., Ørnboel, E., and Olesen, F. (2007). Symptoms and syndromes of bodily distress: an exploratory study of 978 internal medical, neurological, and primary care patients. *Psychosom. Med.* 69, 30–39. doi: 10.1097/PSY.0b013e31802e46eb
- Flanagan, V. (2012). “Gender studies,” in *The Routledge Companion to Children's Literature*, ed. D. Rudd (Abingdon: Routledge), 42–54. doi: 10.4324/9780203889855-10
- Foa, E. B., Riggs, D. S., Massie, E. D., and Yarczower, M. (1995). The impact of fear activation and anger on the efficacy of exposure treatment for posttraumatic stress disorder. *Behav. Ther.* 26, 487–499. doi: 10.1016/S0005-7894(05)80096-6
- Fondacaro, K. M., Holt, J. C., and Powell, T. A. (1999). Psychological impact of childhood sexual abuse on male inmates: the importance of perception. *Child Abuse Neglect* 23, 361–369. doi: 10.1016/S0145-2134(99)00004-6
- Forum on Global Violence Prevention (2011). *Direct and Indirect Costs of Violence. Social and Economic Costs of Violence: Workshop Summary*. Washington, DC: National Academies Press (US).
- Fraser, D. E. (2020). *Impact of COVID-19 Pandemic on Violence against Women and Girls*. 16. New York, NY: UN WOMEN.
- Frederiksen, B., and Gomez, I. (2020). *Coronavirus: A Look at Gender Differences in Awareness and Actions*. San Francisco, CA: KFF.
- Freund, C., and Hamel, I. (2020). *COVID is Hurting Women Economically, but Governments Have the Tools to Offset the Pain*. World Bank. Available online at: <https://blogs.worldbank.org/psd/covid-hurting-women-economically-governments-have-tools-offset-pain>
- Garcia, N. M., Walker, R. S., and Zoellner, L. A. (2018). Estrogen, progesterone, and the menstrual cycle: A systematic review of fear learning, intrusive memories, and PTSD. *Clin. Psychol. Rev.* 66, 80–96. doi: 10.1016/j.cpr.2018.06.005
- Gariballa, S. S., Schauer, M., Neuner, F., Saleptsi, E., Kluttig, T., Elbert, T., et al. (2006). Traumatic events, PTSD, and psychiatric comorbidity in forensic patients – assessed by questionnaires and diagnostic interview. *Clin. Pract. Epidemiol. Ment. Health* 2:7. doi: 10.1186/1745-0179-2-7
- Gelles, R. (1993). *Aggression: Its Causes, Consequences, and Control* by Leonard Berkowitz. Available ONLINE AT: <https://www.proquest.com/openview/19221df0825f9b8b416cf005e9bef465/1?pq-origsite=gscholar&cbl=47867> (accessed May 15, 2021).
- Gierk, B., Kohlmann, S., Kroenke, K., Spangenberg, L., Zenger, M., Brähler, E., et al. (2014). The somatic symptom scale-8 (SSS-8): a brief measure of somatic symptom burden. *JAMA Intern. Med.* 174:399. doi: 10.1001/jamainternmed.2013.12179
- Global Study on Homicide (2019). Available online at: <https://www.unodc.org/unodc/en/data-and-analysis/global-study-on-homicide.html> (accessed May 18, 2021).
- Golden, S. A., Jin, M., and Shaham, Y. (2019). Animal models of (or for) aggression reward, addiction, and relapse: behavior and circuits. *J. Neurosci.* 39, 3996–4008. doi: 10.1523/JNEUROSCI.0151-19.2019
- Golden, S. A., and Shaham, Y. (2018). Aggression addiction and relapse: a new frontier in psychiatry. *Neuropsychopharmacology* 43, 224–225. doi: 10.1038/npp.2017.173
- Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., et al. (2021). A global panel database of pandemic policies (Oxford COVID-19 government response tracker). *Nat. Hum. Behav.* 5, 529–538. doi: 10.1038/s41562-021-01079-8
- Halford, E., Dixon, A., Farrell, G., Malleson, N., and Tilley, N. (2020). Crime and coronavirus: social distancing, lockdown, and the mobility elasticity of crime. *Crime Sci.* 9:11. doi: 10.1186/s40163-020-00121-w
- Hammarström, A., Lehti, A., Danielsson, U., Bengs, C., and Johansson, E. E. (2009). Gender-related explanatory models of depression: a critical evaluation of medical articles. *Public Health* 123, 689–693. doi: 10.1016/j.puhe.2009.09.010
- Hank, K., and Steinbach, A. (2020). The virus changed everything, didn't it? Couples' division of housework and childcare before and during the Corona crisis. *J. Fam. Res.* 33, 99–114. doi: 10.20377/jfr-488
- Hinz, A., Klein, A. M., Brähler, E., Glaesmer, H., Luck, T., Riedel-Heller, S. G., et al. (2017). Psychometric evaluation of the generalized anxiety disorder screener GAD-7, based on a large German general population sample. *J. Affect. Disord.* 210, 338–344. doi: 10.1016/j.jad.2016.12.012
- Hodes, G. E., Walker, D. M., Labonté, B., Nestler, E. J., and Russo, S. J. (2017). Understanding the epigenetic basis of sex differences in depression. *J. Neurosci. Res.* 95, 692–702. doi: 10.1002/jnr.23876
- Hodgkinson, T., and Andresen, M. A. (2020). Show me a man or a woman alone and I'll show you a saint: Changes in the frequency of criminal incidents during the COVID-19 pandemic. *J. Crim. Justice* 69:101706. doi: 10.1016/j.jcrimjus.2020.101706
- Jalnapurkar, I., Allen, M., and Pigott, T. (2018). Sex differences in anxiety disorders: a review. *J. Psychiatry Depress Anxiety* 4:12. doi: 10.24966/PDA-0150/100012
- Jeong, H., Yim, H. W., Song, Y.-J., Ki, M., Min, J.-A., Cho, J., et al. (2016). Mental health status of people isolated due to Middle East Respiratory Syndrome. *Epidemiol. Health* 38:e2016048. doi: 10.4178/epih.e2016048

- Jin, J.-M., Bai, P., He, W., Wu, F., Liu, X.-F., Han, D.-M., et al. (2020). Gender differences in patients with COVID-19: focus on Severity and mortality. *Front. Public Health* 8:152. doi: 10.3389/fpubh.2020.00152
- Joyce, P. R., Oakley-Browne, M. A., Wells, J. E., Bushnell, J. A., and Hornblow, A. R. (1990). Birth cohort trends in major depression: increasing rates and earlier onset in New Zealand. *J. Affect. Disord.* 18, 83–89. doi: 10.1016/0165-0327(90)90063-e
- Jurczyk, M., and Lalak, D. (2020). Aggressive and delinquent behavior among youth: an empirical study in Poland. *Violence Gender* 7, 188–199. doi: 10.1089/vio.2019.0065
- Kang, H.-J., Park, Y., Yoo, K.-H., Kim, K.-T., Kim, E.-S., Kim, J.-W., et al. (2020). Sex differences in the genetic architecture of depression. *Sci. Rep.* 10:9927. doi: 10.1038/s41598-020-66672-9
- Kazmi, S. S. H. (2020). COVID-19 and lockdown: a study on the impact on mental health. *Mukt. Shabd. J.* 9, 1477–1489.
- Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., et al. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. Results from the national comorbidity survey. *Arch. Gen. Psychiatry* 51, 8–19. doi: 10.1001/archpsyc.1994.03950010008002
- Klose, M., and Jacobi, F. (2004). Can gender differences in the prevalence of mental disorders be explained by sociodemographic factors? *Arch. Womens Ment. Health* 7, 133–148. doi: 10.1007/s00737-004-0047-7
- Knight, G. P., Guthrie, I. K., Page, M. C., and Fabes, R. A. (2002). Emotional arousal and gender differences in aggression: a meta-analysis. *Aggres. Behav.* 28, 366–393. doi: 10.1002/ab.80011
- Ko, N.-Y., Lu, W.-H., Chen, Y.-L., Li, D.-J., Wang, P.-W., Hsu, S.-T., et al. (2020). COVID-19-related information sources and psychological well-being: An online survey study in Taiwan. *Brain Behav. Immunity* 87, 153–154. doi: 10.1016/j.bbi.2020.05.019
- Koebach, A., Carleial, S., Elbert, T., Schmitt, S., and Robjant, K. (2021). Treating trauma and aggression with narrative exposure therapy in former child and adult soldiers: a randomized controlled trial in Eastern DR Congo. *J. Consult. Clin. Psychol.* 89, 143–155. doi: 10.1037/ccp0000632
- Koebach, A., and Elbert, T. (2015). Sensitive periods for developing a robust trait of appetitive aggression. *Front. Psychiatry* 6:144. doi: 10.3389/fpsy.2015.00144
- Kohlmann, S., Gierk, B., Hümmelgen, M., Blankenberg, S., and Löwe, B. (2013). Somatic symptoms in patients with coronary heart disease: Prevalence, risk factors, and quality of life. *JAMA Internal Med.* 173, 1469–1471. doi: 10.1001/jamainternmed.2013.6835
- Kreyenfeld, M., Zinn, S., Entringer, T., Goebel, J., Grabka, M., Graeber, D., et al. (2020). *DIW Berlin: Coronavirus & Care: How the Coronavirus Crisis Affected Fathers' Involvement in Germany*. Berlin: DIW, I.
- Kröber, H.-L. (2012). Zusammen kämpfen, zusammen schlagen? (Conjoint fighting, conjoint bashing? The young prosocial violent perpetrator). *Forensische Psychiatr. Psychol. Kriminol.* 6, 166–176. doi: 10.1007/s11757-012-0168-1
- Kroenke, K., Arrington, M. E., and Mangelsdorff, A. D. (1990). The prevalence of symptoms in medical outpatients and the adequacy of therapy. *Arch. Internal Med.* 150, 1685–1689. doi: 10.1001/archinte.150.8.1685
- Kroenke, K., Jackson, J. L., and Chamberlin, J. (1997). Depressive and anxiety disorders in patients presenting with physical complaints: clinical predictors and outcome. *Am. J. Med.* 103, 339–347. doi: 10.1016/s0002-9343(97)00241-6
- Kroenke, K., and Spitzer, R. L. (2002). The PHQ-9: a new depression diagnostic and severity measure. *Psychiatr. Ann.* 32, 509–515. doi: 10.3928/0048-5713-20020901-06
- Kroenke, K., Zhong, X., Theobald, D., Wu, J., Tu, W., and Carpenter, J. S. (2010). Somatic symptoms in patients with cancer experiencing pain or depression: prevalence, disability, and health care use. *Arch. Internal Med.* 170, 1686–1694. doi: 10.1001/archinternmed.2010.337
- Kuzminkaite, E., Penninx, B. W. J. H., van Harmelen, A.-L., Elzinga, B. M., Hovens, J. G. F. M., and Vinkers, C. H. (2021). Childhood trauma in adult depressive and anxiety disorders: an integrated review on psychological and biological mechanisms in the NESDA cohort. *J. Affect. Disord.* 283, 179–191. doi: 10.1016/j.jad.2021.01.054
- Lagerspetz, K. M., Björkqvist, K., and Peltonen, T. (1988). Is indirect aggression typical of females? Gender differences in aggressiveness in 11- to 12-year-old children. *Aggressive Behav.* 14, 403–414.
- Leslie, E., and Wilson, R. (2020). Sheltering in place and domestic violence: evidence from calls for service during COVID-19. *J. Public Econ.* 189:104241. doi: 10.1016/j.jpubeco.2020.104241
- Li, S. H., and Graham, B. M. (2017). Why are women so vulnerable to anxiety, trauma-related and stress-related disorders? The potential role of sex hormones. *Lancet Psychiatry* 4, 73–82. doi: 10.1016/S2215-0366(16)30358-3
- Ling, S., Umbach, R., and Raine, A. (2019). Biological explanations of criminal behavior. *Psychol. Crime Law* 25, 626–640. doi: 10.1080/1068316X.2019.1572753
- Losada-Baltar, A., Jiménez-Gonzalo, L., Gallego-Alberto, L., Pedrosa-Chaparro, M., del, S., Fernandes-Pires, J., et al. (2020). “We’re staying at home”. Association of self-perceptions of aging, personal and family resources and loneliness with psychological distress during the lock-down period of COVID-19. *J. Gerontol. Ser. B* 76, 10–16. doi: 10.1093/geronb/gbaa048
- Löwe, B., Wahl, I., Rose, M., Spitzer, C., Glaesmer, H., Wingenfeld, K., et al. (2010). A 4-item measure of depression and anxiety: validation and standardization of the patient health questionnaire-4 (PHQ-4) in the general population. *J. Affect. Disord.* 122, 86–95. doi: 10.1016/j.jad.2009.06.019
- Manzo, L. K. C., and Minello, A. (2020). Mothers, childcare duties, and remote working under COVID-19 lockdown in Italy: cultivating communities of care. *Dialogues Hum. Geogr.* 10, 120–123. doi: 10.1177/2043820620934268
- Matsudaira, K., Oka, H., Kawaguchi, M., Murakami, M., Fukudo, S., Hashizume, M., et al. (2017). Development of a Japanese version of the somatic symptom scale-8: psychometric validity and internal consistency. *Gen. Hosp. Psychiatry* 45, 7–11. doi: 10.1016/j.genhosppsych.2016.12.002
- Mazza, C., Ricci, E., Marchetti, D., Fontanesi, L., Di Giandomenico, S., Verrocchio, M. C., et al. (2020). How personality relates to distress in parents during the Covid-19 lockdown: the mediating role of child’s emotional and behavioral difficulties and the moderating effect of living with other people. *Int. J. Environ. Res. Public Health* 17:6236. doi: 10.3390/ijerph17176236
- McCullough, J. P. (2003). Treatment for chronic depression using cognitive behavioral analysis system of psychotherapy (CBASP). *J. Clin. Psychol.* 59, 833–846. doi: 10.1002/jclp.10176
- McHenry, J., Carrier, N., Hull, E., and Kabbaj, M. (2014). Sex differences in anxiety and depression: role of testosterone. *Front. Neuroendocrinol.* 35:42–57. doi: 10.1016/j.yfrne.2013.09.001
- McLean, C. P., and Anderson, E. R. (2009). Brave men and timid women? A review of the gender differences in fear and anxiety. *Clin. Psychol. Rev.* 29, 496–505. doi: 10.1016/j.cpr.2009.05.003
- McLean, C. P., Asnaani, A., Litz, B. T., and Hofmann, S. G. (2011). Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. *J. Psychiatr. Res.* 45, 1027–1035. doi: 10.1016/j.jpsychires.2011.03.006
- Meyer-Parlapanis, D., Weierstall, R., Nandi, C., Bambonyé, M., Elbert, T., and Crombach, A. (2016). Appetitive aggression in women: comparing male and female war combatants. *Front. Psychol.* 6:1972. doi: 10.3389/fpsyg.2015.01972
- Moore, S. E., Wierenga, K. L., Prince, D. M., Gillani, B., and Mintz, L. J. (2021). Disproportionate impact of the COVID-19 pandemic on perceived social support, mental health and somatic symptoms in sexual and gender minority populations. *J. Homosex.* 68, 577–591. doi: 10.1080/00918369.2020.1868184
- Moscovitch, D. A., Hofmann, S. G., and Litz, B. T. (2005). The impact of self-construals on social anxiety: a gender-specific interaction. *Pers. Individ. Diff.* 38, 659–672. doi: 10.1016/j.paid.2004.05.021
- Msherghi, A., Alsuyhili, A., Alsoufi, A., Ashini, A., Alkshik, Z., Alsharea, E., et al. (2021). Mental health consequences of lockdown during the COVID-19 pandemic: a cross-sectional study. *Front. Psychol.* 12:605279. doi: 10.3389/fpsyg.2021.605279
- Nell, V. (2006). Cruelty’s rewards: the gratifications of perpetrators and spectators. *Behav. Brain Sci.* 29, 211–224; discussion 224–257. doi: 10.1017/s0140525x06009058
- Neria, Y., Nandi, A., and Galea, S. (2008). Post-traumatic stress disorder following disasters: a systematic review. *Psychol. Med.* 38, 467–480. doi: 10.1017/S0033291707001353

- Norman, R. E., Byambaa, M., De, R., Butchart, A., Scott, J., and Vos, T. (2012). The long-term health consequences of child physical abuse, emotional abuse, and neglect: a systematic review and meta-analysis. *PLoS Med.* 9:e1001349. doi: 10.1371/journal.pmed.1001349
- Novaco, R. W., and Chemtob, C. M. (1998). "Anger and trauma: conceptualization, assessment, and treatment," in *Cognitive-Behavioral Therapies for Trauma*, eds F. R. Abueg, J. I. Ruzek, and V. M. Follette (New York, NY: The Guilford Press), 162–190.
- Oka, M., and Whiting, J. B. (2011). Contemporary MFT theories and intimate partner violence: a review of systemic treatments. *J. Couple Relationsh. Ther.* 10, 34–52. doi: 10.1080/15332691.2011.539173
- Olaseni, A. O. (2020). Psychological distress experiences of Nigerians during Covid-19 pandemic; the gender difference. *Soc. Sci.* 2:100052. doi: 10.1016/j.ssaoh.2020.100052
- O'Leary, O. F., and Cryan, J. F. (2013). Towards translational rodent models of depression. *Cell Tissue Res.* 354, 141–153. doi: 10.1007/s00441-013-1587-9
- Olendick, T. H., King, N. J., and Muris, P. (2002). Fears and phobias in children: phenomenology, epidemiology, and aetiology. *Child Adolesc. Ment. Health* 7, 98–106. doi: 10.1111/1475-3588.00019
- Orgilés, M., Morales, A., Delvecchio, E., Mazzechi, C., and Espada, J. P. (2020). Immediate psychological effects of the COVID-19 quarantine in youth from Italy and Spain. *PsyArXiv*[Preprint] doi: 10.31234/osf.io/5bpfz
- Orth, U., and Wieland, E. (2006). Anger, hostility, and posttraumatic stress disorder in trauma-exposed adults: a meta-analysis. *J. Consult. Clin. Psychol.* 74, 698–706. doi: 10.1037/0022-006X.74.4.698
- Overmier, J. B., and Seligman, M. E. (1967). Effects of inescapable shock upon subsequent escape and avoidance responding. *J. Comp. Physiol. Psychol.* 63, 28–33. doi: 10.1037/h0024166
- Ozamiz-Etxebarria, N. (2020). Psychological symptoms during the two stages of lockdown in response to the COVID-19 outbreak: an investigation in a sample of citizens in northern Spain. *Front. Psychol.* 11:9.
- Pennebaker, J. W., and Roberts, T.-A. (1992). Toward a his and hers theory of emotion: gender differences in visceral perception. *J. Soc. Clin. Psychol.* 11, 199–212. doi: 10.1521/jscp.1992.11.3.199
- Perez-Vincent, S., Carreras, E., Gibbons, M. A., Murphy, T., and Rossi, M. (2020). *COVID-19 Lockdowns and Domestic Violence: Evidence from Two Studies in Argentina* | Publications. Inter-American Development Bank.
- Peterman, A., Potts, A., O'Donnell, M., Shah, N., Oertelt-Prigione, S., Thompson, K., et al. (2020). *Pandemics and Violence Against Women and Children*. CGD Working Paper 528. Washington, DC: Center for Global Development.
- Pieh, C., Budimir, S., and Probst, T. (2020). The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. *J. Psychosom. Res.* 136:110186. doi: 10.1016/j.jpsychores.2020.110186
- Piquero, A. R., Jennings, W. G., Jemison, E., Kaukinen, C., and Knaul, F. M. (2021). *Domestic Violence During COVID-19: Evidence from a Systematic Review and Meta-Analysis*. 21. Washington, D.C: Council on Criminal Justice.
- Powell, T. A., Holt, J. C., and Fondacaro, K. M. (1997). The prevalence of mental illness among inmates in a rural state. *Law Hum. Behav.* 21, 427–438. doi: 10.1023/a:1024811303834
- Ran, L., Wang, W., Ai, M., Kong, Y., Chen, J., and Kuang, L. (2020). Psychological resilience, depression, anxiety, and somatization symptoms in response to COVID-19: a study of the general population in China at the peak of its epidemic. *Soc. Sci. Med.* 262:113261. doi: 10.1016/j.socscimed.2020.113261
- Raps, C. S., Peterson, C., Reinhard, K. E., Abramson, L. Y., and Seligman, M. E. P. (1982). Attributional style among depressed patients. *J. Abnorm. Psychol.* 91, 102–108. doi: 10.1037/0021-843X.91.2.102
- Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., and Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *Eur. Child Adolesc. Psychiatry* 1–11. doi: 10.1007/s00787-021-01726-5
- Rief, W., Martin, A., Klaiberg, A., and Brähler, E. (2005). Specific effects of depression, panic, and somatic symptoms on illness behavior. *Psychosom. Med.* 67, 596–601. doi: 10.1097/01.psy.0000171158.59706.e7
- Ritchie, H., and Roser, M. (2018). *Mental Health*. Our World in Data. Available online at: <https://ourworldindata.org/mental-health> (accessed March 20, 2021).
- Robjant, K., Koebach, A., Schmitt, S., Chibashimba, A., Carleial, S., and Elbert, T. (2019). The treatment of posttraumatic stress symptoms and aggression in female former child soldiers using adapted Narrative Exposure therapy—A RCT in Eastern Democratic Republic of Congo. *Behav. Res. Ther.* 123:103482. doi: 10.1016/j.brat.2019.103482
- Rosenfield, S., and Mouzon, D. (2013). "Gender and mental health," in *Handbook of the Sociology of Mental Health*, eds C. S. Aneshensel, J. C. Phelan, and A. Bierman (Dordrecht: Springer), 277–296. doi: 10.1007/978-94-007-4276-5_14
- Rossi, R., Socci, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., et al. (2020). COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Front. Psychiatry* 11:790. doi: 10.3389/fpsy.2020.00790
- Rubenstein, L. M., Freed, R. D., Shapero, B. G., Fauber, R. L., and Alloy, L. B. (2016). Cognitive attributions in depression: bridging the gap between research and clinical practice. *J. Psychother. Integr.* 26, 103–115. doi: 10.1037/int0000030
- Salari, N., Hosseini-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., et al. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Glob. Health* 16:57. doi: 10.1186/s12992-020-00589-w
- Salk, R. H., Hyde, J. S., and Abramson, L. Y. (2017). Gender differences in depression in representative national samples: meta-analyses of diagnoses and symptoms. *Psychol. Bull.* 143, 783–822. doi: 10.1037/bul0000102
- Sánchez-Teruel, D. (2021). Do psychological strengths protect college students confined by COVID-19 to emotional distress? The role of gender. *Pers. Individ. Diff.* 171:110507.
- Scott, S. M., and Gross, L. J. (2021). COVID-19 and crime: analysis of crime dynamics amidst social distancing protocols. *PLoS One* 16:e0249414. doi: 10.1371/journal.pone.0249414
- Seedat, S., Scott, K. M., Angermeyer, M. C., Berglund, P., Bromet, E. J., Brugha, T. S., et al. (2009). Cross-national associations between gender and mental disorders in the WHO World Mental Health Surveys. *Arch. Gen. Psychiatry* 66, 785–795. doi: 10.1001/archgenpsychiatry.2009.36
- Seligman, M. E. P. (1972). Learned helplessness. *Annu. Rev. Med.* 23, 407–412. doi: 10.1146/annurev.me.23.020172.002203
- Shelef, L., and Zalsman, G. (2020). The psychological impact of COVID-19 on mental health – literature review. *Harefuah* 159, 320–325.
- Simon, G. E., VonKorff, M., Piccinelli, M., Fullerton, C., and Ormel, J. (1999). An international study of the relation between somatic symptoms and depression. *N. Engl. J. Med.* 341, 1329–1335. doi: 10.1056/NEJM199910283411801
- Simon, R. W. (1995). Gender, multiple roles, role meaning, and mental health. *J. Health Soc. Behav.* 36, 182–194. doi: 10.2307/2137224
- Spielberger, C. D., Jacobs, G., Russel, S., and Crane, R. S. (1983). "Assessment of anger: the state-trait anger scale," in *Advances in Personality Assessment*, Vol. 2, eds C. D. Spielberger and J. N. Butcher (Abingdon: Routledge).
- Spielberger, C. D., Reheiser, E. C., and Sydeman, S. J. (1995). Measuring the experience, expression, and control of anger. *Issues Compr. Pediatr. Nurs.* 18, 207–232. doi: 10.3109/01460869509087271
- Spitzer, R. L., Kroenke, K., Williams, J. B. W., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch. Intern. Med.* 166:1092. doi: 10.1001/archinte.166.10.1092
- Stewart, J. L., Bismark, A. W., Towers, D. N., Coan, J. A., and Allen, J. J. B. (2010). Resting frontal EEG asymmetry as an endophenotype for depression risk: sex-specific patterns of frontal brain asymmetry. *J. Abnorm. Psychol.* 119, 502–512. doi: 10.1037/a0019196
- Sutherland, M., McKenney, M., and Elkbali, A. (2021). Gun violence during COVID-19 pandemic: paradoxical trends in New York city, Chicago, Los Angeles and Baltimore. *Am. J. Emergency Med.* 39, 225–226. doi: 10.1016/j.ajem.2020.05.006
- Szabo, A., Ábel, K., and Boros, S. (2020). Attitudes toward COVID-19 and stress levels in Hungary: effects of age, perceived health status, and gender. *Psychol. Trauma* 12, 572–575.
- Telles, L. E., de, B., Valença, A. M., Barros, A. J. S., da Silva, A. G., Telles, L. E., et al. (2020). Domestic violence in the COVID-19 pandemic: a forensic psychiatric perspective. *Braz. J. Psychiatry Ahead* 43, 233–234. doi: 10.1590/1516-4446-2020-1060

- Turanovic, J. J., Pratt, T. C., and Piquero, A. R. (2017). Exposure to fetal testosterone, aggression, and violent behavior: a meta-analysis of the 2D:4D digit ratio. *Aggression Violent Behav.* 33, 51–61. doi: 10.1016/j.avb.2017.01.008
- Usher, K., Bhullar, N., Durkin, J., Gyamfi, N., and Jackson, D. (2020). Family violence and COVID-19: increased vulnerability and reduced options for support. *Int. J. Ment. Health Nurs.* 29, 549–552. doi: 10.1111/inm.12735
- Vitoratou, S., Ntzoufras, I., Smyrnis, N., and Stefanis, N. C. (2009). Factorial composition of the aggression questionnaire: a multi-sample study in greek adults. *Psychiatry Res.* 168, 32–39. doi: 10.1016/j.psychres.2008.01.016
- von Collani, G., and Werner, R. (2005). Self-related and motivational constructs as determinants of aggression. An analysis and validation of a German version of the Buss-Perry Aggression Questionnaire. *Pers. Individ. Diff.* 38, 1631–1643. doi: 10.1016/j.paid.2004.09.027
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729
- Wang, G., Zhang, Y., Zhao, J., Zhang, J., and Jiang, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *Lancet (London, England)* 395, 945–947. doi: 10.1016/S0140-6736(20)30547-X
- Watt, M. C., Stewart, S. H., and Cox, B. J. (1998). A retrospective study of the learning history origins of anxiety sensitivity. *Behav. Res. Ther.* 36, 505–525. doi: 10.1016/S0005-7967(97)10029-8
- Webster, G. D., DeWall, C. N., Pond, R. S. Jr., Deckman, T., Jonason, P. K., Le, B. M., et al. (2014). The brief aggression questionnaire: psychometric and behavioral evidence for an efficient measure of trait aggression. *Aggressive Behav.* 40, 120–139. doi: 10.1002/ab.21507
- Webster, G. D., DeWall, C. N., Pond, R. S. Jr., Deckman, T., Jonason, P. K., Le, B. M., et al. (2015). The brief aggression questionnaire: structure, validity, reliability, and generalizability. *J. Pers. Assessment* 97, 638–649. doi: 10.1080/00223891.2015.1044093
- Weissman, M. M., and Klerman, G. L. (1977). Sex differences and the epidemiology of depression. *Arch. Gen. Psychiatry* 34, 98–111. doi: 10.1001/archpsyc.1977.01770130100011
- Wenham, C. (2020). *The Gendered Impact of the COVID-19 Crisis and Post-crisis Period*. 68. London: LSE.
- WHO (2020). *The impact of COVID-19 on Mental, Neurological and Substance use Services*. Available online at: <https://www.who.int/publications-detail-redirect/978924012455> (accessed March 19, 2021).
- Wiborg, O. (2013). Chronic mild stress for modeling anhedonia. *Cell Tissue Res.* 354, 155–169. doi: 10.1007/s00441-013-1664-0
- Wickramaratne, P. J., Weissman, M. M., Leaf, P. J., and Holford, T. R. (1989). Age, period and cohort effects on the risk of major depression: results from five united states communities. *J. Clin. Epidemiol.* 42, 333–343. doi: 10.1016/0895-4356(89)90038-3
- Williams, S. N., Armitage, C. J., Tampe, T., and Dienes, K. (2020). Public perceptions and experiences of social distancing and social isolation during the COVID-19 pandemic: A UK-based focus group study. *MedRxiv [Preprint]* doi: 10.1101/2020.04.10.20061267 MedRxiv: 2020.04.10.20061267,
- Wu, T., Jia, X., Shi, H., Niu, J., Yin, X., Xie, J., et al. (2021). Prevalence of mental health problems during the COVID-19 pandemic: a systematic review and meta-analysis. *J. Affect. Disord.* 281, 91–98. doi: 10.1016/j.jad.2020.11.117
- Xiang, Y.-T., Yang, Y., Li, W., Zhang, L., Zhang, Q., Cheung, T., et al. (2020). Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet Psychiatry* 7, 228–229. doi: 10.1016/S2215-0366(20)30046-8
- Xie, X., Xue, Q., Zhou, Y., Zhu, K., Liu, Q., Zhang, J., et al. (2020). Mental health status among children in home confinement during the coronavirus disease 2019 outbreak in hubei province, China. *JAMA Pediatr.* 174:898. doi: 10.1001/jamapediatrics.2020.1619
- Yan, S., Xu, R., Stratton, T. D., Kavcic, V., Luo, D., Hou, F., et al. (2021). Sex differences and psychological stress: responses to the COVID-19 pandemic in China. *BMC Public Health* 21:79. doi: 10.1186/s12889-020-10085-w
- Ye, B., Zeng, Y., Im, H., Liu, M., Wang, X., and Yang, Q. (2021). The relationship between fear of COVID-19 and online aggressive behavior: a moderated mediation model. *Front. Psychol.* 12:589615. doi: 10.3389/fpsyg.2021.589615
- Zamarro, G., and Prados, M. J. (2021). Gender differences in couples' division of childcare, work and mental health during COVID-19. *Rev. Econ. Household* 19, 11–40. doi: 10.1007/s11150-020-09534-7
- Zhang, Y., and Ma, Z. F. (2020). Impact of the COVID-19 pandemic on mental health and quality of life among local residents in liaoning province, china: a cross-sectional study. *Int. J. Environ. Res. Public Health* 17:2381. doi: 10.3390/ijerph17072381
- Zimmert, F. (2019). *Early Child Care and Maternal Employment: Empirical Evidence from Germany*. IAB-Discussion Paper, No.2. Nürnberg: Institut für Arbeitsmarkt-und Berufsforschung (IAB), 32.
- Zimonyi, S., Kasos, K., Halmay, Z., Csirmaz, L., Stadler, H., Rózsa, S., et al. (2021). Hungarian validation of the buss-perry aggression questionnaire—is the short form more adequate? *Brain Behav.* 11:e02043. doi: 10.1002/brb3.2043

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Family Life in Lockdown

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The lockdown imposed following the COVID-19 pandemic of spring 2020 dramatically changed the daily lives and routines of millions of people worldwide. We analyze how such changes contributed to patterns of activity within the household using a novel survey of Italian, British, and American families in lockdown. A high percentage report disruptions in the patterns of family life, manifesting in new work patterns, chore allocations, and household tensions. Though men have taken an increased share of childcare and grocery shopping duties, reallocations are not nearly as stark as disruptions to work patterns might suggest, and families having to reallocate duties report greater tensions. Our results highlight tightened constraints budging up against stable and gendered patterns of intra-household cooperation norms. While the long-run consequences of the COVID-19 lockdown on family life cannot be assessed at this stage, we point toward the likely opportunities and challenges.

Keywords: lockdown, care, housework, tensions, COVID-19

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“Kitchen life is based on a musical rhythm, on a concatenation of movements, like dance steps, and when I speak of rapid gestures, it’s a female hand I think of, not my own clumsy sluggish movements, that’s for sure, always getting in the way of everybody else’s work. At least that’s what I’ve been told my life long by parents, friends –male and female– superiors, underlings and even my daughter these days. They’ve been conspiring together to demoralize me, I know; they think that if they go on telling me I’m hopeless they’ll convince me there’s an element of truth to the story. But I hang back on the sidelines, waiting for an opportunity to make myself useful, to redeem myself. Now the plates are all caged up in their little carriage, round faces astonished to find themselves standing upright, curved backs waiting for the storm about to break over them down there at the bottom of the tunnel where they will be sent off in exile until the cycle of cloudbursts, waterspouts and steam jet is over. This is the moment for me to go into action.” Italo Calvino, “La Poubelle Agree” in The Road to San Giovanni, pp. 58/59¹

INTRODUCTION

Frantically trying to limit the spread of the COVID-19 pandemic, governments worldwide imposed severe lockdown policies that suddenly changed the daily lives and routines of millions of people. This lockdown artificially created a fusion between the work and family life of men and women, who had to come to terms with their relative contribution to childcare and household chores. Such

¹ All of the code and the (de-identified) data to reproduce the results presented in this paper can be found here <https://osf.io/upq5g/>

unexpected changes to the domestic division of labor fueled tensions and exacerbated pre-existing gender and socio-economic inequalities, and might lead to long-term changes in gender norms.

Through the lens of behavioral and gender economic models, augmented by language and discourse analysis, we view these lockdown policies as a requirement for citizens to cooperate with each other at multiple levels: on the one hand they need to cooperate with government in respecting lockdown measures themselves, and on the other they have to cooperate more within their households as the usual divisions between work, home, and school become blurred. It is important to understand how such cooperation has occurred as this has likely impacted households differently, depending on what happened to the livelihoods of household members and on the presence of children who need care and schoolwork help. For example, whilst the overwhelming evidence on the immediate *health* consequences of COVID-19 suggests that men have fared much worse than women, the emerging evidence on labor markets indicates that the impact has been stronger on sectors with high female employment shares and that women are more likely to be working in jobs that can be done from home and more likely to lose their jobs (Adams-Prassl et al., 2020 for the United Kingdom, the United States, and Germany; Alon et al., 2020 for the United States, Hupkau and Petrongolo, 2020 in the United Kingdom).

We study the personal and family consequences of this abrupt change in daily life via an online survey in three of the most severely hit OECD countries – Italy, the United Kingdom, and the United States – during the height of the initial lockdowns. Looking at the reallocation of household chores following the lockdown, we find a dramatic increase in the proportion of shared childcare across all countries and increases in the sharing of most other household chores. The only exception is grocery shopping, which has instead become a more specialized task largely done by men. In all three countries we have surveyed, job loss or working from home when the partner is working outside are associated with a greater deviation from the *status quo* in terms of division of labor. These unexpected shifts in division of household tasks fueled an increase in tension within couples, suggesting that the disruption in who *did* what around the house often came into conflict with ideas about who *should* do various activities.

Documenting the extent to which family members have changed the work they do inside the household in response to lockdown is an important matter in both the short and long run, as this may dampen or amplify the effects of school closures on both children and their parents, women's chances of returning to work, as well as mental health and family outcomes since domestic tensions can affect family stability (Ruppanner et al., 2018).

BACKGROUND LITERATURE

Household bargaining models (Manser and Brown, 1980; McElroy and Horney, 1981; Lundberg and Pollak, 1993, 1994, 1996) predict that the division of tasks inside and outside of the household will be shaped by new labor market constraints,

such as restrictions or expansions of working hours as well as the possibility of remote working and its relative flexibility. Updating this theoretical literature on household bargaining based on the expected results from the COVID-19 pandemic, Croda and Grossbard (2021) shows that the shifts taking place with the COVID-19 crisis suggested those with less bargaining power would acquire the majority of the additional domestic tasks. Bansak et al. (2021) indeed find that women living in United States states incentivizing stay-at-home parents (states with community property regimes or with homemaking provisions) were more likely to shift out of paid labor during school closures.

Besides changing external constraints, the COVID-19 crisis can be viewed as an information shock for both partners. This unanticipated shock may have revealed to partners their true (as opposed to expected) disutility from working from home, and the associated cost of sharing childcare and other household duties. Following the crisis, both partners might have updated their priors and re-bargained the division of household chores accordingly. As a result, we can expect: (1) an increase in household bargaining with its associated tension and stress; and (2) an increase in strategic behavior, with partners believing the situation to be temporary signaling a higher willingness to cooperate than would normally be the case but revealing their true colors by specializing at gendered tasks.

The burden of extra home production has fallen unequally on women with the potential for long-term negative impacts on their wages and job prospects, as well as potentially creating tensions within households. More positively, new ways of working – and the fact that many fathers are also now doing more – has been hailed as having the potential to help change gender norms and lead to a more equal allocation in some households in the longer term.

Although the expectation from the outset was that mothers would invest more of their own time and resources into home schooling, childcare, and domestic tasks than fathers (Sevilla and Smith, 2020) thus exacerbating existing inequalities (the parenting penalty literature has amply illustrated the impact of caring on women's labor market outcomes Kleven et al., 2019), some hopeful voices were suggesting that fathers who were working from home or furloughed might actually change their preferences toward caring once they were exposed to large amounts of it (Alon et al., 2020).

MATERIALS AND METHODS

Procedure, Participants, and Data Collection

In April 2020 we ran an online survey on a total of 3,157 adults (18–83 years old) and 235 children (4–18 years old). The survey was administered in three countries: the United States, the United Kingdom and Italy over the period 11–19 April, when our respondents had been in lockdown for between 5–6 weeks in Italy, 2–3 in the United Kingdom, and 1–4 in the United States depending on the respondent's specific location. Rather than being a cross-cultural comparison study, these countries were

chosen as they were among the worst affected OECD countries by COVID-19 (in its initial wave) in both reported COVID-19 deaths per capita,² excess mortality during the pandemic³ and, according to OECD projections,⁴ in economic terms too.

The participants in the United States (949 adults and 42 children) and the United Kingdom (1,001 adults and 52 children) were recruited using an online survey collection tool⁵ which stratifies samples across age, sex, and ethnicity. The participants in Italy (1,207 adults and 141 children) were recruited primarily through social media and thus cannot be expected to constitute as representative a sample as those of the United States and United Kingdom.⁶ Of the 3,157 adult respondents, 2,526 indicated that they are cohabiting with either their partner or another adult during the quarantine period (1,034 in Italy, 800 in the United Kingdom, and 692 in the United States). This is the subset for which, when division of labor responses were provided, we measured and summarized the re-allocation of household tasks. Of these 2,526 cohabiting respondents, 893 indicated that they are also living with their children during the quarantine period (468 in Italy, 220 in the United Kingdom, and 205 in the United States).

The Survey Instrument

All recruited participants were directed to a Google Forms survey which varied by country. The Italian participants completed a survey which was in Italian, and the United States and United Kingdom participants completed versions of the survey in English, with minor variations to account for language use and demographic questions which vary across the two countries. All versions of the full survey may be found at <https://osf.io/upq5g/>. Adults were asked 46 questions. For the purpose of this paper, we focus on the adults.

Our survey is a study of family life during the first lockdown, aimed at understanding how daily routine had been modified, how the division of labor within the household had changed, and how personal wellbeing, family tension, beliefs and aspirations, risk attitudes, and the willingness to cooperate within and outside of the household had been during this lockdown.

Questions asked about participants' demographics, family status and living situation, as well as the ways in which the pandemic affected them and their households personally. This encompassed their health, wellbeing, employment situation, the allocation of labor within the household, tensions between household members, and anti-COVID prophylactic behaviors. Furthermore, to measure cooperation within couples, respondents took part in an incentivized Prisoners Dilemma game (Fehr and Gächter, 2002).

²<https://coronavirus.jhu.edu/map.html>

³<https://www.economist.com/graphic-detail/2020/04/16/tracking-covid-19-excess-deaths-across-countries>

⁴<http://www.oecd.org/economic-outlook/june-2020/>

⁵<https://www.prolific.co/>

⁶We use Inverse Probability Weighting (IPW) to reproduce our regression analyses while controlling for selection bias in the Italian sample. See the **Supplementary Materials**. Results are broadly consistent with unweighted estimates. For ease of interpretation we focus on our sample as it is, without weights.

Most of our questions are adapted wholesale from two main validated sources: Understanding Society – and in particular the Understanding Society Coronavirus Study: March 2021 questionnaire – and the United Kingdom Labour Force Survey. Some questions particular to COVID-19 were not piloted, our intention was rather to get the surveys out as quickly as possible during the height of the first pandemic wave. The children's survey was written following the model of the Youth Questionnaire by Understanding Society and is composed of 45 questions, among which we included one unincentivized risk elicitation question.

Many of the family dynamics we were interested in might have changed suddenly at the start of lockdown, so we asked subjects to describe their current as well as pre-pandemic work status, chore allocation, and levels of tension. This allowed us to implement a “pseudo-panel” design, in which we can investigate changes in the outcome for a participant, even though both are measured at the same moment in time.

RESULTS

Summary Statistics

By April 2020, the impact of the virus was already sizable. We find that 17% of respondents in Italy, 11% of respondents in the United Kingdom, and 10% of respondents in the United States were directly affected by COVID-19 either because they were tested for it or knew someone who was infected. 15% of respondents in Italy, 20% of respondents in the United Kingdom, and 17% of respondents in the United States lost their job or were furloughed. On a psychological level, respondents showed high levels of anxiety⁷ (55% of respondents in Italy, 48% in the United Kingdom, and 43% in the United States reported to be anxious on the day prior to the survey), and low levels of happiness⁸ (13% of respondents in Italy and 24% in the United Kingdom and in the United States reported not being happy). Respondents clearly feel isolated, and most reported that one of the first things they would like to do once lockdown ends is to visit family and friends (78% of respondents in Italy, 77% of respondents in the United Kingdom, and 64% of respondents in the United States). 20% of respondents in Italy, 41% of respondents in the United Kingdom, and 47% of respondents in the United States reported that one of the first things they would like to do once lockdown ends is to go shopping.

Even while struggling with the personal and social toll imposed by the pandemic, individuals sustain high levels of cooperation. In terms of cooperation with lockdown measures, most people adopt the recommended protective measures such as washing hands (80% of respondents in Italy, 91% of respondents in the United Kingdom, and 90% of respondents in the United States), avoiding shaking hands (88% of respondents in Italy and 90% of respondents in the United Kingdom

⁷Reporting 5 or more on a scale from 0 (“not at all”) to 10 (“completely”) to the question “How anxious did you feel yesterday?”

⁸Reporting less than 5 on a scale from 0 (“not at all”) to 10 (“completely”) to the question “How happy did you feel yesterday?”

and the United States), keeping a safe distance from others (91% of respondents in Italy and 96% of respondents in the United Kingdom and the United States), and avoiding crowded places (83% of respondents in Italy, 92% of respondents in the United Kingdom, and 91% of respondents in the United States). Mask-wearing habits vary greatly by country, 84% of respondents in Italy, 13% of respondents in the United Kingdom, and 58% of respondents in the United States reporting that they wear a mask in public, reflecting the lack of a general consensus amongst governments and intergovernmental organizations on mask effectiveness at the time of the survey. A majority of respondents also follow more restrictive lockdown measures like limiting supermarket visits as much as possible (87% of respondents in Italy, 88% of respondents in the United Kingdom, and 89% of respondents in the United States), refraining from visiting friends (82% of respondents in Italy, 94% of respondents in the United Kingdom, and 82% of respondents in the United States), refraining from visiting relatives (82% of respondents in Italy, 92% of respondents in the United Kingdom, and 72% of respondents in the United States), and staying home except in case of emergency (78% of respondents in Italy, 47% of respondents in the United Kingdom, and 41% of respondents in the United States).

In terms of cooperation, 69% of respondents in Italy, 71% of respondents in the United Kingdom, and 75% of respondents in the United States are willing to cooperate with strangers who respect social distancing measures, whilst 21% of respondents in Italy, 14% of respondents in the United Kingdom, and 20% of respondents in the United States would cooperate also with strangers who do not respect measures. These results indicate a strong willingness to cooperate, but only with those who are deemed responsible and trustworthy. We furthermore tie households' willingness to shift domestic labor allocations to cooperativeness. More cooperative households show propensity for a greater share of chores to be allocated toward the partner who experiences a relatively greater shift in time available to be spent at home – i.e., someone who has been furloughed when their partner has not. This indicates to us that the descriptive changes we see are not merely the utility-maximizing reallocations of a unitary household's labor supply (Becker, 1965). Norms make behavioral patterns persistent (Young, 2015) but sometimes exogenous shocks to behavior can cause long-term norm change (Bicchieri and Mercier, 2014). The COVID-19 pandemic has certainly constituted a great exogenous shock – we have yet to see which of its many disruptions persist.

Allocation of Household Chores

In terms of household work, sharing of most duties increased during lockdown, but so did the burden on women. The proportion of *shared* childcare increased dramatically (17 percentage points in Italy, 8 percent in the United Kingdom and 11 percent in the United States), and for most other tasks (cleaning, cooking and gardening) sharing grew between 2 and 11 percentage points on average. The one exception is grocery shopping, which during lockdown became a more male-specialized task (sharing went down 16 percentage points in Italy, 12 percent in the United Kingdom and 9 percent in the

United States). Overall, the burden of household chores on women increased, which is problematic as there are significant reductions in lifetime earnings associated with performing these activities (Folbre, 2018; Grossman, 2019; Chu et al., 2020).

When comparing reporting of household tasks, interesting gender discrepancies arise. There are gender differences in reported increases in both one's own tasks (on average men report larger increases, driven by grocery shopping, childcare and cleaning), and in the partner's tasks, with men both in the United Kingdom and the United States samples reporting they do more (although to a small extent) than what women say their partners do.

To understand the reallocation of tasks within the household, and the ensuing tension, it is important to first understand the *time constraints* faced by couples. Time constraints in our data are proxied by grouping individuals into three categories, according to their work status: working outside of the home (least time at home); working at home (moderate time at home); not working (most time available at home). Looking at the change in time constraints faced by respondents and their partners from before to during the lockdown, we can establish the potential for taking on more household work. We analyze the “shift in comparative advantage toward home production” by taking the difference between the respondents' and their partners' change in time constraints, in the spirit of a difference-in-differences⁹ approach (before vs. after the lockdown, self vs. partner). We focus on the perspective of individuals who saw an increase in time at home relative to their partners, for example people who started working from home during the lockdown while their partner kept on going to the office, or people who were laid off while the partner kept on working.¹⁰ As expected, those who lost their job report doing more now, while those who are still working report doing the same or less, especially in the case of women. The opposite is true for those whose partners lost their job, again especially for women. Similar results are found by Del Boca et al. (2020) who analyze the change in time use of a representative sample of 520 Italian women and find that the additional burden during lockdown has been greater on women than on men, regardless of the partner working arrangement, while men spend more time doing housework only when their partner continues to work outside of the household.

Figures 1, 2 report changes in childcare and grocery shopping from before the lockdown to during the lockdown. The figures are split according to those who have more time at home during lockdown than before, relative to their partner, and those who do

⁹Ours is an event study. We emphasize that while the COVID-19 pandemic was an exogenous shock, families' labor-force responses to it are endogenous. I.e., an essential worker may nevertheless have chosen to leave their job in order to look after family. We cannot control for the unobserved reasons why people changed their labor market status, and do not make causal claims about how work arrangements affect the division of household labor. Our purpose is rather to document how these changed due to the COVID-19 pandemic.

¹⁰Only one member of the couple responds to the survey, and reports both their own and their partner's job status before and during the lockdown. To keep the perspective of the partner with more time available at home, sometimes the answers are swapped. That is, if the respondent has relatively more time at home during the lockdown than their partner, we keep the answers related to the respondent; if the opposite occurs, we look at the answers related to the respondent's partner.

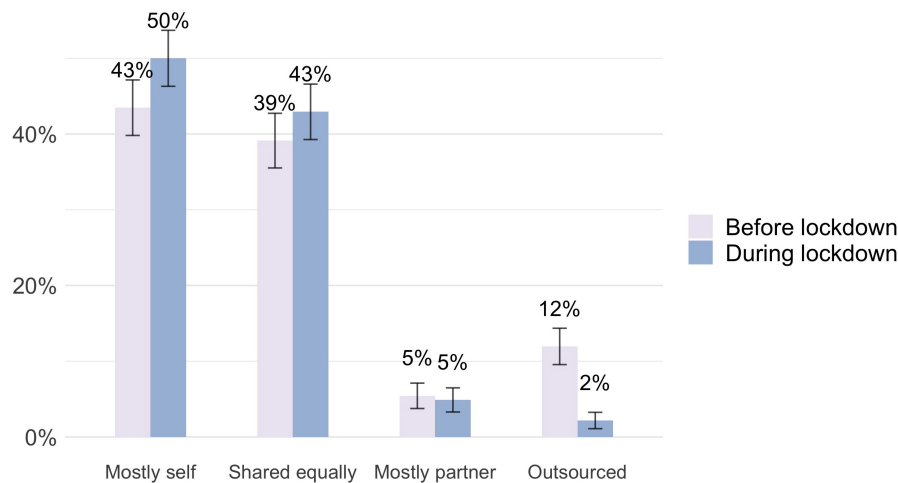


FIGURE 1 | The division of childcare from before to during the lockdown, as reported by women who experienced a relative increase in time at home compared with their partner.

not. As an example, **Figure 1** presents the division of childcare amongst women respondents who experienced a relative increase in time at home compared with their partner, that is women who spend more time at home during the lockdown than before, while their partner does not. The upper left panel of **Figure 2** reports the same data as **Figure 1** in Sankey diagram format. Sankey diagrams augment the before/after totals by showing the dynamics of the shifts in the division of labor. The width of the connecting segments in the Sankey diagram indicates the proportions of those who went from one category before to another after.

The left panel of **Figure 2** includes those who have more time at home during lockdown than before relative to their partner (for example because they started working from home while their partner still works from the office) while the right panel includes those whose time constraints relative to their partner remain unchanged (for example because both used to work outside and both started working from home during lockdown).

For childcare, both men and women who saw a shift in comparative advantage toward home production take on more of this responsibility themselves compared to before. This same pattern, though slightly less pronounced, holds true across most other household work (see **Supplementary Figure 1**). However, when we look at grocery shopping, men are taking on more of it, while women less, regardless of their relative job status. This shift to men doing the shopping occurs across all households, including the ones where we would predict otherwise based on available time at home. The fact that relative time constraints are not predictive of who is doing grocery shopping suggests that the importance of time availability is outweighed by other factors such as risk perceptions, the unskilled nature of the task, and gender norms. For example, a possible interpretation of this finding is that men are more willing to take the risk (and possibly the pleasure) of going out of the house to buy food, or conform to the gender norms pertaining to the role of men as hunters or connectors between the domestic and public sphere. Gender

norms are known to be related to a range of family, economic, and educational outcomes (Inglehart and Norris, 2003; Seguino, 2007; Guiso et al., 2008), and are quite different across the three countries that we surveyed.¹¹

Additional evidence supporting the notion that shifting time availability is predictive of some – but not all – variation in household task reallocation is shown in **Table 1**. Here we report the marginal coefficients from ordered probit regressions using time constraints and cooperation with the partner to predict the change in household tasks following the lockdown. The outcome variable is coded such that a higher number is indicative of less involvement.¹² We see that having relatively more time at home is always related to greater involvement in household chores (a negative coefficient), slightly more for men than women, although often the relationship is small. Specifically, men who experience relatively more time at home compared to their partners take on a greater share of childcare, as well as a greater share of grocery shopping, though this latter effect is smaller as we observe men taking on more grocery shopping duties regardless of their change in relative time at home. Only a few women are seen to take on a greater share of grocery shopping when they experience an increase in available time at home relative to their partners. Women also take on more cleaning

¹¹The United States and United Kingdom are both ranked 15th in the Gender Development Index of the United Nations Development Programme (<http://hdr.undp.org/en/content/gender-development-index-gdi>), and the labor force gender participation gap is smallest in the United Kingdom (10.6 percentage points in 2018 according to the OECD (<https://stats.oecd.org/index.aspx?queryid=54751>), followed by the United States with 12% and Italy with 18.3%). However, the last WEF report on gender equality (http://www3.weforum.org/docs/WEF_GGGR_2020.pdf) indicates that the representation of women on company boards is highest in Italy at 34% (this was mandatory for listed companies since 2012), followed by the United Kingdom at 27.2%, and the United States at 21.7%; politics is also somewhat different with 30% of women MPs the United Kingdom, 19.1% in the United States, and 31% in Italy.

¹²Specifically, the outcome variable is the first difference (during vs. before the lockdown) of self-reported allocation of several household tasks, coded such that 2 corresponds to “Mostly partner,” 1 to “Shared equally,” and 0 to “Mostly self.”

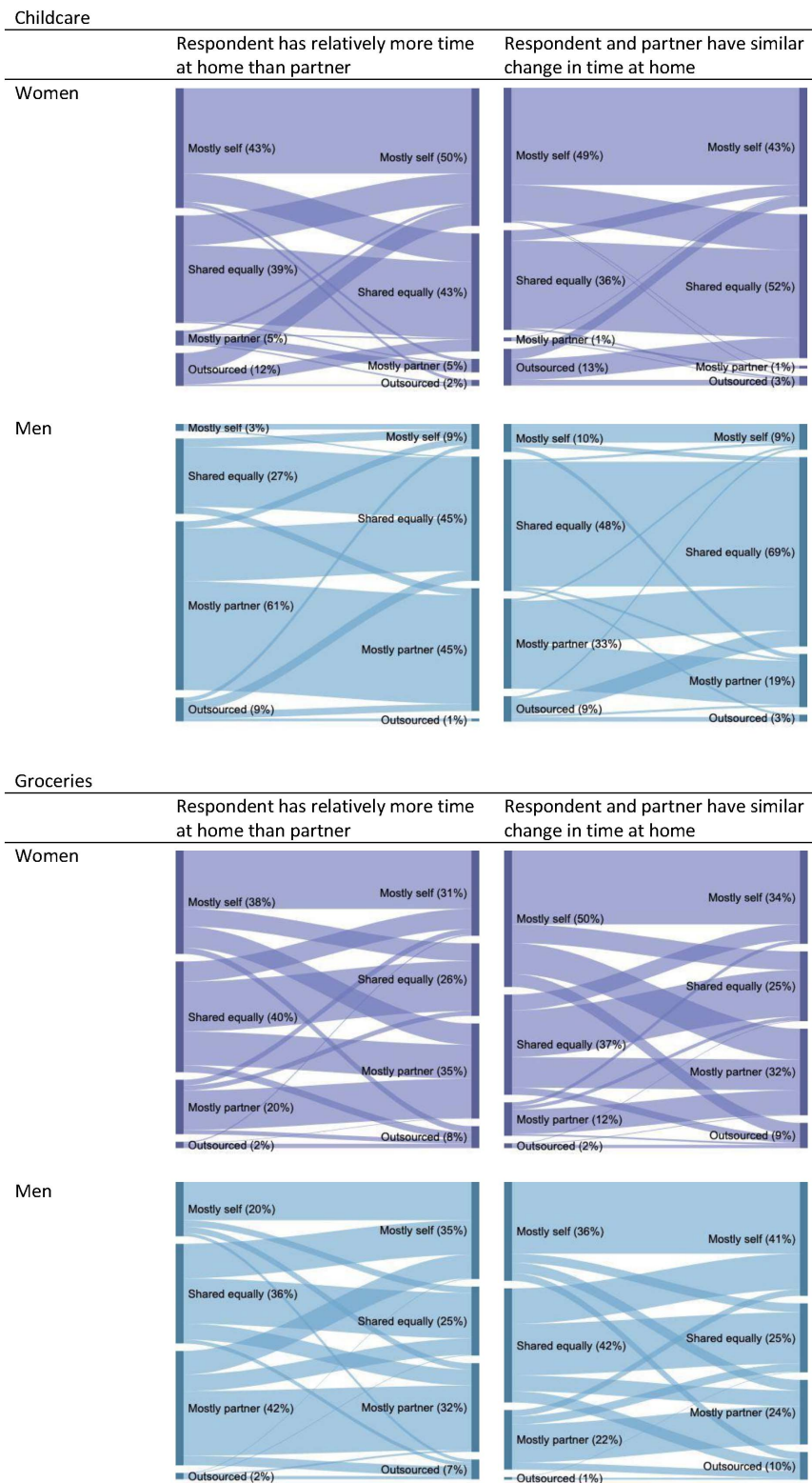


FIGURE 2 | Changes in division of childcare and grocery shopping from before to during the lockdown, split by relative change in time at home. The above Sankey diagrams report changes in childcare and grocery shopping allocation from before the lockdown (left-hand side of each diagram) to during the lockdown (right-hand side of each diagram) for women and men respectively. The figures are split according to whether the respondent has relatively more time at home than their partner during the lockdown compared to before (left-hand side panel) or experienced a similar change in time at home as their partner following the lockdown (right-hand side panel). Source: online survey in Italy, United Kingdom, United States. For childcare, $N = 476$ (women) and 316 (men). For grocery shopping, $N = 1,208$ (women) and 873 (men).

TABLE 1 | Ordered probit regressions predicting changes in family chore allocations.

Men												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Childcare		Groceries		Cooking		Cleaning		Laundry		Gardening	
Relatively	−0.401**	−0.393**	−0.240***	−0.240***	−0.060	−0.060	−0.066	−0.062	−0.072	−0.072	−0.076	−0.076
More time	(0.177)	(0.178)	(0.091)	(0.177)	(0.105)	(0.105)	(0.112)	(0.112)	(0.121)	(0.121)	(0.122)	(0.122)
Cooperate		−0.309*		0.017		−0.023		−0.158		−0.012		−0.005
w/partner		(0.184)		(0.099)		(0.110)		(0.116)		(0.127)		(0.125)
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	214	214	646	646	646	646	646	646	646	646	646	646
Women												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Childcare		Groceries		Cooking		Cleaning		Laundry		Gardening	
Relatively	−0.198	−0.197	−0.168**	−0.169**	−0.006	−0.004	−0.169*	−0.163	−0.169	−0.171	−0.017	−0.022
More time	(0.153)	(0.153)	(0.079)	(0.079)	(0.098)	(0.098)	(0.105)	(0.105)	(0.109)	(0.186)	(0.010)	(0.100)
Cooperate		−0.207		−0.017		0.055		0.174*		−0.071		−0.157
w/partner		(0.151)		(0.080)		(0.105)		(0.108)		(0.113)		(0.109)
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	305	305	849	849	849	849	849	849	849	849	849	849

The coefficients are marginal effects from an ordered probit regression. Standard errors in parenthesis. *Indicates p -value < 0.10 ; ** p -value < 0.05 ; *** p -value < 0.01 . Outcome variable is the first-difference (during the lockdown minus before) in self-reported allocation of several household tasks, with 2 corresponding to “Mostly partner,” 1 to “Shared equally,” and 0 to “Mostly self.” All other answers (“paid help/deliveries” or “prefer not to say”) are coded as missing. Relatively more time is an indicator variable for having relatively more time at home than the partner during the lockdown compared to before [constructed as a difference-in-differences between the time available at home because of job status during the pandemic vs. before (first diff.) and of the respondent vs. the partner (second difference)]. Cooperate with partner is an indicator variable for willingness to cooperate with the partner in a Prisoner’s Dilemma game. Controls include country fixed effects and polynomial in age. Source: online survey in Italy, United Kingdom, United States.

duties when they experience an increase in relative time at home. Interestingly, whether respondents would be willing to cooperate with their partners in the Prisoner’s Dilemma game is also predictive of taking on more household responsibilities during lockdown, particularly men taking on more childcare and women doing more cleaning. Controlling for propensity to cooperate with one’s partner does not substantially change the estimated predictive power of experiencing a relative shift in time at home, suggesting independent contributions to the respondents’ willingness to reallocate household chores. Few movements in the allocation of cooking, laundry, or gardening duties are predicted. **Supplementary Figure 2** plots the coefficients from the ordered probit regressions in **Table 1**, as well as estimates of these coefficients in which the Italian respondents are weighted by similarity to the representative United States and United Kingdom samples.¹³ Estimates are broadly similar whether or not we account for selection in the Italian sample.

¹³Observations are weighted using an Inverse Probability Weighting (IPW) method as suggested by, e.g., Hernán et al. (2004); Howe et al. (2016). We run a logit regression where the outcome variable is an indicator for being part of the Italian sample and the explanatory variables are gender, age, age squared, age cube, presence of children, and several indicator variables for the job status (essential job, furloughed, freelance, family job, on leave, homemaker, in education, retired). The predicted probability \hat{p} from this logit regression is used to construct IPW weights: $(1 - \hat{p}) / \hat{p}$ for the Italian sample and 1 for the rest.

Family Cooperation and Tensions

So far, we have shown that the lockdown led to substantial reallocation of household chores, following not only changes in time constraints, but also individual propensity to cooperate with the partner and task-specific gender norms. Next we ask: is this reallocation of tasks conducive to more or less harmony within the couple? To investigate the potential consequences of an uneven reallocation of chores, we examine the respondent’s report on tensions about the division of household labor, quarrels before and during the lockdown, and the language used to discuss these issues.

Marked gender differences are present when looking at tension over the division of household tasks and general wellbeing. Tensions in the household are reported in all countries, with women generally reporting higher household tensions than men. Some household tension¹⁴ is reported by 28% of men and 43% of women amongst respondents in Italy, 28% of men and 37% of women amongst respondents in the United Kingdom, and 32% of both men and women amongst respondents in the United States. Child respondents report household tensions more frequently than adults, with 67% of children from the Italy sample and 64% of children from the United Kingdom and

¹⁴Reporting 3 or more on a scale from 0 (“no tension at all”) to 10 (“a lot of tension”) to the question “Are you experiencing tensions over the division of work to do in the household at the moment?”

United States samples reporting significant household tension. In line with national surveys of wellbeing over the same period, most respondents report higher anxiety and lower instantaneous wellbeing relative to overall life satisfaction and sense of leading a worthwhile life, with women reporting consistently higher anxiety and lower wellbeing than men in both Italy and the United Kingdom, while the averages are closer for women and men in the United States sample. Average life satisfaction is 5% lower amongst women than men in the Italy sample, 1% lower in the United Kingdom sample, and less than 1% lower in the United States sample. Instantaneous anxiety, on average, is 19% higher among women than men in the Italy

sample, and 12% higher among women relative to men in the United Kingdom and United States sample.¹⁵ These findings align with those in the United Kingdom and United States indicating that women, and mothers in particular, experienced a markedly larger decline in wellbeing than men during the pandemic (Zhou et al., 2020; Prados and Zamorro, 2021). When asking questions directly to children, we find that those with above-average assessments of their school, their teachers, how

¹⁵This is calculated by computing simple averages of the 1–10 scale responses for the wellbeing variables from each group and then the percent increase/decrease in this average going from the male group to the female group in each country.

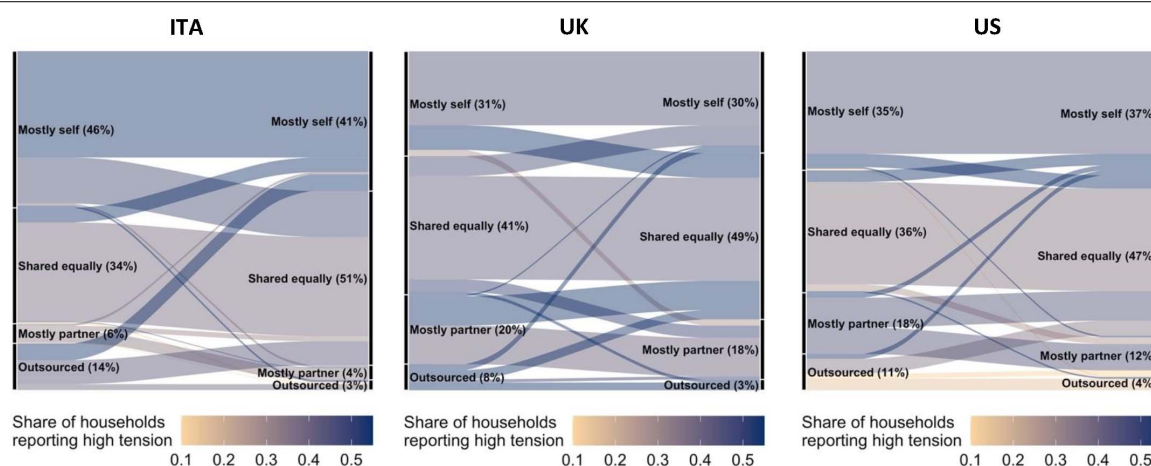


FIGURE 3 | Changes in division of childcare from before to during the lockdown, colored by share of households reporting high tension. The above Sankey diagrams report changes in childcare allocation from before the lockdown (left-hand side of each diagram) to during the lockdown (right-hand side of each diagram) for each of the countries surveyed. Diagram flows are color-coded by the share of respondents reporting high household tensions specifically related to the allocations of household tasks. Darker lines correspond to subsets with higher reported household tensions, and are useful in capturing the effect of task reallocation in lockdown. Source: online survey in Italy, United Kingdom, United States; $N = 893$.

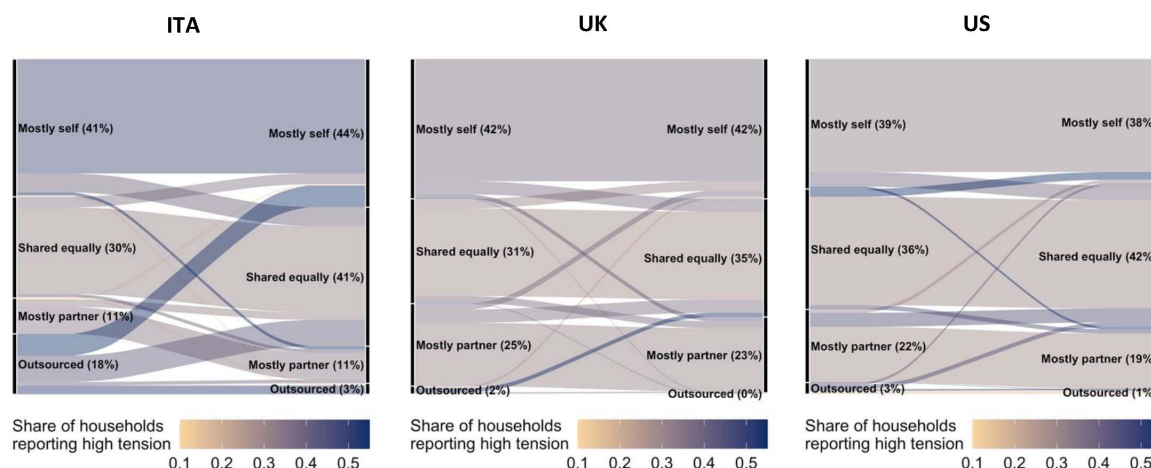


FIGURE 4 | Changes in division of cleaning from before to during the lockdown, colored by share of household reporting high tension. The above Sankey diagrams report changes in cleaning allocation from before the lockdown (left-hand side of each diagram) to during the lockdown (right-hand side of each diagram) for each of the countries surveyed. Diagram flows are color-coded by the share of respondents reporting high household tensions specifically related to the allocations of household tasks. Darker lines correspond to subsets with higher reported household tensions, and are useful in capturing the effect of task reallocation in lockdown. Source: online survey in Italy, United Kingdom, United States; $N = 2,527$.

hard they work, and how well they perform consistently report higher wellbeing and instantaneous wellbeing than children with below-average assessments, as do those who report using social media less than an hour both during quarantine and before.

To understand how these changes in wellbeing are related to reallocation of household tasks, the Sankey diagrams in **Figures 3, 4** represent how the allocation of childcare and cleaning changed from before to during the lockdown, for Italy, the United Kingdom, and the United States respectively, with flows color-coded based on the level of household tension reported by respondents specifically related to the allocations of household tasks.¹⁶ Darker lines indicate higher levels of reported tension. Considering for example childcare, across all samples, the respondents more likely to report the lowest level of tension in the household are those who share childcare, alongside those who report that their partner is mostly doing it and, only in the United States sample, those who outsource it. This observation aligns with the finding from a study in the United States that insufficient support with childcare has been a key driver of conflict amongst couples with young children during the lockdown (Calarco et al., 2020). The respondents who report high levels of tensions vary by country. Respondents in Italy who report the highest tension are those who either continue to be solely responsible for childcare or saw a reallocation of childcare to themselves, compared to a previous shared or outsourced provision. This is different from the United Kingdom case, where the highest tensions are reported by respondents who are now sharing more of the childcare than before the lockdown, regardless of whether they were previously solely responsible or their partner was. The United States sample is somewhat in between, with highest tensions reported by both those who saw an increase in their own load and those who were previously solely responsible and started sharing during the lockdown.

When considering other household activities, we again find that respondents reporting the lowest levels of tension are those who report sharing tasks. High levels of tension are related to deviations from the *status quo*, and not just changes that increase one's own load, but also those that shift tasks away from oneself and to the partner. These patterns of low tension when sharing and high tension when changing allocations are clearly illustrated by the diagrams displaying changes in the allocation of cleaning in **Figure 4** (see **Supplementary Figures 3–6** for the other tasks).

Additional evidence supporting the notion that changes in allocation of household tasks is predictive of higher tension is shown in **Table 2**. Via an OLS regression, we find that changing the usual allocation of any household task during the lockdown is related to higher levels of tension. Higher tension is particularly predicted by changes in grocery shopping, cleaning, and childcare duties (see **Supplementary Tables 2, 4**), while the association with changes in cooking and gardening chores is smaller and less precisely estimated. To give an idea of the magnitude, the association between tension and changing who

TABLE 2 | OLS regression predicting tension due to change in allocation of household tasks.

	(1)	(2)	(3)	(4)
Tension over the division of household tasks				
Changed division: grocery	0.284** (0.114)	0.264** (0.119)	0.246** (0.115)	0.324 (0.210)
Ch. Grocery × fem				−0.119 (0.251)
Changed division: clean	0.472*** (0.161)	0.440*** (0.163)	0.390** (0.155)	0.491* (0.259)
Ch. clean × fem				−0.157 (0.321)
Changed division: cook	0.117 (0.183)	−0.002 (0.183)	0.045 (0.178)	0.078 (0.279)
Ch. cook × fem				−0.070 (0.363)
Changed division: gardening	0.113 (0.175)	0.200 (0.189)	0.164 (0.177)	0.337 (0.364)
Ch. gardening × fem				−0.241 (0.416)
Job status	No	Yes	Yes	Yes
Personal characteristics	No	No	Yes	Yes
N	2348	2121	2120	2111

Coefficients from an OLS regression. Robust standard errors in parenthesis. *Indicates p -value < 0.10; ** p -value < 0.05; *** p -value < 0.01. Outcome variable is self-reported answer to the question 'Are you experiencing tensions over the division of work to do in the household at the moment?' on a scale from 0 (no tension at all) to 10 (a lot of tension). Changed division: indicator equal to one if the division of the household task is different during the lockdown than before, and zero otherwise (i.e., indicator for the diagonal flows in the Sankey diagrams). Ch. × fem: interaction between the indicator for changed division of household labor and female respondent. Demographic controls: cubic polynomial in age and indicator for presence of children in the household. Job status: controls for respondent and partner's job status, including indicators for working remotely (omitted category); working outside of home (both as essential workers and non-essential workers); work for a family business; government-sponsored training scheme; apprenticeship; employed with other paid work; self-employed; furlough; temporary leave (e.g., maternity leave or ill); student; homemakers; retired. Personal characteristics: controls for cooperating with the partner in a Prisoner's Dilemma game; indicator for risk-seeking behaviors reported in reasons to leave home (see friends, tired of being in the home, getting bored, getting some adrenaline, exercising free will); self-reported life satisfaction; living a worthwhile life; happiness; anxiety; frequency talking with family or friends; indicator for wanting to buy a gift to the partner when lockdown ends. Source: online survey in Italy, United Kingdom, United States.

is in charge of groceries or cleaning because of the lockdown is between one third and one half of the association between tensions during the lockdown and having a child present in the household (see **Supplementary Table 1a**).¹⁷ Except for cooking, the strong association between changing tasks and tension is robust to the inclusion of detailed controls for the respondent's and their partner's job status, as well as personal characteristics such as cooperation, risk seeking, mental health and wellbeing (see columns 2 and 3 of **Table 2** and **Supplementary Tables 1–4**). Furthermore, similar patterns can be found by using an indicator

¹⁶After the questions about the division of tasks, we asked "Are you experiencing tensions over the division of work to do in the household at the moment?", with possible answers from 0 ("no tension at all") to 10 ("a lot of tension"). Similar results can be found by color-coding the flows by answers to the question "How often do you and your partner/flatmate quarrel?"

¹⁷Inverse Probability Weighted (IPW) regressions which attempt to control for selection in the Italian sample may be found in **Supplementary Table 1b**. The weights are calculated as above.

Word cloud women (left—"not happening") and men (right—"not doing it") addressing tensions Italy



Word cloud women (left—"we do it") and men (right—"No routine") addressing tensions UK



Word cloud women (left—"ask help") and men (right—"get help") addressing tensions USA

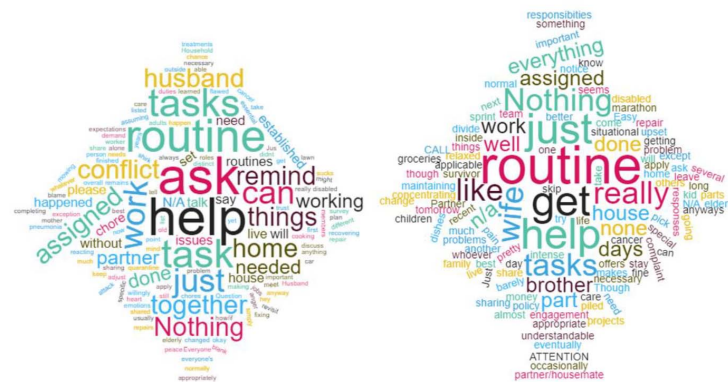


FIGURE 5 | Word clouds from the open answers to the question regarding tension on the division of assigned household tasks.

of higher levels of quarreling during the lockdown as outcome variable (see **Supplementary Tables 3, 4**).¹⁸

Gender differences in the relationship between tensions and changes in allocation of household tasks are not pronounced. As shown in column 4 of **Table 2** (and **Supplementary**

¹⁸Since both the outcome variable (change in frequency of quarreling) and the main regressors (change in allocation of household tasks) are first-differences from during to before the lockdown, this analysis is similar to fixed-effect regression holding fixed time-invariant individual unobservables.

Tables 1–4), gender differences in this association are usually small, and often noisily estimated. Exceptions are changes in who is responsible for gardening, which is twice as strongly associated with tension when the respondent is male (0.337 for males, $0.337 - 0.241 = 0.096$ for females, but the difference is still not statistically significant), and changes in childcare (which is strongly associated with tension when the respondent is male, almost uncorrelated if female, see **Supplementary Table 2,** column 4).

These results are important as tensions can impact family stability: divorce filings were reported to be on the rise in Wuhan¹⁹ and family dynamics can be altered by calamities and natural disasters: divorces increased in New York after 9/11 and marriage, birth, and divorce rates increased in the year following Hurricane Hugo in 1989 in the 24 counties of South Carolina that were declared disaster areas compared with the 22 other counties in the state (Cohan and Cole, 2002; Cohan et al., 2009). In our sample, 21 of 2,607 respondents with partners declare they want a divorce when quarantine ends. Our survey instrument was not designed to investigate domestic violence and the nature of our sample and its collection mode would probably have excluded vulnerable families where this issue would be more prevalent, but it is important to note that lockdown has been linked to domestic violence (Peterman et al., 2020), and the inability to meet financial obligations and maintaining social ties is likely to increase family stress and domestic violence (although Beland et al., 2020, do not find strong evidence in this regard).

Talking Through It

Communication difficulties play a vital role in marriage unhappiness and communications-related issues are cited much more often as causes for divorce than external issues, including economic ones (Thompson, 2008). To better understand potential issues with communication, we analyzed the language that respondents used to answer open ended questions to our survey. When it comes to the language used to address tensions arising from the establishment of a new routine and allocation of household tasks during the lockdown, we find markedly different styles by gender and, to a lesser extent, by country. In all three countries, women are more likely than men to voice their concerns in our survey. When addressing the disagreement (about half the women in our sample prefer to say nothing) women talk about their expectations, dissatisfaction, and anger. Men's preferred strategy is to say nothing, and when they do, they do so to signal there is not a big problem and no routine has been established, often because it does not seem to be needed.

The word clouds in **Figure 5** show the language used by female and male respondents in each country.

This gender difference in the use of language to talk about tensions can be interpreted as a reflection of the gendered expectations in terms of role divisions, and might further reinforce such roles. Household work and the related communications are seen as a female domain and not a space for men to engage in conversations. The 'proper' workplace, and not the household, is the place for men to communicate. Also, women are socially expected to express emotions and hence are possibly more likely to open up about their frustrations as opposed to men who are expected to be more restrained (Lakoff, 1975; Tannen, 1990; Sunderland, 2004; Jaworska and Ryan, 2018).

CONCLUSION

Our study finds a dramatic increase across Italy, the United Kingdom, and the United States in the proportion of shared childcare, and increases in the sharing of most other tasks, with the exception of grocery shopping which instead became a more specialized task done largely by men during the lockdown. In all three countries we surveyed, the reallocation of household tasks mirrors the relative changes of job status within the couple: respondents who lost their job (while their partners did not) or who are working from home (while their partners kept on working outside of the house) are shouldering a greater share of household chores. The opposite is true for those whose partners lost jobs (but not them). Thus, asymmetric changes in job situations are strongly associated with a deviation from the *status quo* in terms of division of labor.

The specialization pattern we find, with women doing more of everything and men doing more shopping, is corroborated by a range of studies carried out during the crisis. In the United States, Carlson et al. (2020) find that both parents report devoting more time to housework, with substantial increases in the sharing of both childcare (from 50 to 60%) and household tasks (from 38 to 53%). Such increases in sharing, however, are slightly disproportionate: in childcare, mothers do more of the homework supervision and fathers more of the playtime; in household tasks, fathers especially increased time devoted to grocery shopping. Parents also disagree on how much fathers actually do: 42% of fathers report an increase in housework time, 45% report more time in the care of young children overall, and 43% report more total care of older children, while only 25, 34, and 20% of mothers respectively say their partners did so. Sevilla and Smith (2020) show that United Kingdom families with young children have been doing the equivalent of a working week in childcare, with women doing the greater share and a reduction in the gender childcare gap, with men's increases very sensitive on their employment status (whether they work from home or have been furloughed or lost their job). In Spain, Farré et al. (2020) show increases in women's loads and a similar pattern of men specializing at grocery shopping, possibly, they argue, because it is a relatively easy, out-of-household task and perceived as carrying more risk.

We must also caution that while our United Kingdom and United States samples are representative on a few sociodemographic variables (age, ethnicity, gender), we have obviously surveyed a segment of the population with stable access to the internet, as well as time availability to complete the survey. We are therefore unlikely to have sampled those families with the greatest tensions or sharpest time constraints. More work must be done to assess the needs of the most vulnerable families, especially since their wellbeing and health are most at risk from the COVID-19 crisis.

As with much of the COVID-19 crisis, it is early days to speculate on the durability of these changes. However, there is some hope that more sharing of childcare and household work might be the silver lining on the cloud of adverse occupational effects that women are set to face: Alon et al. (2020) and Hupkau and Petrongolo (2020) speculate that this

¹⁹<https://www.globaltimes.cn/content/1181829.shtml>

pandemic and the consequent reallocation of household chores may lead to a change of work and gender norms similar to that experienced with paternity leave introductions. However, these increases in sharing are not documented across all households, but rather among respondents who also report low tensions, and we might therefore be seeing a very partial silver lining, with women in some households experiencing multiple in- and out-of-household shocks.

There is, as yet, no direct evidence on the impact of COVID-19 on gender norms. In many households, women are doing more childcare, and pre-existing norms may become entrenched. But some households, particularly those where men are not working, are now experiencing a more equal gender division and this may lead to longer-term positive changes, particularly if they are combined with new ways of working (more working from home). Sevilla and Smith (2020) report that 28% of those who are currently working from home did not previously do so.

Even although the pandemic is forcing men to participate more in house work, many still do so by exercising their freedom to choose the more pleasant tasks, deciding how to contribute through gender-tinted lenses. The disaster literature suggests alternative scenarios for the short and the long run in terms of changes in the division of labor: Peek and Fothergill (2008) relay how the gendered division of labor may be even more pronounced in disasters, with women cast as nurturers and men as protectors, but also cite studies conducted on hurricane Andrew in the 1990s that found that, while gender roles were suspended and readapted during the crisis, they then reverted to previous arrangements (Alway et al., 1998) largely due to external constraints related to labor market forces and availability of childcare. Some evidence from paternity leave policies suggests that temporary changes can have longer-term effects on social norms, shown by increases in the time that fathers spend in household activities, including childcare (Farré and González, 2019; Patnaik, 2019). In the United Kingdom, data from Understanding Society show however that with the easing of restrictions toward the end of 2020, the share of fathers working positive hours had recovered close to their pre-pandemic rates, but for mothers, particularly single mothers, they continued to lag (Harkness, 2021).

A feature of the COVID-19 lockdown is that most of the work that was still happening, and all of the childcare, have moved into homes. This forced fusion of work and family life means that men at the very least witnessed, if not shared, the demand to be available for both work and family, typically experienced more acutely by working mothers. We do not yet know whether this will be sufficient to generate the changes in workplace and household culture necessary to create more balanced allocations

of both paid and unpaid work (Grossbard-Schechtman, 1993; Goldin, 2014; Folbre, 2018), but the differences we find in levels of tension across households suggest this will not be a smooth or an evenly distributed transition.

Two things are distinctive about COVID-19 lockdowns. The first is the scale of the demand-side shock. The changes have been profound. The total amount of childcare being done at home is of a completely different order of magnitude higher than usual because of the closure of almost all formal childcare. The impact has been across the board, affecting all families, meaning that almost all men have increased the quantity of childcare they do.

The second difference is that this is not a deliberate policy to promote a more equal distribution of childcare: changes in the division of labor are unintended consequences of measures to stop the virus from spreading. The changes in the division of household tasks that have been brought about may need to be recognized and reinforced to have longer-term effects.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repository and accession number(s) can be found below: <https://osf.io/upq5g/>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Reading, School of Politics, Economics and International Relations Ethics Committee. Written informed consent to participate in this study was provided by the participants' or their legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

SB, PB, and JV generated the Sankey diagrams of household task allocations. PB, JV, and MDG generated the household tension diagrams. SJ generated the word cluster diagrams. All authors contributed to the design of the study and to the writing of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.687570/full#supplementary-material>

REFERENCES

- Adams-Prassl, A., Boneva, T., Golin, M., and Rau, C. (2020). Inequality in the impact of the coronavirus shock: evidence from real time surveys. *J. Public Econ.* 189:104245. doi: 10.1016/j.jpubeco.2020.104245
- Alon, T. M., Doepke, M., Olstead-Rumsey, J., and Tertilt, M. (2020). *The Impact of COVID-19 On Gender Equality*. NBER Working Paper No. 26947. Cambridge, MA: NBER.
- Alway, J., Belgrave, L. L., and Smith, K. J. (1998). Back to normal: gender and disaster. *Symb. Interact.* 21, 175–195. doi: 10.1525/si.1998.21.2.175

- Bansak, C., Grossbard, S., and Wong, C. H. P. (2021). *Mothers' Caregiving During COVID: The Impact of Divorce Laws and Homeownership on Women's Labor Force Status*. IZA DP No. 14408. Bonn: University of Bonn.
- Becker, G. S. (1965). A theory of the allocation of time. *Econ. J.* 75, 493–515. doi: 10.2307/2228949
- Beland, L.-P., Brodeur, A., Haddad, J., and Mikola, D. (2020). *COVID-19, Family Stress and Domestic Violence: Remote Work, Isolation and Bargaining Power*. IZA DP No. 13332. Bonn: University of Bonn.
- Bicchieri, C., and Mercier, H. (2014). "Norms and beliefs: how change occurs," in *The Complexity of Social Norms*, eds M. Xenitidou and B. Edmonds (Cham: Springer), 37–54.
- Calarco, J. M., Meanwell, E., Anderson, E., and Knopf, A. (2020). 'My husband thinks I'm crazy: COVID-19-related conflict in couples with young children. *SocArXiv* [Preprint]. doi: 10.31235/osf.io/cpkj6
- Carlson, D. L., Petts, R., and Pepin, J. R. (2020). Changes in parents' domestic labor during the COVID-19 pandemic. *SocArXiv* [Preprint]. doi: 10.31235/osf.io/jy8fn
- Cohan, C. L., and Cole, S. W. (2002). Life course transitions and natural disaster: marriage, birth, and divorce following Hurricane Hugo. *J. Family Psychol.* 16, 14–25. doi: 10.1037//0893-3200.16.1.14
- Cohan, C. L., Cole, S. W., and Schoen, R. (2009). Divorce following the September 11 terrorist attacks. *J. Soc. Pers. Relatsh.* 26, 512–530. doi: 10.1177/0265407509351043
- Chu, Y.-W. L., Cuffe, H. E., and Doan, N. (2020). *Motherhood Employment Penalty and Gender Wage Gap Across Countries: 1990–2010*. Wellington: Victoria University of Wellington.
- Croda, E., and Grossbard, S. (2021). Women pay the price of COVID-19 more than men. *Rev. Econ. Household* 19, 1–9. doi: 10.1007/s11150-021-09549-8
- Del Boca, D., Oggero, N., Profeta, P., and Rossi, M. (2020). Women's and men's work, housework and childcare, before and during COVID-19. *Rev. Econ. Household* 18, 1001–1017. doi: 10.1007/s11150-020-09502-1
- Farré, L., Fawaz, Y., González, L., and Graves, J. (2020). *How the COVID-19 Lockdown Affected Gender Inequality in Paid and Unpaid Work in Spain*. IZA Discussion Paper No. 13434. Bonn: University of Bonn.
- Farré, L., and González, L. (2019). Does paternity leave reduce fertility? *J. Public Econ.* 172, 52–66. doi: 10.1016/j.jpubeco.2018.12.002
- Fehr, E., and Gächter, S. (2002). Altruistic punishment in humans. *Nature* 415, 137–140. doi: 10.1038/415137a
- Folbre, N. (2018). "The care penalty and gender inequality," in *Oxford Handbook of Women and Economy*, eds S. L. Averett, L. M. Arys, and S. D. Hoffman (New York: Oxford University Press), 1–28.
- Goldin, C. (2014). A grand gender convergence: its last chapter. *Am. Econ. Rev.* 104, 1091–1119. doi: 10.1257/aer.104.4.1091
- Grossman, D. (2019). The unintended effects of place based programs: fertility and health effects of urban empowerment zones. *J. Health Econ.* 63, 114–127. doi: 10.1016/j.jhealeco.2018.11.005
- Grossbard-Schectman, S. (1993). *On the Economics of Marriage: A Theory of Marriage, Labor, and Divorce*. Boulder, CO: Westview Press.
- Guiso, L., Monte, F., Sapienza, P., and Zingales, L. (2008). Culture, gender, and math. *Science* 320, 1164–1165. doi: 10.1126/science.1154094
- Harkness, S. (2021). Update: how is the response to coronavirus affecting gender equality? *Econ. Observ.* [Epub ahead of print].
- Hernán, M. A., Hernández-Díaz, S., and Robins, J. M. (2004). A structural approach to selection bias. *Epidemiology* 15, 615–625. doi: 10.1097/01.ede.0000135174.63482.43
- Howe, C. J., Cole, S. R., Lau, B., Napravnik, S., and Eron, J. J. Jr. (2016). Selection bias due to loss to follow up in cohort studies. *Epidemiology* 27, 91–97. doi: 10.1097/EDE.0000000000000409
- Hupkau, C., and Petrongolo, B. (2020). Work, care and gender during the COVID-19 crisis. *Fiscal Stud.* 41, 623–651. doi: 10.1111/1475-5890.12245
- Inglehart, R., and Norris, P. (2003). *Rising Tide: Gender Equality and Cultural Change Around the World*. New York, NY: Cambridge University Press.
- Jaworska, S., and Ryan, K. (2018). Gender and the language of pain in chronic and terminal illness: a corpus-based discourse analysis of patients' narratives. *Soc. Sci. Med.* 215, 107–114. doi: 10.1016/j.socscimed.2018.09.002
- Kleven, H., Landais, C., Posch, J., Steinhauer, A., and Zweimüller, J. (2019). Child penalties across countries: evidence and explanations. *AEA Pap. Proc.* 109, 122–126. doi: 10.1257/pandp.20191078
- Lakoff, R. (1975). Language and woman's place. *Lang. Soc.* 2, 45–79. doi: 10.1017/S0047404500000051
- Lundberg, S., and Pollak, R. A. (1993). Separate spheres bargaining and the marriage market. *J. Polit. Econ.* 101, 988–1010. doi: 10.1086/261912
- Lundberg, S., and Pollak, R. A. (1994). Noncooperative bargaining models of marriage. *Am. Econ. Rev.* 84, 132–137.
- Lundberg, S., and Pollak, R. A. (1996). Bargaining and distribution in marriage. *J. Econ. Perspect.* 10, 139–158. doi: 10.1257/jep.10.4.139
- Manser, M., and Brown, M. (1980). Marriage and household decision-making: a bargaining analysis. *Int. Econ. Rev.* 21, 31–44. doi: 10.2307/2526238
- McElroy, M. B., and Horney, M. J. (1981). Nash-bargained household decisions: toward a generalization of the theory of demand. *Int. Econ. Rev.* 22, 333–349. doi: 10.2307/2526280
- Patnaik, A. (2019). Reserving time for daddy: the consequences of fathers' quotas. *J. Labor Econ.* 37:703115. doi: 10.1086/703115
- Peek, L., and Fothergill, A. (2008). Displacement, gender, and the challenges of parenting after Hurricane Katrina. *NWSA J.* 20, 69–105.
- Peterman, A., Potts, A., O'Donnell, M., Thompson, K., Shah, N., Oertelt-Prigione, S., et al. (2020). *Pandemics and Violence Against Women and Children*. Center for Global Development Working Paper 528. Washington, DC: Center for Global Development.
- Prados, M., and Zamarro, G. (2021). Gender differences in couples' division of childcare, work and mental health during COVID-19. *Rev. Econ. Household* 19, 11–40. doi: 10.1007/s11150-020-09534-7
- Ruppanner, L., Brandén, M., and Turunen, J. (2018). Does unequal housework lead to divorce? Evidence from Sweden. *Sociology* 52, 75–94. doi: 10.1177/0038038516674664
- Seguino, S. (2007). Plus ça change? Evidence on global trends in gender norms and stereotypes. *Feminist Econ.* 13, 1–28. doi: 10.1080/13545700601184880
- Sevilla, A., and Smith, S. (2020). Baby steps: the gender division of childcare during the COVID-19 pandemic. *Oxf. Rev. Econ. Policy* 36, S169–S186. doi: 10.1093/oxrep/graa027
- Sunderland, J. (2004). *Gendered Discourses*. London: Palgrave.
- Tannen, D. (1990). *You Just Don't Understand: Women and Men in Conversation*. London: Virago Press.
- Thompson, P. (2008). Desperate housewives? Communication difficulties and the dynamics of marital (un)happiness. *Econ. J.* 118, 1640–1669. doi: 10.1111/j.1468-0297.2008.02184.x
- Young, H. P. (2015). The evolution of social norms. *Annu. Rev. Econ.* 7, 359–387. doi: 10.1146/annurev-economics-080614-115322
- Zhou, M., Hertog, E., Kolpashnikova, K., and Kan, M.-Y. (2020). Gender inequalities: changes in income, time use and well-being before and during the UK COVID-19 lockdown. *SocArXiv* [Preprint]. doi: 10.31235/osf.io/u8ytc

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Gender Differences in Fear and Risk Perception During the COVID-19 Pandemic

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The COVID-19 pandemic has led many people to suffer from emotional distress. Previous studies suggest that women process and express affective experiences, such as fear, with a greater intensity compared to men. We administered an online survey to a sample of participants in the United States that measures fear of COVID-19, perceptions about health and financial risks, and preventative measures taken. Despite the empirical fact that men are more likely to experience adverse health consequences from COVID-19, women report greater fear and more negative expectations about health-related consequences of COVID-19 than men. However, women are more optimistic than men regarding the financial consequences of the pandemic. Women also report more negative emotional experiences generally during the pandemic, particularly in situations where other people or the government take actions that make matters worse. Though women report taking more preventative measures than men in response to the pandemic, gender differences in behavior are reduced after controlling for fear. These results shed light on how differences in emotional experiences of the pandemic may inform policy interventions.

Keywords: gender differences, COVID-19, fear, health behavior, beliefs, risk perception, affect heuristic

INTRODUCTION

The consequences of COVID-19 transcend public health. The pandemic has profoundly affected economic activity, social interactions, and emotional wellbeing. Despite the universality of the pandemic, experience with previous natural disasters suggests that its impact may vary across individuals. Gender, age, socioeconomic status, and affective responses all influence how people are affected by catastrophic events (Neumayer and Plümper, 2007; Taylor et al., 2008; Eckel et al., 2009; Ibuka et al., 2010; Huang et al., 2013; Callen et al., 2014; Jang et al., 2020). For example, among earthquake victims in Turkey, women were more likely to recall panicking during the crisis (Yilmaz et al., 2005). Moreover, women were also more likely to report fear of disasters, such as landslide or flooding in Taiwan (Ho et al., 2008), and to worry about serious negative consequences of climate change in Sweden (Sundblad et al., 2007).

Gender differences are common in self-reported emotional experiences. Women report greater affective intensity (Fujita et al., 1991) and experience negative emotions, such as fear more frequently (Brebner, 2003; Fischer et al., 2004). The COVID-19 pandemic is no exception. In recent surveys conducted in the United States, Cuba, and China, women reported greater fear and stress associated with the pandemic (Broche-Pérez et al., 2020; Fitzpatrick et al., 2020;

Liu et al., 2020; Park et al., 2020). Early research on the impact of the COVID-19 pandemic suggests that local COVID-19 infection rates (Bu et al., 2020) and fear of the virus decrease risk taking (Alsharawy et al., 2020) and predict adherence to prevention measures (Harper et al., 2020; Müller and Rau, 2021). In addition, across eight different countries, women had a greater perception of the severity of the COVID-19 pandemic and greater adherence to prevention measures (Galasso et al., 2020).

Interestingly, these differences run counter to sex differences in the health consequences of the pandemic. Though disease prevalence is roughly equal between males and females, males are more likely to experience serious health consequences and to die from COVID-19 (Bhopal and Bhopal, 2020; Gebhard et al., 2020; Jin et al., 2020; Peckham et al., 2020). A recent meta-analysis indicates that, conditional on a positive diagnosis, males have roughly a 40% greater mortality risk from COVID-19 and are nearly three times more likely to be admitted to hospital intensive treatment units (Peckham et al., 2020).

We surveyed nearly 1,500 people across the United States to measure emotions, behaviors, and expectations associated with the COVID-19 pandemic. We hypothesized that women would report higher levels of fear, and this would motivate higher adherence to COVID-19 prevention measures, such as washing hands or physical distancing. Similarly, we explore whether pro-sociality increases adherence to mitigation strategies. Finally, based on the previous studies of natural disasters, we also expected that women would report greater concern about the negative consequences of the crisis.

MATERIALS AND METHODS

In April 2020, we administered a repeated cross-sectional survey to a random sample of around 1,500 people residing in the United States on Amazon Mechanical Turk (MTurk). We collected a third of our data every two weeks starting on April 2, 2020. There were approximately 200,000 confirmed COVID-19 cases in the United States at the time of our first sample; this number was tripled in the following two weeks and reached over 1 million cases by our third wave. The number of United States deaths from COVID-19 was less than 4,000 at the time of our initial sample, reached about 26,000 two weeks later, and passed 50,000 around the time of our third sample wave (Coronavirus disease 2019 (COVID-19) Situation Report – 73, 2020; Coronavirus disease 2019 (COVID-19) Situation Report – 87, 2020; Coronavirus disease 2019 (COVID-19) Situation Report – 101, 2020). To determine local COVID-19 infection rates, we matched participants' ZIP codes to counties (using a publicly available ZIP code database)¹ and obtained county-level data on population and COVID-19-related deaths from the COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University² (Dong et al., 2020).

¹www.unitedstateszipcodes.org/zip-code-database

²<https://github.com/CSSEGISandData/COVID-19>

Our survey captured self-reported fear of COVID-19 and adherence to preventative health behavior. Participants also indicated their perceptions of health and financial risks in the form of probabilistic beliefs about the percent chance that (1) they or a household member will lose a job due to the pandemic, (2) total household income will decrease over the next 12 months, (3) they or someone close will develop COVID-19, and (4) they or someone close will die from COVID-19. To elicit these beliefs, we adapted question formats that were validated against realizations of the same events (Manski, 2004). We also elicited anticipated negative emotions after people or institutions make decisions that make matters worse during a crisis. The full list of survey questions is provided in the **Supplementary Material** (see Sections 1.4 and 1.5). The survey included other measures that are discussed in a companion paper on fear of COVID-19 and economic preferences, which finds that risk and time preferences varied significantly with fear of COVID-19 and the association weakening over time (Alsharawy et al., 2020). We designed this survey in the early weeks of the pandemic to capture individual and socioeconomic characteristics (22 questions), economic preferences from the Global Preference Survey (10 questions; Falk et al., 2016, 2018), unincentivized risky lottery preference (Eckel and Grossman, 2002), and trust (nine questions adapted from Global Preference Survey, Socio-Economic Panel Study and World Value Survey, Inglehart, 2004; Wagner et al., 2007; Falk et al., 2016, 2018). In addition, we surveyed participants on their behavior and beliefs with regard to the pandemic (14 questions), and expectations about the emotions they would experience if people/institutions made wrong decisions in response to a crisis (4 questions). In this study, we explore gender differences in behavior, beliefs, and expectations with regard to the pandemic.

We set an initial criterion in our first wave of master status for MTurk workers. For subsequent waves, we then dropped this requirement, due to difficulties in collecting our predetermined sample size of 500 per wave, while still requiring a 99% or higher approval rating and at least 5,000 approved Human Intelligence Tasks. Due to random sampling from eligible participants, our sample is not strongly balanced across genders (690 women and 794 men). Moreover, 71% of our sample participants took the survey only once, so there is not a sufficient number of repeaters in our sample to investigate individual changes over time. We therefore combine the three waves, and in our regression analyses, we include controls for wave-specific effects. There are some differences in survey responses across genders on factors, such as age, political orientation, and education (see **Supplementary Table S2**). Similar to other studies analyzing survey responses (Dohmen et al., 2011; Falk et al., 2018), we control for these differences statistically using individual-level characteristics to establish the robustness of our findings: age, age-squared, indicator for race (Caucasian) or origin (Hispanic), self-reported high household income relative to others in one's community, working full time, education level, parents receiving a bachelor's degree, smoking behavior, and frequency of attending religious services. In addition, we control for occupation adapting a categorization from the Census classification as outlined in the

Supplementary Material (2010 Census Occupational Classification, 2016). Our regression analysis also controls for the state in which the participant resided, in which of the three survey waves they participated, and the local (county) death rate of COVID-19 (per 100,000 population) (Bu et al., 2020).

HYPOTHESES

Building on previous findings of women reporting higher frequency of negative emotions (Brebner, 2003; Fischer et al., 2004), we hypothesized that women would report higher fear levels of COVID-19 in the early weeks of the pandemic (question 60 in our survey; see **Supplementary Material**). Confirming this hypothesis would bolster the credibility of recent findings that are reported in surveys in the United States and Cuba (Broche-Pérez et al., 2020; Fitzpatrick et al., 2020).

H1: Women, compared to men, report higher fear of the COVID-19 pandemic.

Since emotional experiences are widely believed to affect behavior (Forgas, 1995; Loewenstein et al., 2001; Barrett, 2006; Baumeister et al., 2007; Van Kleef, 2009) and the pandemic evoked emotional responses in many ways (Alsharawy et al., 2020; Taylor et al., 2020a,b), we were interested in whether gender differences in adherence to the disease's prevention measures were mediated by fear of COVID-19. In particular, we hypothesized that controlling for self-reported fear of the pandemic would weaken the relationship between gender and adherence to preventative measures (measured in question 54 in our survey; see **Supplementary Material**).

H2: Controlling for fear of COVID-19 weakens observed gender differences in adherence to prevention measures.

Worries about the health-related dangers of the COVID-19 have been strongly linked to distress (Taylor et al., 2020a), so we explored gender differences in expectations about COVID-19-related outcomes. In particular, we elicited participants' beliefs of experiencing both health and financial hardships as a result of the pandemic. Since women tend to report greater affective intensity (Fujita et al., 1991) and consistent with the affect heuristic (Finucane et al., 2000; Loewenstein et al., 2001; Slovic and Peters, 2006; Slovic et al., 2007), we hypothesized that women have more negative perceptions about the COVID-19 risks (measured in questions 56–59 in our survey; see **Supplementary Material**). Moreover, we explore whether gender differences extend to expectations about experiencing negative emotions when decisions made by other people, the government, the media, or autonomous devices make matters worse during a crisis (measured in questions 43–46). We hypothesized that women expect to experience stronger negative emotions in such cases.

H3A: Women, compared to men, report higher expectations of negative health- and financial-related consequences of the COVID-19 pandemic.

H3B: Women, compared to men, report higher expectations of experiencing negative emotions in a crisis when decisions made by other people, institutions, or autonomous devices make matters worse.

RESULTS

First, we investigate whether emotional responses to the pandemic, in particular fear, differed across self-reported gender. Confirming our first hypothesis, women reported higher fear of the COVID-19 pandemic compared to men in our pooled sample ($\mu_{\text{difference}} = 0.939$, Wilcoxon rank-sum test: $p < 0.001$; see **Figure 1**). In addition to reporting the results of the widely used nonparametric Wilcoxon rank-sum test that probe for differences in central tendency, we report in **Supplementary Table S1** the results of two additional statistical analyses: two-sided t -tests (parametric: central tendency) and Epps-Singleton tests (nonparametric: distributional characteristics). Importantly, this gender difference in fear of the pandemic is robust across statistical tests. When we examine the distribution of the Likert scale responses, we find that women were more than twice as likely to report extreme levels of fear than men. Nearly 20.0% of women chose the highest available value for fear of the pandemic, compared to around 9.3% of men. This finding of increased fear of the pandemic among women is also robust in multiple regression analysis controlling for state and survey-wave fixed effects ($\beta = 0.963$, $p = 0.001$) and to individual-specific controls, including age, ethnicity, occupation, employment status, political orientation, smoking behavior, self and parent's education, self-reported income, and a self-reported measure of cognitive ability ($\beta = 0.654$, $p = 0.014$; see **Supplementary Table S3**). As reported in our companion paper, we use the local death rate as a proxy for the intensity of individual experience of the pandemic.

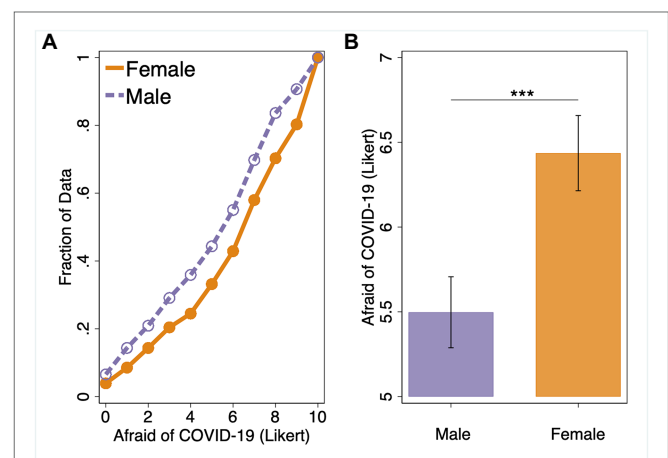


FIGURE 1 | (A) Empirical cumulative distribution function for fear of COVID-19 by gender (11-point Likert question with response alternatives ranging from “Not at all afraid” at 0 to “Very afraid” at 11). **(B)** Average fear of COVID-19 by gender (error bars represent 95% confidence intervals). Wilcoxon rank-sum tests: *** $p < 0.001$.

The local death rate was positively and significantly associated with fear of COVID-19 (Alsharawy et al., 2020). These results also hold when we standardize (z-score) the Likert response for each individual to account for differences in response styles (Fischer and Milfont, 2010; results available upon request). Moreover, when we include the interaction between the gender and each of the two waves, we find that the rate by which self-reported fear declined over time was similar across genders ($p > 0.100$; result available upon request).

Second, we turn to self-reports of whether respondents adopted recommended preventative health behaviors in response to the COVID-19 pandemic. We examine the following: (1) hand washing, (2) using hand sanitizer, (3) avoiding touching one's face, (4) cleaning and disinfecting surfaces in the home, (5) wearing a face mask, and (6) practicing physical distancing. Using an Ordered Logit regression where the dependent variable is the number of preventative measures taken (see Table 1), we find that women adopted significantly more preventative measures than men ($OR = 1.355$, $p = 0.003$). This result is robust to the inclusion of individual-level controls ($OR = 1.314$, $p = 0.010$). Holding all other variables constant, this model suggests that the odds of following all six preventative measures are 1.314 greater for women than men. Interestingly, when we include self-reported fear of the COVID-19 pandemic as a predictor, the gender difference result no longer holds ($OR = 1.104$, $p > 0.100$). Instead, the coefficient for fear of the COVID-19 pandemic is positive and statistically significant ($OR = 1.255$, $p < 0.001$). With a one (Likert)-unit increase in self-reported fear of the pandemic while holding other variables constant,

the odds of adhering to all six health behaviors versus the combined other categories are greater by a factor of 1.255. Again, these results are robust to the inclusion of individual-level controls (see Table 1). Our findings suggest that gender differences in behavioral responses, both in our and in other studies (e.g., Galasso et al., 2020), are driven by emotional responses to the COVID-19 pandemic. There is recent evidence suggesting that social preferences, in particular pro-sociality, increases adherence to prevention measures (Campos-Mercade et al., 2021). Moreover, in our companion paper, we report that fear of COVID-19 and altruism are positively and significantly associated (Alsharawy et al., 2020). In our survey, we capture an experimentally validated measure of altruism (question 26 in our survey; see **Supplementary Material**; Falk et al., 2016, 2018), and we also find that pro-sociality is positively and significantly associated with compliance to preventative measures ($OR = 1.173$, $p < 0.001$; see Table 1; Campos-Mercade et al., 2021). Importantly, however, the positive statistical significance between fear of COVID-19 and compliance to preventative measures remains robust despite controlling for altruism ($OR = 1.236$, $p < 0.001$). In addition, we find a similar result for local COVID-19 infection rates. In particular, the positive relationship between local death rate and the number of prevention measure taken ($OR = 1.009$, $p = 0.004$) is weakened when we control for fear of COVID-19 ($OR = 1.006$, $p = 0.044$). These results confirm the importance of affective responses, namely fear, in behavioral responses during a crisis, like the COVID-19 pandemic.

We run alternative specifications investigating each of the six prevention measures separately, using a series of Logit regressions

TABLE 1 | Number of preventative measures taken in response to COVID-19 (Ordered Logit Regression).

Dependent variable	(a) Preventative measures taken	(b) Preventative measures taken	(c) Preventative measures taken	(d) Preventative measures taken	(5) Preventative measures taken
Female	1.3546*** (0.1397)	1.1043 (0.1249)	1.3141*** (0.1392)	1.1419 (0.1451)	0.992 (0.1433)
Afraid of COVID-19	–	1.2549*** (0.0262)	–	1.245*** (0.0262)	1.2357*** (0.0269)
Wave 2	2.0753*** (0.1826)	2.4407*** (0.2338)	2.0755*** (0.1789)	2.4736*** (0.2531)	2.5451*** (0.2716)
Wave 3	3.193*** (0.4561)	4.1211*** (0.5525)	2.9551*** (0.4651)	3.761*** (0.5781)	3.8504*** (0.6041)
Altruism	–	–	–	–	1.1731*** (0.0278)
Local death rate	–	–	1.0089*** (0.0031)	1.0062** (0.003)	1.0063** (0.0032)
Cognitive ability	–	–	0.9779 (0.0239)	0.9975 (0.0243)	0.9946 (0.024)
Liberal	–	–	1.1104*** (0.0228)	1.0572*** (0.0197)	1.0475*** (0.0188)
Additional controls	No	No	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,484	1,484	1,484	1,484	1,484

The six measures are as follows: (1) washing hands more frequently, (2) using hand sanitizers more frequently, (3) make more effort to avoid touching face, (4) cleaning and disinfecting surfaces in home more than usual, (5) wearing a face mask, and (6) engaging in physical distancing. Odds ratios reported. Standard errors (clustered at the state level) in parentheses. Additional controls included age, age-squared, and indicators for race (Caucasian) and origin (Hispanic), occupation (eight categories), self-reported same or high household income relative to others in one's community, working full time, education level, parents receiving a bachelor's degree, smoking behavior, and frequency of attending religious services. *** $p < 0.01$; ** $p < 0.05$. Table was created using *asdoc*, a Stata program written by Shah (2020).

that control for state and survey-wave fixed effects and individual-level characteristics (see **Supplementary Tables S4 and S5**). We find that women, compared to men, were significantly more likely to report making an effort to avoid touching one's face ($OR = 1.483$, $p = 0.030$), to clean and disinfect surfaces ($OR = 1.553$, $p = 0.003$) and to engage in physical distancing ($OR = 1.661$, $p = 0.036$). These associations become weaker when we control for fear of COVID-19. Though women are still significantly more likely to report cleaning and disinfecting surfaces ($OR = 1.409$, $p = 0.025$) after controlling for fear, gender differences in making an effort to avoid touching one's face or engaging in physical distancing shrunk when including fear as a covariate ($OR = 1.311$, $p = 0.172$; $OR = 1.431$, $p = 0.216$, respectively). Importantly, however, we find that fear of COVID-19 is strongly associated with adherence to each of our six preventative measures ($OR > 1.189$, $p < 0.001$ for all tests). This result holds even after controlling for altruism, which was positively and significantly associated with compliance to all preventative measures except washing hands more frequently ($OR > 1.079$, $p < 0.010$; results available upon request). Again, these findings provide evidence in favor of our second hypothesis and demonstrate the importance of fear of COVID-19 in predicting preventative behavior (Harper et al., 2020).

Next, we explore whether there were gender differences in self-reported probabilistic beliefs about the likelihood of experiencing health and financial hardships due to the COVID-19 pandemic. We find that beliefs about the likelihood of health consequences of COVID-19 differed between men and women. Contrary to the empirical observation that men are more likely to experience severe illness or die as a result of COVID-19 (Bhopal and Bhopal, 2020; Gebhard et al., 2020; Jin et al., 2020; Peckham et al., 2020), men reported systematically lower expectations of negative health-related consequences of the pandemic. Women, on average, reported a 5.2% higher chance that they or someone close would develop COVID-19 compared to men and 3.4% higher chance of oneself or someone close dying from COVID-19 (see **Figure 2**). The distribution of beliefs about the likelihood of experiencing health hardships indeed differed significantly for both contracting COVID-19 and dying from COVID-19 (Wilcoxon rank-sum test: $p < 0.001$ and $p < 0.001$, respectively). Men were more likely to indicate a low likelihood of contracting COVID-19, with 35.0% of men indicating a 10% or less chance, compared to 27.7% of women. This difference holds when we look at beliefs about the likelihood of dying from COVID-19, with 73.5% of women indicating a 10% or less chance of that scenario relative to 80.6% for men. Taken together, this means that we find that women report higher fear of the COVID-19 pandemic and stronger negative beliefs about health consequences. The finding that women believe there are significantly higher chances of developing or dying from COVID-19 is robust to the inclusion of state and survey-wave fixed effects and individual-level controls ($\beta = 3.341$, $p = 0.009$; $\beta = 2.425$, $p = 0.022$, respectively; see **Supplementary Table S6**).

Despite the absence of central tendency gender differences in the expectation of experiencing financial hardships, such as job loss or decline in income ($\mu_{\text{difference}} = 0.793$ and $\mu_{\text{difference}} = -1.912$; Wilcoxon rank-sum test: $p = 0.354$ and

$p = 0.137$, respectively; see **Supplementary Figure S1 and Supplementary Tables S1 and S6**), tests that probe more broadly to distributional characteristics (Epps and Singleton, 1986; Goerg and Kaiser, 2009) reveal some variations in the spread of expectations in the probabilistic beliefs about the likelihood of job loss and income loss across genders (see **Supplementary Table S1**). These differences can be attributed to lower expectations of experiencing financial hardship among women than among men. For example, 48.0% of women indicated a 10% or less chance of job loss compared to only 42.8% of the men. Furthermore, 32.3% of women indicated a 10% or less chance of experiencing income loss compared to only 27.1% of men. Thus, we find significant gender differences in expectations regarding health, but not financial consequences of the COVID-19 pandemic, partially confirming Hypothesis 3A. Moreover, both women and men predicted a lower chance of job loss due to the COVID-19 pandemic than of income loss ($\mu_{\text{difference}_{\text{women}}} = 13.465$; $\mu_{\text{difference}_{\text{men}}} = 16.171$ Wilcoxon signed-rank test: $p < 0.001$). Overall, survey responders anticipated a 26.6% chance of job loss and a 41.5% chance of a decline in household income.

We also elicited the extent to which survey responders experience negative emotions, such as sadness or anger, when decisions made by other people, the government, the media, or autonomous devices might make matters worse during a crisis. Across all these measures, we find that women anticipated experiencing significantly more intense negative emotions than men ($\mu_{\text{difference}_{\text{people}}} = 0.517$, $\mu_{\text{difference}_{\text{government}}} = 0.594$, $\mu_{\text{difference}_{\text{media}}} = 0.528$, and $\mu_{\text{difference}_{\text{autonomous}}} = 0.488$, Wilcoxon rank-sum test: $p < 0.001$ for all four measures; see **Figure 3**). We find that women reported not only higher fear of the COVID-19 pandemic but also a higher tendency to experience negative emotions during crises in general, in particular as a result of unfavorable actions taken by people, institutions, and devices. This confirms Hypothesis 3B. After including state and survey-wave fixed effects and individual-level controls in multiple regression analysis, the intensity of negative emotions that women report experiencing during crises was significantly greater than that of men (people: $\beta = 0.356$, $p = 0.007$; government: $\beta = 0.463$, $p = 0.002$; media: $\beta = 0.385$, $p = 0.016$; autonomous: $\beta = 0.315$, $p = 0.016$; see **Supplementary Table S7**).

DISCUSSION

We investigated gender differences in the intensity of experiencing negative emotions, namely fear, in response to the COVID-19 outbreak. In our study, women report higher fear of the COVID-19 pandemic compared to men. Gender differences in preventative health behaviors disappeared once we controlled for emotional experiences, suggesting that fear of the COVID-19 pandemic, and not gender *per se*, drives behavioral differences. Women report more negative perceptions about the pandemic's health, but not economic, risks. Thus, our findings on health risks are consistent with the affect heuristic: the notion that emotional experience shapes the perception of risk (Finucane et al., 2000; Loewenstein et al., 2001; Slovic and Peters, 2006; Slovic et al., 2007; Skagerlund et al., 2020). Maladaptation in

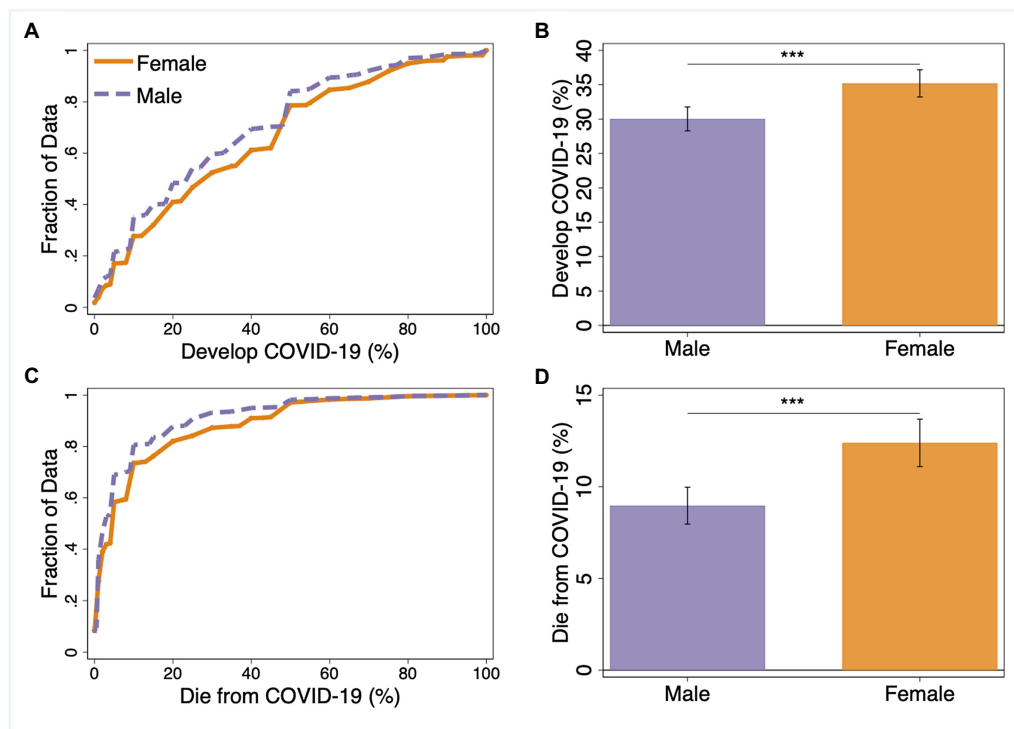


FIGURE 2 | (A) Empirical cumulative distribution function (eCDF) for self-reported beliefs about the likelihood of oneself or someone close developing COVID-19 (develop COVID-19). **(B)** Average self-reported beliefs of developing COVID-19. **(C)** eCDF for the self-reported beliefs about the likelihood of oneself or someone close dying from COVID-19 (Die from COVID-19). **(D)** Average self-reported beliefs of dying from COVID-19. Data are split by gender (error bars represent 95% confidence interval). Wilcoxon rank-sum tests: *** $p < 0.001$.

face of threats has been linked to overconfidence and positive illusion (Johnson and Levin, 2009). Our results may thus be related to domain specific overconfidence/underconfidence (Klayman et al., 1999; Johnson and Fowler, 2011), with men being more overconfident and women being more underconfident (Barber and Odean, 2001; Bengtsson et al., 2005; Johnson et al., 2006). Gender stereotypes are manifested in women's emphasis on care compared to men's emphasis on agency (Ellemers, 2018), while social concerns have been argued to modulate overconfidence (Burks et al., 2013). Our results may suggest that gender stereotyping may play a role in the existence of a gap between negative perception of health but not financial risks. In addition, structural labor market concerns, such as the gender wage gap, as well as workplace- and occupation-specific factors (Blau and Kahn, 2017; Wiswall and Zafar, 2018), may also contribute to the observed differences in perceptions of health and financial risks. While we account for occupation in our analyses, the broad classifications utilized (see **Materials and Methods** section) are somewhat limited. For example, our observation that women have less extreme views of the financial consequences of the pandemic could result from their self-selection into jobs with greater work flexibility and job stability (Wiswall and Zafar, 2018). Nonetheless, we find that women report stronger negative emotions resulting from crises in general, as a result of unfavorable actions taken by, for example, other people and the government. Our results

contribute to the literature on gender differences in economic preferences, which finds that women are typically more risk averse (Eckel and Grossman, 2002; Dohmen et al., 2011; Charness and Gneezy, 2012) and less likely to prefer competition (Niederle and Vesterlund, 2007; Buser et al., 2014). As in our study, these gender differences may reflect state dependent variation, rather than stable traits (Frey et al., 2017; Pedroni et al., 2017; Mata et al., 2018).

One limitation of our study is the reliance on questionnaire responses. This seemed a reasonable compromise between our desire to obtain data at the beginning of the COVID-19 event in the United States and the need to keep both participants and experimenters safe. In fact, recent empirical work on preference elicitation suggests that self-reported preferences are generalizable and may be more stable across time compared to incentivized behavioral measures (Frey et al., 2017; Pedroni et al., 2017; Mata et al., 2018). Our questionnaire was designed in the early days of the pandemic and prior to the development of the multiple-scale measures of fear of COVID-19 (Ahorsu et al., 2020; Feng et al., 2020; Mejia et al., 2020). Nonetheless, our survey question that captures fear of the pandemic matches one of the items with a strong factor loading in the commonly used fear of COVID-19 scale (Ahorsu et al., 2020). The finding of gender differences in fear of the pandemic is not unique to the early days of the pandemic (Alsharawy et al., 2021). In

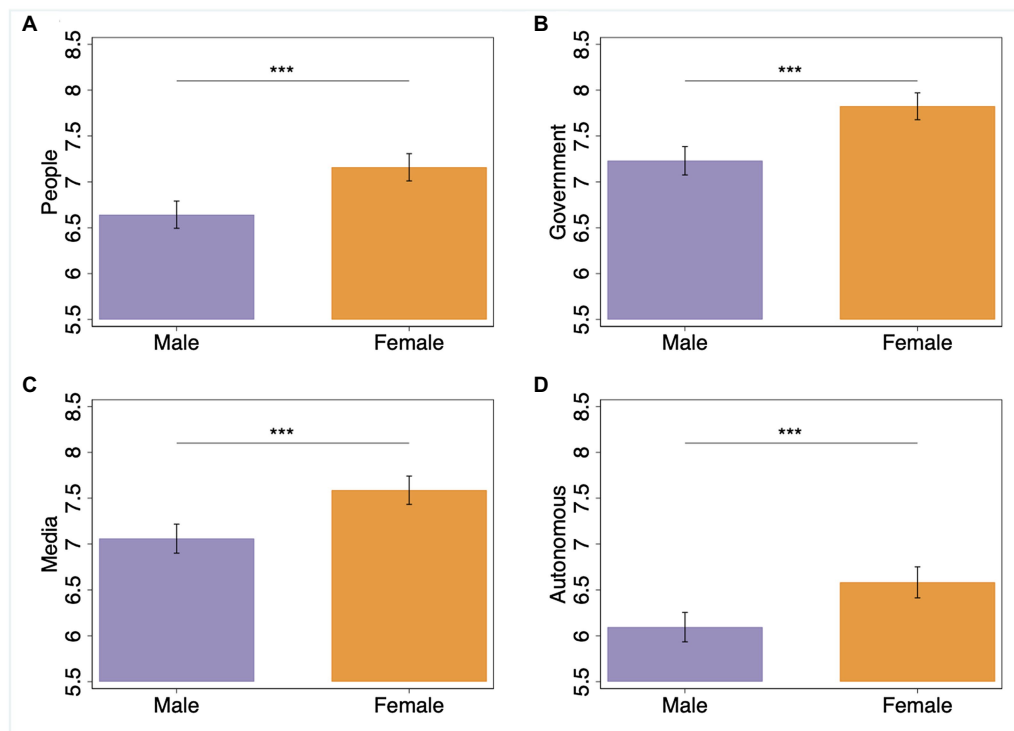


FIGURE 3 | Expected negative emotional experience (e.g., sadness or anger) in a hypothetical scenario where (A) other people (B) the government (C) the media, or (D) an autonomous system take actions that make matters worse in a crisis (11-point Likert question with response alternatives ranging from “Not at all” at 0 to “A great deal” at 11). Data are split by gender (error bars represent 95% confidence interval). Wilcoxon rank-sum test: *** $p < 0.001$.

addition, though our study relies on correlations between survey measures, and therefore, our results cannot be interpreted as causal, we demonstrate that our findings are robust.

Our study suggests avenues for future study for researchers interested in effective crisis management. To mitigate the severity of a crisis, for example, policy makers sometimes employ fear messaging, or scare tactics, to promote adherence to prevention measures. Our results suggest that this approach may have differential impact depending on gender, since women report higher fear. Furthermore, scare tactics may also have unintended consequences, such as increasing message avoidance (Kok et al., 2014) or exacerbating existing stressors (Stolow et al., 2020). Messaging strategies that emphasize the pro-social implications of preventative measures, that focus on evidence-based health communications, or that “nudge” behavior in a contextually appropriate manner (Kreuter and Wray, 2003; Campos-Mercade et al., 2021; Heffner et al., 2021; Milkman et al., 2021) without increasing psychological distress may be preferred during health crises.

DATA AVAILABILITY STATEMENT

Data and analysis script that support the findings of this study is available through the Open Science Framework at <https://osf.io/drhfw>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Institutional Review Board of Virginia Tech. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the study, manuscript revision, read, and approved the submitted version. AA and RS organized the database. AA performed the statistical analysis and wrote the first draft of the manuscript. AA, AS, and SB wrote the sections of the manuscript.

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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.2021.689467/full#supplementary-material>

REFERENCES

- 2010 Census Occupational Classification (2016). U.S. Bureau of Labor Statistics. Available at: <https://www.bls.gov/cps/cenocc2010.htm> (Accessed July 10, 2021).
- Ahorsu, D. K., Lin, C.-Y., Imani, V., Saffari, M., Griffiths, M. D., and Pakpour, A. H. (2020). The fear of COVID-19 scale: development and initial validation. *Int. J. Ment. Heal. Addict.*, 1–9. doi: 10.1007/s11469-020-00270-8 [Epub ahead of print].
- Alsharawy, A., Ball, S. B., Smith, A., and Spoon, R. (2020). Fear of COVID-19 changes economic preferences: evidence from a repeated cross-sectional Mturk survey. SSRN [Preprint]. doi: 10.2139/ssrn.3750351
- Alsharawy, A., Dwibedi, E., Aimone, J., and Ball, S. (2021). Vaccine hesitancy and betrayal aversion. SSRN [Preprint]. doi: 10.2139/ssrn.3843385
- Barber, B. M., and Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *Q. J. Econ.* 116, 261–292. doi: 10.1162/003355301556400
- Barrett, L. F. (2006). Are emotions natural kinds? *Perspect. Psychol. Sci.* 1, 28–58. doi: 10.1111/j.1745-6916.2006.00003.x
- Baumeister, R. F., Vohs, K. D., Nathan DeWall, C., and Zhang, L. (2007). How emotion shapes behavior: feedback, anticipation, and reflection, rather than direct causation. *Personal. Soc. Psychol. Rev.* 11, 167–203. doi: 10.1177/1088868307301033
- Bengtsson, C., Persson, M., and Willenhag, P. (2005). Gender and overconfidence. *Econ. Lett.* 86, 199–203. doi: 10.1016/j.econlet.2004.07.012
- Bhopal, S. S., and Bhopal, R. (2020). *Sex Differential in COVID-19 Mortality Varies Markedly by Age*. London, England: Lancet.
- Blau, F. D., and Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *J. Econ. Lit.* 55, 789–865. doi: 10.1257/jel.20160995
- Brebner, J. (2003). Gender and emotions. *Personal. Individ. Differ.* 34, 387–394. doi: 10.1016/S0191-8869(02)00059-4
- Broche-Pérez, Y., Fernández-Fleites, Z., Jiménez-Puig, E., Fernández-Castillo, E., and Rodríguez-Martin, B. C. (2020). Gender and fear of COVID-19 in a Cuban population sample. *Int. J. Ment. Heal. Addict.*, 1–9. doi: 10.1007/s11469-020-00343-8 [Epub ahead of print].
- Bu, D., Hanspal, T., Liao, Y., and Liu, Y. (2020). Risk taking during a global crisis: Evidence from Wuhan. *Covid Econ.* 5, 106–146. doi: 10.2139/ssrn.3559870
- Burks, S. V., Carpenter, J. P., Goette, L., and Rustichini, A. (2013). Overconfidence and social signalling. *Rev. Econ. Stud.* 80, 949–983. doi: 10.1093/restud/rds046
- Buser, T., Niederle, M., and Oosterbeek, H. (2014). Gender, competitiveness, and career choices. *Q. J. Econ.* 129, 1409–1447. doi: 10.1093/qje/qju009
- Callen, M., Isaqzadeh, M., Long, J. D., and Sprenger, C. (2014). Violence and risk preference: Experimental evidence from Afghanistan. *Am. Econ. Rev.* 104, 123–148. doi: 10.1257/aer.104.1.123
- Campos-Mercade, P., Meier, A. N., Schneider, F. H., and Wengström, E. (2021). Prosociality predicts health behaviors during the COVID-19 pandemic. *J. Public Econ.* 195:104367. doi: 10.1016/j.jpubeco.2021.104367
- Charness, G., and Gneezy, U. (2012). Strong evidence for gender differences in risk taking. *J. Econ. Behav. Organ.* 83, 50–58. doi: 10.1016/j.jebo.2011.06.007
- Coronavirus disease 2019 (COVID-19) Situation Report – 73 (2020). *World Health Organization*. Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200402-sitrep-73-covid-19.pdf?sfvrsn=5ae25bc7_6 (Accessed December 8, 2020).
- Coronavirus disease 2019 (COVID-19) Situation Report – 87 (2020). *World Health Organization*. Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200416-sitrep-87-covid-19.pdf?sfvrsn=9523115a_2 (Accessed December 8, 2020).
- Coronavirus disease 2019 (COVID-19) Situation Report – 101 (2020). *World Health Organization*. Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200430-sitrep-101-covid-19.pdf?sfvrsn=2ba4e093_2 (Accessed December 8, 2020).
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *J. Eur. Econ. Assoc.* 9, 522–550. doi: 10.1111/j.1542-4774.2011.01015.x
- Dong, E., Du, H., and Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect. Dis.* 20, 533–534. doi: 10.1016/S1473-3099(20)30120-1
- Eckel, C. C., El-Gamal, M. A., and Wilson, R. K. (2009). Risk loving after the storm: A Bayesian-network study of hurricane Katrina evacuees. *J. Econ. Behav. Organ.* 69, 110–124. doi: 10.1016/j.jebo.2007.08.012
- Eckel, C. C., and Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evol. Hum. Behav.* 23, 281–295. doi: 10.1016/S1090-5138(02)00097-1
- Ellemers, N. (2018). Gender stereotypes. *Annu. Rev. Psychol.* 69, 275–298. doi: 10.1146/annurev-psych-122216-011719
- Epps, T., and Singleton, K. J. (1986). An omnibus test for the two-sample problem using the empirical characteristic function. *J. Stat. Comput. Simul.* 26, 177–203. doi: 10.1080/00949658608810963
- Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., and Sunde, U. (2018). Global evidence on economic preferences. *Q. J. Econ.* 133, 1645–1692. doi: 10.1093/qje/qjy013
- Falk, A., Becker, A., Dohmen, T. J., Huffman, D., and Sunde, U. (2016). The preference survey module: A validated instrument for measuring risk, time, and social preferences. Netspar Discussion Paper No. 01/2016-003, Available at SSRN: <https://ssrn.com/abstract=2725874>
- Feng, L.-S., Dong, Z.-J., Yan, R.-Y., Wu, X.-Q., Zhang, L., Ma, J., et al. (2020). Psychological distress in the shadow of the COVID-19 pandemic: preliminary development of an assessment scale. *Psychiatry Res.* 291:113202. doi: 10.1016/j.psychres.2020.113202
- Finucane, M. L., Alhakami, A., Slovic, P., and Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *J. Behav. Decis. Mak.* 13, 1–17. doi: 10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S
- Fischer, R., and Milfont, T. L. (2010). Standardization in psychological research. *Int. J. Psychol. Res.* 3, 88–96. doi: 10.21500/20112084.852
- Fischer, A. H., Rodríguez Mosquera, P. M., Van Vianen, A. E., and Manstead, A. S. (2004). Gender and culture differences in emotion. *Emotion* 4:87. doi: 10.1037/1528-3542.4.1.87
- Fitzpatrick, K. M., Harris, C., and Drawve, G. (2020). Fear of COVID-19 and the mental health consequences in America. *Psychol. Trauma Theory Res. Pract. Policy* 12, S17–S21. doi: 10.1037/tra0000924
- Forgas, J. P. (1995). Mood and judgment: the affect infusion model (AIM). *Psychol. Bull.* 117:39. doi: 10.1037/0033-2909.117.1.39
- Frey, R., Pedroni, A., Mata, R., Rieskamp, J., and Hertwig, R. (2017). Risk preference shares the psychometric structure of major psychological traits. *Sci. Adv.* 3:e1701381. doi: 10.1126/sciadv.1701381
- Fujita, F., Diener, E., and Sandvik, E. (1991). Gender differences in negative affect and well-being: the case for emotional intensity. *J. Pers. Soc. Psychol.* 61, 427–434. doi: 10.1037/0022-3514.61.3.427
- Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., and Foucault, M. (2020). Gender differences in COVID-19 attitudes and behavior: panel evidence from eight countries. *Proc. Natl. Acad. Sci.* 117, 27285–27291. doi: 10.1073/pnas.2012501117
- Gebhard, C., Regitz-Zagrosek, V., Neuhauser, H. K., Morgan, R., and Klein, S. L. (2020). Impact of sex and gender on COVID-19 outcomes in Europe. *Biol. Sex Differ.* 11, 1–13. doi: 10.1186/s13293-020-00304-9
- Goerg, S. J., and Kaiser, J. (2009). Nonparametric testing of distributions—the Epps-Singleton two-sample test using the empirical characteristic function. *Stata J.* 9, 454–465. doi: 10.1177/1536867X0900900307
- Harper, C. A., Satchell, L. P., Fido, D., and Latzman, R. D. (2020). Functional fear predicts public health compliance in the COVID-19 pandemic. *Int. J. Ment. Heal. Addict.*, 1–14. doi: 10.1007/s11469-020-00281-5
- Heffner, J., Vives, M.-L., and FeldmanHall, O. (2021). Emotional responses to prosocial messages increase willingness to self-isolate during the COVID-19 pandemic. *Personal. Individ. Differ.* 170:110420. doi: 10.1016/j.paid.2020.110420
- Ho, M., Shaw, D., Lin, S., and Chiu, Y. (2008). How do disaster characteristics influence risk perception? *Risk Anal. Int. J.* 28, 635–643. doi: 10.1111/j.1539-6924.2008.01040.x
- Huang, L., Zhou, Y., Han, Y., Hammitt, J. K., Bi, J., and Liu, Y. (2013). Effect of the Fukushima nuclear accident on the risk perception of residents near a nuclear power plant in China. *Proc. Natl. Acad. Sci.* 110, 19742–19747. doi: 10.1073/pnas.1313825110
- Ibuka, Y., Chapman, G. B., Meyers, L. A., Li, M., and Galvani, A. P. (2010). The dynamics of risk perceptions and precautionary behavior in response

- to 2009 (H1N1) pandemic influenza. *BMC Infect. Dis.* 10, 1–11. doi: 10.1186/1471-2334-10-296
- Inglehart, R. (2004). *Human Beliefs and Values: A Cross-Cultural Sourcebook Based on the 1999–2002 Values Surveys*. eds. R. Inglehart, M. Basáñez, J. Diez-Medrano, L. C. J. M. Halman, and R. Luijckx (México: Siglo XXI).
- Jang, W. M., Kim, U.-N., Jang, D. H., Jung, H., Cho, S., Eun, S. J., et al. (2020). Influence of trust on two different risk perceptions as an affective and cognitive dimension during Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak in South Korea: serial cross-sectional surveys. *BMJ Open* 10:e033026. doi: 10.1136/bmjopen-2019-033026
- Jin, J.-M., Bai, P., He, W., Wu, F., Liu, X.-F., Han, D.-M., et al. (2020). Gender differences in patients with COVID-19: focus on severity and mortality. *Front. Public Health* 8:152. doi: 10.3389/fpubh.2020.00152
- Johnson, D. D., and Fowler, J. H. (2011). The evolution of overconfidence. *Nature* 477, 317–320. doi: 10.1038/nature10384
- Johnson, D., and Levin, S. (2009). The tragedy of cognition: psychological biases and environmental inaction. *Curr. Sci.*, 1593–1603. doi: 10.1038/nature10384
- Johnson, D. D., McDermott, R., Barrett, E. S., Cowden, J., Wrangham, R., McIntyre, M. H., et al. (2006). Overconfidence in wargames: experimental evidence on expectations, aggression, gender and testosterone. *Proc. R. Soc. B Biol. Sci.* 273, 2513–2520. doi: 10.1098/rspb.2006.3606
- Klayman, J., Soll, J. B., Gonzalez-Vallejo, C., and Barlas, S. (1999). Overconfidence: it depends on how, what, and whom you ask. *Organ. Behav. Hum. Decis. Process.* 79, 216–247. doi: 10.1006/obhd.1999.2847
- Kok, G., Bartholomew, L. K., Parcel, G. S., Gottlieb, N. H., and Fernández, M. E. (2014). Finding theory- and evidence-based alternatives to fear appeals: intervention mapping. *Int. J. Psychol.* 49, 98–107. doi: 10.1002/ijop.12001
- Kreuter, M. W., and Wray, R. J. (2003). Tailored and targeted health communication: strategies for enhancing information relevance. *Am. J. Health Behav.* 27, S227–S232. doi: 10.5993/ajhb.27.1.s3.6
- Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., and Welch, N. (2001). Risk as feelings. *Psychol. Bull.* 127, 267–286. doi: 10.1037/0033-2909.127.2.267
- Manski, C. F. (2004). Measuring expectations. *Econometrica* 72, 1329–1376. doi: 10.1111/j.1468-0262.2004.00537.x
- Mata, R., Frey, R., Richter, D., Schupp, J., and Hertwig, R. (2018). Risk preference: A view from psychology. *J. Econ. Perspect.* 32, 155–172. doi: 10.1257/jep.32.2.155
- Mejia, C., Ticona, D., Rodriguez-Alarcon, J., Campos-Urbina, A., Catay-Medina, J., Porta-Quinto, T., et al. (2020). The media and their informative role in the face of the coronavirus disease 2019 (COVID-19): validation of fear perception and magnitude of the issue (MED-COVID-19). *Electron. J. Gen. Med.* 17:em239. doi: 10.29333/ejgm/7946
- Milkman, K. L., Patel, M. S., Gandhi, L., Graci, H. N., Gromet, D. M., Ho, H., et al. (2021). A megastudy of text-based nudges encouraging patients to get vaccinated at an upcoming doctor's appointment. *Proc. Natl. Acad. Sci.* 118:e2101165118. doi: 10.1073/pnas.2101165118
- Müller, S., and Rau, H. A. (2021). Economic preferences and compliance in the social stress test of the COVID-19 crisis. *J. Public Econ.* 194:104322. doi: 10.1016/j.jpubeco.2020.104322
- Neumayer, E., and Plümper, T. (2007). The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002. *Ann. Assoc. Am. Geogr.* 97, 551–566. doi: 10.1111/j.1467-8306.2007.00563.x
- Niederle, M., and Vesterlund, L. (2007). Do women shy away from competition? Do men compete too much? *Q. J. Econ.* 122, 1067–1101. doi: 10.1162/qjec.122.3.1067
- Park, C. L., Russell, B. S., Fendrich, M., Finkelstein-Fox, L., Hutchison, M., and Becker, J. (2020). Americans' COVID-19 stress, coping, and adherence to CDC guidelines. *J. Gen. Intern. Med.* 35, 2296–2303. doi: 10.1007/s11606-020-05898-9
- Peckham, H., de Grujter, N. M., Raine, C., Radziszewska, A., Ciurtin, C., Wedderburn, L. R., et al. (2020). Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ICU admission. *Nat. Commun.* 11, 1–10. doi: 10.1038/s41467-020-19741-6
- Pedroni, A., Frey, R., Bruhin, A., Dutilh, G., Hertwig, R., and Rieskamp, J. (2017). The risk elicitation puzzle. *Nat. Hum. Behav.* 1, 803–809. doi: 10.1038/s41562-017-0219-x
- Shah, A. (2020). “ASDOC: Stata module to create high-quality tables in MS Word from Stata output,” Statistical Software Components S458466, Boston College Department of Economics.
- Skagerlund, K., Forsblad, M., Slovic, P., and Västfjäll, D. (2020). The affect heuristic and risk perception—stability across elicitation methods and individual cognitive abilities. *Front. Psychol.* 11:970. doi: 10.3389/fpsyg.2020.00970
- Slovic, P., Finucane, M. L., Peters, E., and MacGregor, D. G. (2007). The affect heuristic. *Eur. J. Oper. Res.* 177, 1333–1352. doi: 10.1016/j.ejor.2005.04.006
- Slovic, P., and Peters, E. (2006). Risk perception and affect. *Curr. Dir. Psychol. Sci.* 15, 322–325. doi: 10.1111/j.1467-8721.2006.00461.x
- Stolow, J. A., Moses, L. M., Lederer, A. M., and Carter, R. (2020). How fear appeal approaches in COVID-19 health communication may be harming the global community. *Health Educ. Behav.* 47, 531–535. doi: 10.1177/1090198120935073
- Sundblad, E.-L., Biel, A., and Gärling, T. (2007). Cognitive and affective risk judgements related to climate change. *J. Environ. Psychol.* 27, 97–106. doi: 10.1016/j.jenvp.2007.01.003
- Taylor, M. R., Agho, K. E., Stevens, G. J., and Raphael, B. (2008). Factors influencing psychological distress during a disease epidemic: data from Australia's first outbreak of equine influenza. *BMC Public Health* 8, 1–13. doi: 10.1186/1471-2458-8-347
- Taylor, S., Landry, C. A., Paluszczek, M. M., Fergus, T. A., McKay, D., and Asmundson, G. J. (2020a). COVID stress syndrome: Concept, structure, and correlates. *Depress. Anxiety* 37, 706–714. doi: 10.1002/da.23071
- Taylor, S., Landry, C. A., Paluszczek, M. M., Fergus, T. A., McKay, D., and Asmundson, G. J. (2020b). Development and initial validation of the COVID stress scales. *J. Anxiety Disord.* 72:102232. doi: 10.1016/j.janxdis.2020.102232
- Van Kleef, G. A. (2009). How emotions regulate social life: The emotions as social information (EASI) model. *Curr. Dir. Psychol. Sci.* 18, 184–188. doi: 10.1111/j.1467-8721.2009.01633.x
- Wagner, G. G., Frick, J. R., and Schupp, J. (2007). “The German Socio-Economic Panel Study (SOEP): Scope, Evolution and Enhancements,” SOEPpapers on Multidisciplinary Panel Data Research 1, DIW Berlin, The German Socio-Economic Panel (SOEP).
- Wiswall, M., and Zafar, B. (2018). Preference for the workplace, investment in human capital, and gender. *Q. J. Econ.* 133, 457–507. doi: 10.1093/qje/qjx035
- Yilmaz, V., Cangur, S., and Çelik, H. E. (2005). Sex difference and earthquake experience effects on earthquake victims. *Personal. Individ. Differ.* 39, 341–348. doi: 10.1016/j.paid.2005.01.014

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Biases in COVID-19 Medical Resource Dilemmas

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Accruing evidence suggest that COVID-19 is more fatal for males and minorities than other sub-populations. In this paper, we study medical dilemmas pertaining to the allocation of medical resources to evaluate whether existing social biases correspond to the demographic disparities of the pandemic. We develop and implement a choice experiment in which participants decide how to allocate scarce medical resources among COVID-19 patients with diverse demographic attributes. We find that participants violate optimal resource allocation significantly more often for the benefit of females. Males are almost half as likely to receive lifesaving resources even if these are medically more beneficial for them. We also find that participants are less likely to assign resources to patients with high compared to low income. Last, we find no evidence of patients' race affecting allocation preferences.

Keywords: allocation dilemma, ethical dilemma, gender bias, experiment, COVID-19

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INTRODUCTION

In less than one year from its appearance, COVID-19 claims millions of human casualties. In many regions, the spread of the virus was so rapid that the health care infrastructure was insufficient to grant everyone the intensive care they needed. In the months following February 2020, media and news extensively featured doctors and medical professionals reporting on the devastating situations taking place in emergency rooms and hospital corridors. There was no cure for COVID-19 and the resources were simply not enough to care for all the patients. Hard decisions had to be made (Robert et al., 2020; Shao, 2020; Truog et al., 2020). For navigating these decisions, many medical professionals reportedly opted for “the greatest amount of good for the greatest number” principle (Huang et al., 2019; Fink, 2020; Frakt, 2020; Mounk, 2020). With many moral dimensions to them, modern medicine has protocols for shorting patients' needs during pandemics and other medical emergencies (Verweij, 2009; Reid, 2020). These contemporary triages are explicit in that patients' gender, race, nationality, or other socioeconomic characteristics should have no bearing on doctors' assessments (Moskop and Iserson, 2007). For example, in the “Ethics and COVID-19” guidelines for doctors issued by WHO¹, it is stated that “Irrelevant characteristics of populations within countries, such as ethnicity, race or creed, should play no role in any resource allocation in any pandemic. This reflects our commitment to treating people with equal respect”. The guidelines also emphasize that doctors follow, among others, the principle of “Utility” (best outcome) to “justify the allocation of resources according to their capacity to do the most good”, and the principle of “Prioritizing the worst off” to justify the allocation of resources to those in greatest medical need or those most at risk.

¹<https://www.who.int/ethics/publications/ethics-covid-19-resource-allocation.pdf?ua=1>

The COVID-19, however, does not treat people with equal respect, i.e., does not ignore morally irrelevant factors. In the counts of the US National Center for Health Statistics², male deaths outnumber female deaths by thousands, while Hispanics and Blacks' share of deaths is disproportionately higher than their respective share in the population³. Important evidence suggest that at least the gender inequalities are not local only to the USA (Jin et al., 2020; Peckham et al., 2021). These disparities in fatalities could be attributed to physiological or sociological factors or a combination of both. The scope of this study is to evaluate whether a set of social biases might produce experimental findings that overlap with the disparities of the pandemic. In more detail, we will be evaluating whether biases pertaining to gender, race, or income might be affecting the allocation of medical resources.

In particular, we use an experiment that allows us to evaluate whether there exist preferential biases in the hypothetical allocation of medical resources by examining whether participants violate the principles of utility and prioritizing the worse off for the benefit of a particular demographic. Indeed, we report that participants violate the said principles significantly more times for the benefit of a female than a male. When considering 913 dilemmas that involve allocations strictly between a male and a female, we observe that 240 patients that ought to have received the resource according its capacity to do the most good, did not. Out of those, 65.5% were males. That is, the number of males who "died" in our experiment due to biased resource allocation is 1.8 times that of females. Considering real deaths, Jin et al. (2020) report that the number of men who died from COVID-19 is 2.4 times that of women. Unlike the real COVID-19 death demographics, our results bring no evidence that patients' race affects allocation decisions. However, they reveal that patients' income does affect allocation decisions in a similar fashion gender does. Participants violate optimal allocation of resources for the benefit of low-income, compared to high-income patients. In a similar exercise, the number of high-income individuals who "die" due to biased allocation is 1.4 times that of low-income individuals.

In the shadow of COVID-19 and the current shortages in its vaccines, medical rationing dilemmas become ever so crucial. A strand of literature, methodologically closer to this paper, focuses on social aspects and human behavior during the pandemic. On the prevention front, experimental evidence suggests that mask wearing increases physical distancing (Seres, Balleyer, Cerutti, Friedrichsen, and Süer) and that men intend to wear face covering to a lesser extent than women do (Capraro and Barcelo, 2020). However, evidence of a fatalism effect are also reported (Akeson et al., 2020); the more infectious people believe that COVID-19 is, the less willing they are to take distancing measures. Further evidence show that risk, time and social preferences correlate with social compliance (Campos-Mercade et al., 2020; Müller and Holger, 2020) and that treatment-seeking

behavior is affected by the perceived trustworthiness of the healthcare system (Antinyan et al., 2020). Evidence on intentions to vaccinate are documented to be sensitive to inconsistent risk messages from public health experts and elected officials (Thunstrom et al., 2020) while demand for antibody testing is found to be sensitive to price (Serra-Garcia and Szech, 2020). The study that we see as closer to this, in that it addresses the effect of demographics on COVID-19 related dilemmas, is the one by Huang et al. (2020). In that survey, participants allocate a one remaining ventilator either to an older patient who arrived at the hospital first or to a younger patient who arrived later. The authors report that when subjects employ a type of "veil of ignorance" reasoning, a method for deliberation that is supposed to reduce biases, they are more likely to allocate the ventilator to the younger patient. In this paper, using a different elicitation approach, one that is explicitly eliciting potential biases, we argue that patients' gender and economic status might be affecting allocation contemplations. Taken together the results of the two papers, albeit different in their objectives and methodologies, suggest that age, gender, and economic status might be factors that have a bearing in individuals' preferences for COVID-19 medical resources allocations.

METHODS

Experimental Design

We conduct a choice experiment in which participants consider two COVID-19 related medical dilemmas, one associated with the principal of utility (best outcome) which we refer to as the Ventilator Dilemma (VD), and one associated with the prioritizing the worse off principle which we refer to as the Hospital Bed Dilemma (HBD). In the VD, two critically ill patients with COVID-19 would die unless they received a ventilator. There is only one available ventilator and participants decide which patient receives it. Life expectancy upon survival is the same between the two patients, 36 years, but one patient has 31% chance of survival if given the ventilator, the other 39%. Participants viewed vignettes that varied the following demographic characteristics of patients:

Gender: Participants view two patients who either have the same or different gender. Gender is conveyed by names and pronouns.

Race/Ethnicity: Participants view two patients who either have the same or different race. Race, either Black, or Latino, or White, is conveyed by names.

Income: Participants view two patients who either have the same or different income level. Income level, either \$22,000, or \$40,000, or \$70,000 is explicitly stated in the vignettes.

Parenthood: Participants view either two patients who are not parents, or two patients who are both parents of two children. We did not allow for an allocation choice between a parent and a non-parent because we conjectured that, in these choice sets, minors' dependency on the parents might trigger behavioral patterns that we did not wish to study in this experiment. However, we opted for explicitly stating the parenthood status of patients to avoid participants' speculations about it and most importantly, to examine whether any biases arise only in the presence of children

²Provisional death counts as of November, 2020.

³Considering the difference between COVID-19 weighted in relation to the geographic areas impacted by COVID-19 and adjusted for age differences across groups.

(for e.g., participants might be more willing to help mothers than fathers but not women over men when neither is a parent. However, none of our results changes when we control for the parenthood status).

In the HBD, two different patients exhibit mild symptoms that could be caused by COVID-19. If they remain in the hospital they will survive with certainty but if they are sent home, there is a chance their condition could worsen and they might die. There is only one hospital bed available and participants decide which patient receives it. Both patients have life expectancy of 41 years but the chance of survival if sent home is 74% for one patient and 67% for the other. Gender, race, income, and parenthood characteristics vary in the same way as in the VD.

In both dilemmas, participants had to allocated medical resources; in the first case, both patients are expected to live 36 years if they survive but their chances of survival differ. If the ventilator goes to the patient with the 31% chance of survival, the expected years of life saved amount to 11.16, and if it goes to the patient with the 39% chance of survival, the expected years of life saved amount to 14.04. Thus, the assignment of the ventilator to the patient with the lower chances deprives roughly 3 years of expected life from the other patient. Similarly, in the HBD, both patients are expected to live 41 years but their chances of survival differ. If untreated, one patient has 74% chance of surviving amounting to 30.03 expected years of life, and the other patient has 67% chance of survival amounting to 27.47 expected years of life. Thus, choosing to allocate the medical bed to the patient with the highest chances of survival deprives roughly 3 years of expected life from the other patient. According to the utility principle, in the VD the ventilator needs to be allocated to the patient with the 39% chance of survival, and in the HBD, the bed should be allocated to the patient with the 67% chance of survival.

Participants also took part in a belief elicitation exercise. Once they made their allocation decisions, they were asked to report how they thought 100 other participants from their respective counties behaved in the same two dilemmas but with different patients.

A **Supplementary Video** with the experiment as experienced participants is accompanying this submission and can also be viewed via this link⁴.

Experimental Procedures

Choice Experiment

The procedural part of this study involved the recruitment of 1,842 individuals from the USA via Qualtrics, for a fixed fee. The study run from the 4th until the 13th of May 2020 (all dates before the death of George Floyd). The sample was balanced to be representative of USA population in the fields of gender, race, age (above 18), and parenthood (being a parent to at least one underage child). The participants had diverse educational and professional backgrounds and were not recruited as medical professionals. In the first part of the experiment, participants' basic demographics as well as exposure

and attitudes toward COVID-19 were elicited. In the next part, participants reviewed the two medical dilemmas—one VD and one HBD each—. Finally, the belief elicitation was performed. Throughout the experiment, three thorough comprehension checks were performed. The 1,842 participants are those who passed the checks. We randomly varied patient characteristics across participants and their appearance as a left or right choice.

Name Check

A name check was performed prior to the choice experiment to verify whether the names presented in the vignettes conveyed gender and race accurately. 100 individuals from USA, recruited via Qualtrics on the 30th of April 2020, reviewed 31 names and guessed whether each belonged to a Black/Latino/White male or female. For the choice experiment, we used 24 of those names, four for each combination of race and gender. Each of the 24 names was guessed accurately by a minimum of 80% of participants. Attention and understanding checks were applied.

IRB and Preregistration

This research is under the NYUAD IRB Approval HRPP-2020-37 Social Science Online Games and Experiments. Consent was elicited according to the specifications of this approval and it occurred after informing participants of risks and benefits associated with participation. The choice experiment and its analysis, together with the name check were preregistered at as predicted #40175.

All data are accompanying this submission and can also be accessed via this link⁵.

RESULTS

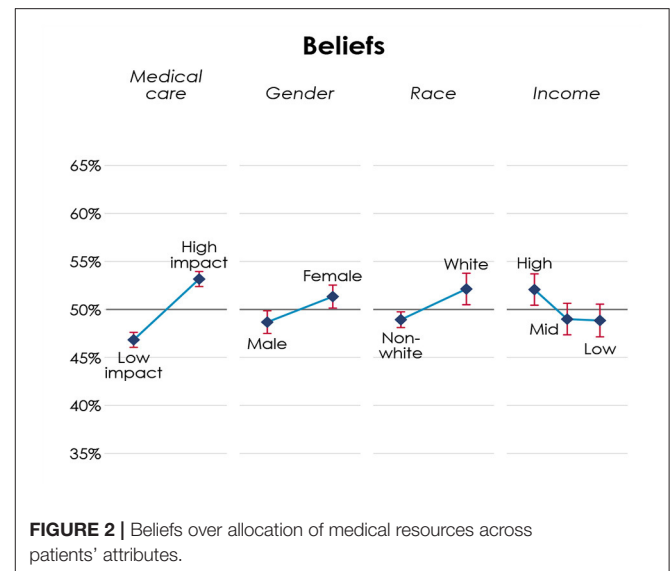
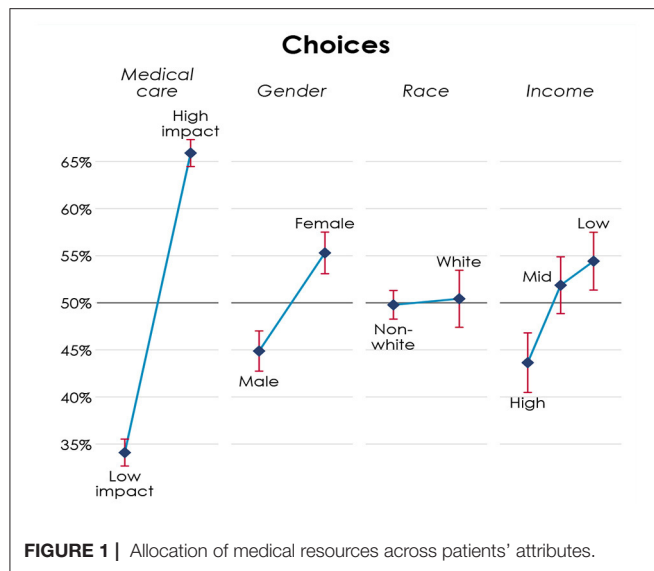
Turning to formal analysis, we consider the data via conditional logit models estimation. More specifically, we assume that a participant j who assigns medical assistance to a patient i in scenario k receives a psychological benefit (utility) given by:

$$u_{jik} = \beta_1(SMed_{ik} - SNo_{ik}) + \beta_2Female_{ik} + \beta_3Black_{ik} + \beta_4Latino_{ik} + \beta_5IncomeLow_{ik} + \beta_6IncomeHigh_{ik} + \Gamma Z_{ik} + \theta_{jk} + \varepsilon_{jik}$$

where $SMed_{ik}$ is the probability of survival with medical assistance of patient i in scenario k , SNo_{ik} is the probability of survival without medical assistance of patient i in scenario k , $Female_{ik}$ is an indicator that patient i in scenario k is female, $Black_{ik}$ is an indicator that patient i in scenario k is black, $Latino_{ik}$ is an indicator that patient i in scenario k is latino, $IncomeLow_{ik}$ is an indicator that patient i in scenario k has an income of \$22k, $IncomeHigh_{ik}$ is an indicator that patient i in scenario k has an income of \$70k, θ_{jk} corresponds to fixed effects for each participant-scenario combination, and ε_{jik} is a random variable capturing decision error. Participant j picks the patient i that gives the highest utility in scenario k . **Figure 1** gives the graphical representation of each of these coefficients when we pool responses from both dilemmas.

⁴https://drive.google.com/file/d/1ooAdwdh9KbTX5Gxex11SPSp1_33TDHas/view

⁵<https://drive.google.com/file/d/1p3ERkV0af1OZ6NusNUTc-U4R5Ys4hHQb/view>



Specifically, **Figure 1** presents the estimated probability of choosing a patient, given their characteristics. Under medical care, High Impact stands for optimal⁶ choices according to the principles of utility and prioritizing the worse off. Participants apply these principles. They are 31.8 percentage points more likely to choose the patient that is consistent with these principles instead of the patient that is not, and this difference is highly significant ($p < 0.01$). Since patients' characteristics are randomly assigned, if there are no social biases, then the probability of choosing a patient with a given characteristic would be 50%. However, females are 10.4 percentage points more likely to be chosen than males, a difference that is also highly significant ($p < 0.01$). We do not find significant effects for race. Neither between low and medium income patients. However, participants are significantly less likely to assign resources to patients with high compared to low income ($p < 0.01$). The results do not change qualitatively if we consider the two dilemmas separately and they are not driven by any of the demographics of the sample. Participants do not behave differently when the patients have children and are not exhibiting any left or right choice bias.

Turning to the participants' beliefs about how 100 other participants from their respective county would behave in similar dilemmas, we apply analogous data estimation procedures and we summarize results in **Figure 2** below.

Figure 2 presents both overlaps, and distinctions between choices and beliefs. Participants believe others are significantly more likely to allocate medical resources according to the principles of utility and prioritizing the worse off ($p < 0.01$), but the effect of principles in beliefs is smaller than in choices. Similarly, participants believe that others are significantly favor women over men ($p < 0.05$), albeit to a small degree than in

choices. Unlike choices, participants believe others significantly favor white ($p < 0.05$) and high-income patients ($p < 0.05$).

DISCUSSION

Summarizing, we can infer that when allocating scarce medical resources, individuals significantly favor women and believe others favor women too. As briefly discussed, when isolating the dilemmas between males and females, this favoritism becomes more striking. As a proportion of all patient population considered here, males have 17.1% chances of not being allocated a ventilator when a ventilator would be more effective for them. The corresponding proportion for females is 9%. Either as a proportion of all patient population, or among those patients who should have been allocated the medical resource but didn't, males are almost half as likely to not receive the critical resource.

The overlap of choices and beliefs regarding this finding, hints to the existence of a behavioral norm. We hypothesize this norm could be associated with benevolent sexism. As proposed in Glick and Fiske (1996) and further discussed in Fiske (2018), benevolent sexism is a set of prosocial behaviors toward women, which are driven by and re-enforce stereotypical gender views such as masculine dominance and feminine dependence. Related, there is evidence from various contexts on how females are more likely to elicit help and males to extend it (Eagly and Crowley, 1986; Sue, 2010) predominately motivated by the belief that, due to females' incompetence to lead any other role than a domestic one, males ought to "bear the burden of taking care of them" (Tajfel, 1969). Potentially, the pandemic brings forward society's protective instincts toward those it views as weaker and most vulnerable. Similarly to the practices of past centuries, during life threatening situations, we might still be guided by the "children and women first" code of practice, a collective behavior with various negative spillovers (Jost and Kay, 2005).

⁶The principles of utility and prioritizing the worse off (as borrowed from WHO) are characterized here as optimal in the economics sense, meaning that not choosing according to these principles leads to the loss of 3 years of expected life.

With regards to race, we do not find that participants over or under allocate medical resources to any of the race groups of our hypothetical patients; a finding that is not aligned with the significant over-representation of Hispanics and Blacks in COVID-19 deaths. However, in the belief elicitation exercise, participants guessed that Hispanics and Blacks were significantly less likely to be allocated the medical resources. We argue that this mismatch between choices and beliefs might be either due to erroneous perception over the prevalence of racism, or, due to concealed racism. In the first case, participants overestimate the extent to which Hispanics and Blacks might be experiencing disadvantageous discrimination. This mismatch between choices and beliefs might be due to participants overestimating the extent to which minorities experience discrimination or, due to participants showing less discrimination because of social desirability bias, yet projecting their racial biases when asked about the choices of others. These results are not at odds with the presence of benevolent sexism. While displaying racial discrimination comes with negative connotations, gender discrimination, concealed in the form of protectiveness, can resonate with past centuries' moral justifications. Although this study brings no support of contemporary racial bias, one should not exclude the possibility that other socio-economic and structural factors might be driving minorities' COVID-19 deaths over-representation; factors molded by years of well-documented institutional racism.

Benevolent and paternalistic attitudes might also explain the reasoning behind participants' preferences to favor low-income compared to high-income individuals. Similarly to women, low-income individuals might be seen as the weaker members of society that ought to be assisted at the expense of high-income individuals who might be assumed to have alternative means of assistance. Interestingly though, this preference does not seem to be a norm. Rather, it seems more as a curative counter to a perceived norm. When asked about their beliefs, participants think that others significantly favor high-income individuals, thus, when choosing, they opt to allocate resources to the low-income individuals, potentially to correct the perceived discrimination.

REFERENCES

- Akesson, J., Ashworth-Hayes, S., Hahn, R., Metcalfe, R. W., and Rasooly, I. (2020). Fatalism, beliefs, and behaviors during the COVID-19. *Pandemic* doi: 10.3386/w27245
- Antinyan, A., Bassetti, T., Corazzini, L., and Pavesi, F. (2020). Trust in the Healthcare System and COVID-19 treatment in the developing world. survey and experimental evidence from Armenia. No 2020:10, Working Papers, Department of Economics, University of Venice, "Ca'Foscari". doi: 10.2139/ssrn.3615831
- Campos-Mercade, P., Meier, A., Schneider, F., and Wengström, E. (2020). Prosociality predicts health behaviors during the COVID-19 pandemic. University of Zurich, Department of Economics, Working Paper No. 346, 2020, Available at SSRN: <https://ssrn.com/abstract=3604094>.
- Capraro, V., and Barcelo, H. (2020). The effect of messaging and gender on intentions to wear a face covering to slow down COVID-19 transmission. *PsyArXiv [Preprint]*. doi: 10.31234/osf.io/tg7vz

Given strong evidence that behavior elicited via the methodology we apply here is indicative of behavior in the real-world (Hainmueller et al., 2015), this paper brings significant evidence that COVID-19 medical resource allocation is socially biased in the domain of gender.

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.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by NYUAD IRB Approval HRPP-2020-37 Social Science Online Games and Experiments. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GM conceptualized the study, designed the experiment, programmed the experiment, preregistered the experiment, executed the experiment, analyzed the data, and wrote the paper.

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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.2021.687069/full#supplementary-material>

- Eagly, A. H., and Crowley, M. (1986). Gender and helping behavior: a meta-analytic review of the social psychological literature. *Psychol. Bull.* 100, 283–308. doi: 10.1037/0033-2909.100.3.283
- Fink, S. (2020). The hardest questions doctors may face: who will be saved? who won't? New York Times. Available online at: <https://www.nytimes.com/2020/03/21/us/coronavirus-medical-rationing.html> (accessed July 27, 2021).
- Fiske, S. T. (2018). *Social Cognition*. Milton Park: Routledge. doi: 10.4324/9781315187280
- Frakt, A. (2020). Who should be saved first? experts offer ethical guidance. New York Times. Available online at: <https://www.nytimes.com/2020/03/24/upshot/coronavirus-rationing-decisions-ethicists.html?auth=login-google> (accessed July 27, 2021).
- Glick, P., and Fiske, S. T. (1996). The ambivalent sexism inventory: differentiating hostile and benevolent sexism. *J. Personal. Soc. Psychol.* 70, 491–512. doi: 10.1037/0022-3514.70.3.491
- Hainmueller, J., Hangartner, D., and Yamamoto, T. (2015). Validating vignette and conjoint survey experiments against real-world behavior. *PNAS* 112, 2395–2400. doi: 10.1073/pnas.1416587112

- Huang, K., Bernhard, R., Barak-Corren, N., Bazerman, M., and Greene, J. (2020). Veil-of-ignorance reasoning favors allocating resources to younger patients during the COVID-19. *Crisis* 16, 1–19. doi: 10.31234/osf.io/npm4v
- Huang, K., Greene, J., and Bazerman, M. (2019). Veil-of-ignorance reasoning favors the greater good. *Proc. Natl. Acad. Sci. U.S.A.* 48, 23989–23995. doi: 10.1073/pnas.1910125116
- Jin, J.-M., Bai, P., He, W., Wu, F., Liu, X.-F., Han, D.-M., et al. (2020). Gender differences in patients with COVID-19: focus on severity and mortality. *Front. Public Health*. 8:152. doi: 10.3389/fpubh.2020.00152
- Jost, J. T., and Kay, A. C. (2005). Exposure to benevolent sexism and complementary gender stereotypes: consequences for specific and diffuse forms of system justification. *J. Personal. Soc. Psychol.* 88, 498–509. doi: 10.1037/0022-3514.88.3.498
- Moskops, J. C., and Iserson, K. V. (2007). Triage in medicine, part II: underlying values and principles. *Ann. Emerg. Med.* 49, 282–287. doi: 10.1016/j.annemergmed.2006.07.012
- Mounk, Y. (2020). The extraordinary decisions facing Italian doctors. The Atlantic. Available online at: <https://www.theatlantic.com/ideas/archive/2020/03/who-gets-hospital-bed/607807/> (accessed July 27, 2021).
- Müller, S., and Holger, A. R. (2020). Economic Preferences and Compliance in the Social Stress Test of the Corona Crisis. CEGE Working Papers, Number 391—April 2020. doi: 10.2139/ssrn.3575633 Available online at SSRN: <https://ssrn.com/abstract=3575633> (accessed July 26, 2021).
- Peckham, H., de Gruijter, N. M., Raine, C., Radziszewska, A., Ciurtin, C., Wedderburn, L. R., et al. (2021). Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ICU admission. *Nat. Commun.* 11, 1–10. doi: 10.1038/s41467-020-19741-6
- Reid, L. (2020). Triage of critical care resources in COVID-19: a stronger role for justice. *J. Med. Ethics*. 46, 526–530. doi: 10.1136/medethics-2020-106320
- Robert, R., Kentish-Barnes, N., Boyer, A., Laurent, A., Azoulay, E., and Reignier, J. (2020). Ethical dilemmas due to the Covid-19 pandemic. *Ann. Inten. Care*. 10, 1–10. doi: 10.1186/s13613-020-00702-7
- Seres, G., Balleyer, A. H., Cerutti, N., Friedrichsen, J., and Süer, M. (n.d.). *Face Mask Use and Physical Distancing before and after Mandatory Masking: Evidence from Public Waiting Lines*. Available online at SSRN.
- Serra-Garcia, M., and Szech, N. (2020). Demand for COVID-19 antibody testing and why it should be free. CESifo Working Paper, No. 8340. doi: 10.2139/ssrn.3607484
- Shao, C. (2020). The COVID trolley dilemma. *Am. J. Surg.* 220, 545–549. doi: 10.1016/j.amjsurg.2020.05.012
- Sue, D. W. (2010). *Microaggressions in Everyday Life: Race, Gender, and Sexual Orientation*. Hoboken, NJ: John Wiley and Sons.
- Tajfel, H. (1969). Cognitive aspects of prejudice. *J. Social Issues* 25, 79–97. doi: 10.1111/j.1540-4560.1969.tb00620.x
- Thunstrom, L., Ashworth, M., Finnoff, D., and Newbold, S. (2020). Hesitancy towards a COVID-19 vaccine and prospects for herd. *Immunity*. doi: 10.2139/ssrn.3593098
- Truog, R. D., Mitchell, C., and Daley, G. Q. (2020). The toughest triage: allocating ventilators in a pandemic. *New England J. Med.* 382, 1973–1975. doi: 10.1056/NEJMp2005689
- Verweij, M. (2009). Moral principles for allocating scarce medical resources in an influenza pandemic. *J. Bioethic. Inquiry*. 6, 159–169. doi: 10.1007/s11673-009-9161-6

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Gender Differences in the Impact of COVID-19 Lockdown on Potentially Addictive Behaviors: An Emotion-Mediated Analysis

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We study the impact of the spring 2020 lockdown in France on gender-related potentially addictive behaviors and associated negative emotions. We rely on an online survey we administered 1 week after the beginning of the lockdown, with responses collected within 2 weeks after the beginning of the lockdown ($N = 1,087$). We focus on potential addictions to non-creative activities as food consumption and smartphone usage (female-related), and videogame play (male-related). We find that women were about 1.6 times more likely than men to losing control of their usual diet and about 2.3 times more likely than men to increase smartphone usage, while no significant gender effect is detected as for increased videogame play. This is since the negative emotions driving the increase of female-related non-creative activities (sadness, discouragement, and nervousness) were themselves female-related, while the negative emotions driving the increase of male-related non-creative activities (boredom, emptiness, and stress) were shared by women too. Our study supports the intuition that the same negative emotion induced by COVID-19 side-effects could lead to different potentially addictive behaviors; this difference is explained by the interplay between different gender's sensitivities to such emotion and different gender's preferences for specific non-creative activities.

Keywords: COVID-19, lockdown, non-creative activity, addiction, food, smartphone, videogames, negative emotions

INTRODUCTION

As almost 1 year has passed from the moment WHO classified and declared COVID-19 as a “global pandemic,” the battle against this virus is still ongoing. And even if society is getting close to the resolution of the reason causing the virus spread, implementing a vaccine campaign for adults while still finding the proper treatment for the illness, the psychological, sociological, and economic negative effects of the pandemic and the subsequent series of lockdown periods throughout the world will, unfortunately, be long-lasting. In this paper, we focus on the former effects, i.e., individuals' psychological attitudes and behavioral responses to the unforeseen contingencies that the spread of COVID-19 has brought with it.

In particular, the lockdown has triggered potential addictions to unhealthy behaviors including increased smoking (Jackson et al., 2021), alcohol consumption (Cummings et al., 2021), and has also been associated with changes in eating habits with a sharp increase in binge and compulsory eating and overall weight gain (Cherikh et al., 2020). Indeed, eating is a simple way to control stress and anxiety and it has been predicted that the prevalence of obesity would increase sharply due to the pandemic and the related lockdown periods (see Alifano et al., 2020, and follow-up papers).

This paper presents the analysis of the lockdown impact on developing potentially addictive behaviors concerning gender. It relies on the data generated by an online survey administered in France by two of the paper authors, belonging to the Addiction Unit of the Department of Psychiatry of University Hospital of Nice, 1–3 weeks after the beginning of the spring 2020 lockdown. As for women, 1 week after the beginning of the lockdown in France, law-enforcement interventions following reports of domestic violence have increased by 32%,¹ with similar tendencies being detected in other European countries during the same timeframe.²

France was the first European country that confirmed a COVID-19 case on the 24th of January. Due to the increasing number of cases, the first 2-week lockdown was implemented starting from 17th of March 2020, which was then extended till the 10th of May 2020. During this period, the most affected areas of France were Paris (Île-de-France) and the Northeast (Souty et al., 2021). The main restrictions imposed by the government's decrees for the lockdown period included the following (Renou, 2020): only essential services (food shops, pharmacies, banks, newsagents, and petrol/service stations) and all essential public services were authorized to remain open; closure of schools and universities; ban on religious gatherings with some exceptions like funeral ceremonies; ban on traveling with some exceptions due to professional, family, or health-related issues.

Our survey was conducted during the 2nd week of the spring lockdown of 2020 in France, namely between the 24th of March and the 31st of March 2020. A stable panel ($N = 1,087$) of adult subjects was surveyed during 7 consecutive days, i.e., after 1–2 weeks from the beginning of the lockdown. The dataset contains information about people's emotional states and reactions to these states in the context of potentially developing addictions to food consumption, smartphone usage, and videogame play. The main reason for our interest in these three types of addictive behavior during the 2020 lockdown period relies on previous psychological literature suggesting gender differences in non-creative activities leading to these addictions through time.

As for *food consumption*, studies in psychology have detected an association between the recurrent occurrence of binge eating

and behavioral manifestations of loss of control over eating behavior on the one side and marked distress due to psychological seizures on the other side (Davis, 2013). The psychological suffering associated with these attacks is a criterion for the diagnosis of binge eating disorder. These attacks are also most often triggered by dysphoric states such as anxiety and depression. In this regard, food addiction is not a separate entity from binge eating, but rather a severe subtype of it, strongly marked by the impulsive component. A meta-analysis of YFAS food addiction studies in 2014 found a 20% prevalence of food addiction in the adult population tested (Pursey et al., 2014). The prevalence of it was twice as high in overweight people. Food addiction was also more prevalent in adults over 35 and – what is interesting for the scope of our study – women were more affected than men.

As for the other two addiction items that we included as items in our survey, consistent findings are lacking on whether the risks of developing those addictions vary across genders (see, e.g., the survey in Chen C. et al., 2017). However, when disentangling specific behaviors, gender differences emerge. Toda et al. (2006) found a higher potential for females to become addicted to online services. For example, in the context of *smartphones*, research indicates that the risk of addiction is higher for females (Walsh et al., 2011; Hong et al., 2012). Conversely, males have been detected to be more likely to be addicted to *videogames* than females (Bianchi and Phillips, 2005; Wittek et al., 2016), with young adult males being at the greatest risk for videogames (King et al., 2012).

In our study, we focus on the psychological determinants of the increase in these three non-creative activities (i.e., potentially addictive behaviors) because of the COVID-19 lockdown, and look for gender effects, assuming – in line with the above-mentioned psychological literature – that food consumption and smartphone usage are non-creative activities to which women are more prone than men (i.e., female-oriented), and that videogame play is a non-creative activity to which men are more prone than women (i.e., male-oriented).

Several studies have tried to identify the main psychological drivers for the three aforementioned potentially addictive behaviors (see section “Research Hypotheses”). However, research on gender differences on these psychological determinants remains scarce. Our study aims at filling this gap by analyzing the increase in these non-creative activities due to the COVID-19 lockdown, detecting possible correlations between gender-related potentially addictive behaviors and associated negative emotions. As for the latter, we consider several negative emotional states – sadness, discouragement, nervousness, boredom, emptiness, and stress –, relating them to the COVID-19 lockdown and the increase in non-creative activities run at home because of this lockdown. Our results support the intuition that the same negative emotion induced by COVID-19 side-effects could lead to different potentially addictive behaviors; this difference is explained by the interplay between different gender's sensitivities to such emotion and different gender's preferences for specific non-creative activities.

The remaining part of this article is structured as follows. Section “Research Hypotheses” introduces our research

¹Source: France Télévisions, LCI, Population, March 28, 2020: www.lci.fr/population/confinement-et-coronavirus-les-violences-conjugales-en-hausse-de-plus-de-30-l-interieur-propose-de-donner-l-alerte-dans-des-pharmacies-2149240.html.

²As for, e.g., Italy, see: Più Europa, April 22, 2020: www.pieueuropa.eu/2020/04/22/COVID-19-violenza-domestica-e-risposta-internazionale.

hypotheses, relying on the previous literature on the psychology of addiction and emotions. Section “Methodology” presents the data and the methodology followed. Section “Results” presents the main results in light of the hypotheses introduced in the section “Research Hypotheses.” Section “Discussion and Conclusion” discusses the results and concludes.

RESEARCH HYPOTHESES

In this section, we elaborate on the hypotheses we want to test about the impact of the COVID-19 lockdown on potentially addictive behaviors of women and men, by looking at the driving (negative) emotions of this impact. We are interested in potential addictions to food consumption, smartphone usage, and videogame play.

The phenomenon of *addiction* is commonly known in modern society. Yet, since it deals with a wide range of behaviors, there are many ways to characterize it.³ The definition we apply in our study is suggested in a publication on models of addiction prepared by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), where addiction is defined as “a repeated powerful motivation to engage in a purposeful behavior that has no survival value, acquired as a result of engaging in that behavior, with significant potential for unintended harm” (West, 2013). Here the emphasis can be put on the word “harm,” since any behavior can be seen as potentially addictive, e.g., gardening. However, to justify academic or medical usage of this term, the feature of negative consequences must be present (Griffiths, 2005).

There are two main types of addictions: substance addiction and non-substance or *behavioral addiction*. The latter is a relatively new concept, as only in 2010 this term was included in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as the official classification of psychiatric diagnoses (Derevensky et al., 2019). Several behaviors can be referred to as potentially addictive. For example, gambling (Griffiths, 1995), sex (Carnes, 2001), exercise (Terry et al., 2004), eating (Pelchat, 2009), overeating (Orford, 2001), Internet usage (Griffiths, 2000), and videogame play (Griffiths, 2002). There are certain distinctions between behavioral addiction and traditional substance addiction in terms of their development, effects, and treatment. However, the way they can be generally defined is remarkably similar. Behavioral addiction shares “the most evident characteristic of addiction, i.e., continuous substance intake (addictive behavior) despite negative consequences, which is associated with craving and lack of control” (Albrecht et al., 2007).

As anticipated in the Introduction, ours is not a study of substance addiction driven by the lockdown. We rather focus on non-substance addictions, namely potential addictions to non-creative activities as food, smartphone, and videogames. The

reason for this focus is due to the nature itself of the COVID-19 lockdown: due to the prolonged confinement at home, behavioral addictions to everyday objects and needs would suddenly emerge. And given that our survey was carried out during the 2nd week of the first COVID-19 lockdown in France, we thought that the first potentially addictive behaviors emerging would not concern drugs or medicines but rather more “familiar” habits, which home confinement would have easily offered.

More precisely, relying on Scitovsky (1992) psychological notion of “*comfort*” as opposed to the one of “*novelty*,”⁴ we define “*comfort*” as setting arousal at its optimum level, i.e., comfort implies “behavior that satisfies various bodily and mental needs and so lowers arousal that is too high; it also includes behavior which combats boredom and so raises arousal that is too low.” Comforts can be viewed as products that relieve pain, “fatigue, eliminate bother and save time” (Scitovsky, 1992: 59–61, 112–113). Sticking to the habits is another type of comfort. An immediate reward (reduction in arousal) followed by any action reinforces this action and consequently forms a habit. Once the habit is formed one continues to follow it not so much for the rewarding effect of the action itself, but mainly for avoiding the discomfort associated with interrupting it. This cycle resembles the one related to harmful addictions. Scitovsky sees harmful addictions as one of the types of habits (Scitovsky, 1992).

The bias for comfort and against novelty appears to be due to the lack of training in the skill of consumption. Eating, interacting with a smartphone, playing videogames are all activities that do not require special skills, as compared to e.g., reading a book, which is a more creative activity.⁵ A bigger variety of consumption skills provides a consumer with a wider range of sources of stimulation. In other words, a skilled consumer is capable to enjoy more creative activities, due to his/her intrinsic motivation (Attanasi et al., 2021). Failure to experience pleasure from creative activities can explain why people are engaging in harmful and addictive ones, which also give them certain stimulation without any required skills for that (Scitovsky, 1992).

⁴“Novelty,” as opposed to comfort, refers to a source of pleasure that comes from resolving the challenge. The more challenging is the problem the more pleasant and enjoyable is the stimulating effect of the novelty, provided it remains resolvable for a person. The evidence from psychological experiments suggests that novelty has a more powerful stimulating effect when it is accompanied by surprise, conflict, incongruity, and divergence between what is expected and what is experienced. From the point of view of motivation, novelty can be seen as a “desire to know the unknown.” Creative activities are referred to as novelty. Novelty also implies uncertainty, as the resolution of the problem cannot be known in advance. For novelty it is the acquisition of related knowledge and experience that enable us to enjoy it, i.e., “the consumption of novelty is a skilled consumption” (Scitovsky, 1992: 11, Ch.3).

⁵As for food, we acknowledge that food preparation and food consumption “rituals,” when people are forced to spend most of their time in the house (under lockdown), could be taken into account as “creative” food-related activities. However, although these food-related activities potentially function as a creative activity to relieve stress, negative effects of COVID-19-induced stress on planning, selecting, and preparing foods can also be expected (see De Backer et al., 2020). Nonetheless, we highlight that the analysis of these opposite effects is out of the scope of this article: the focus of our research is on the mere non-creative part of food consumption (overeating, i.e., losing control of one’s own usual diet).

³The term “addiction” itself is not always used. For instance, World Health Organization in the 1960s substituted it with the word “dependence” (at least for the case of substance abuse), which is more applicable for various degrees of severity. However, it is still quite common for both professionals and the public to apply the term “addiction.” This paper will consider and use both terms as synonyms.

The association between activities that do not require special skills, i.e., non-creative activities, and the formation of habits during the COVID-19 lockdown leads to our first research hypothesis, which relies on the intuition that, due to the huge amount of time spent at home during the 1st weeks of the lockdown, people have looked for comfort by enhancing the risk of potential addictions to non-creative activities.

Hypothesis 1 [Non-creative activities]: *COVID-19 lockdown has enhanced non-creative activities (food consumption, smartphone usage, and videogame play).*

The second research hypothesis comes from the observation that the three non-creative activities on which our study focuses – food, smartphone, and videogames –, are at the base of specific potential addictions that usually vary across genders, as the psychological literature discussed in the Introduction highlights. Relying again on Scitovsky's (1992) link between a search for comfort and addiction to non-creative activities, it seems natural to take on each gender “specializing” during the lockdown on their more frequent non-creative activity before the lockdown. More precisely, we hypothesize that the abrupt COVID-19 lockdown has led people to relieve pain and find comfort by sticking to their habits, thereby boosting gender differences in non-creative activities, with women increasing more than men food and smartphone consumption – which were already female-based activities –, and men increasing more than women videogame play – which was already a male-based activity.

Hypothesis 2 [Gender difference in non-creative activities]: *COVID-19 lockdown has enhanced more gender-related non-creative activities, with females (resp., males) increasing food and smartphone (resp., videogames) consumption more than male (resp., female).*

Our third research hypothesis focuses on the emotional drivers of the three aforementioned potentially addictive behaviors. Our main theoretical reference is Loewenstein (1999), who sees “visceral factors” (drive states such as hunger, thirst, sexual desire, emotions, etc.) playing the leading role in determining behavior. Therefore, emotions are a main defining feature of potentially addictive behavior, as the psychological literature has shown for eating loss of control, smartphone usage increase, videogame play increase.

As for food consumption, research in emotional drivers of eating is plentiful (see Canetti et al., 2002 for a survey). Mehrabian (1980) found that higher food consumption was reported during boredom, depression, and fatigue, and lower food intake was reported during fear, tension, and pain. Lyman (1982) showed a greater tendency to consume healthy food during positive emotions and a greater tendency to consume junk food during negative emotions. Patel and Schlundt (2001) found that meals eaten in positive and negative moods were significantly larger than meals eaten in a neutral mood. Macht (1999) detected higher levels of hunger during anger and joy than during fear and sadness, with anger linked to an increase of impulsive eating and joy linked to an increase of hedonic eating.

As for smartphone usage, Chen B. et al. (2017) identified associations between smartphone usage, psycho-behavioral

factors, and smartphone addiction, and showed that the associations differ between males and females. Mediation of specific negative emotions in smartphone addiction has been documented. In particular, a plethora of studies reports a strong boredom-smartphone interaction (e.g., Matic et al., 2015; Elhai et al., 2018; Leung, 2020) and an equally strong stress-smartphone interaction (e.g., Wang et al., 2015; Samaha and Hawi, 2016; Vahedi and Saiphoo, 2018), and emptiness has been detected as mediating the association between pathological narcissism and problematic smartphone use (Zerach, 2021).

As for videogame play, recent psychological studies have found associations with both positive mental states (e.g., Villani et al., 2018) and negative mental states (e.g., Gibbons and Bouldin, 2019). Among the latter studies, Loton et al. (2016) have documented a significant relationship between videogame addiction and symptoms of depression, anxiety, and stress.

With all the above, we elaborate our third research hypothesis on the effect of overcoming negative emotions in undertaking potentially addictive behaviors, separately for each non-creative activity – food, smartphone, and videogames – and for each negative emotion included in our survey – sadness, discouragement, nervousness, boredom, emptiness and stress.

Hypothesis 3 [Emotional mediation in non-creative activities]: *Potentially addictive behaviors are more likely to occur for subjects with negative emotions, and especially for those who tend to overcome them with the help of non-creative activities.*

Our last hypothesis starts from the consideration that the COVID-19 pandemic has caused significant effects on our mental health and that these effects have been different for different genders and different gender-related emotions. In this regard, Guadagni et al. (2020) report that the COVID-19 pandemic in Canada has affected women differently than it has affected men: women reported more sleep troubles, more symptoms of anxiety and depression, and greater empathy for others. In the same vein, García-Fernández et al. (2021) assess that during the 1st weeks of the COVID-19 lockdown in Spain, women presented greater severity in symptoms of anxiety, depression, and acute stress. Ausín et al. (2021) confirm gender-related differences in the psychological impact of confinement in Spain, with COVID-19 having a greater psychological impact on women than men.

Other studies provide support to gender differences in the increase of negative emotions due to COVID-19 sudden health and lifestyle changes (Ahuja et al., 2020; Galasso et al., 2020; García-Fernández et al., 2021; Shockley et al., 2020; Bernabe-Valero et al., 2021; Kidd et al., 2021), although they do not provide a final say on which specific emotion women are more affected than men, and whether the gender difference is driven by that specific emotion or by the fixed effect of a mental state degraded by COVID-19 side-effects. Furthermore, like those of Guadagni et al. (2020) and Ausín et al. (2021), these studies focus on at least one of the emotions we included in our survey, although none of them analyze gender effects on sadness, discouragement, nervousness, boredom, emptiness, and stress within the same survey. With this, we formulate our last hypothesis.

Hypothesis 4 [Gender differences in emotional mediation]: The negative emotions driving gender-related potentially addictive behaviors are themselves gender-related.

This last hypothesis aims at detecting whether women's (resp., men's) specific potentially addictive behavior is correlated with specific female-related (resp., male-related) negative mental states due to the COVID-19 lockdown, or whether gender-related specific potentially addictive behavior is independent of gender-related emotions.

The next section describes how the survey was designed and implemented, to obtain the data used to test our four research hypotheses.

METHODOLOGY

Our survey was conducted during the 2nd week of the spring lockdown of 2020 in France, namely between March 24th and March 31st, 2020. The questionnaire was designed by two of the paper authors within the Addictology Unit of University Hospital of Nice during the 1st week of the lockdown. More precisely, the base of the questionnaire was represented by the same questionnaire that patients of the Addictology Unit of the Archet Hospital in Nice are asked to fill in since 2016, i.e., since Faredj Cherikh, one of the paper authors, is Head of this Unit. That questionnaire is meant to screen for addictive behaviors during everyday life. This is the first time that this questionnaire has been administered to a general population. Some of the questionnaire items were adapted in order to detect lockdown side-effects. Other questions related to lockdown side effects were added.

The questionnaire was distributed through social media in France during the 2nd week of the lockdown. More precisely, the online survey was mainly shared *via* Facebook, since at the time of the survey it was the social media with the highest market share in France (58.7%).⁶ The survey, conducted in French and taking less than 10 min on average, was open to any adult person undergoing lockdown in France. The population of the study was unspecific. 1,087 individuals replied to the questionnaires within the first 7 days of online sharing of the questionnaire.

The questionnaire contained questions about experiencing various emotional states and performing different potentially addictive behaviors. The questionnaire on which the survey relied was made of four families of items: *socio-demographics*, *emotional states*, *non-creative activities*, and *potentially addictive behaviors*. For emotional states, our questionnaire includes two types of items: emotions elicited without relating them to specific behavior (*unconditional*: sadness, discouragement, and nervousness) and emotions elicited conditionally to the (non-creative) activity – web, food, and videogame consumption – aimed at managing them (*conditional*: boredom, emptiness, and stress).

Table 1 presents summary statistics of the selected variables, while the detailed description of these variables can be found in

TABLE 1 | Summary statistics of selected variables.

	Obs.	Type	Mean	SD	Min	Max
Socio-demographics						
Female	1.087	D	0.75	0.44	0	1
Age 1 (18–35)	1.087	D	0.64	0.48	0	1
Age 2 (36–55)	1.087	D	0.28	0.45	0	1
Age 3 (56–75)	1.087	D	0.07	0.26	0	1
Age 4 (>75)	1.087	D	0.01	0.06	0	1
Health 0 (good)	1.087	D	0.77	0.42	0	1
Health – 1 (pathologies)	1.087	D	–0.21	0.41	0	1
Health – 2 (serious pathologies)	1.087	D	–0.02	0.13	0	1
Lockdown period 1 (<1 week)	1.085	D	0.11	0.31	0	1
Lockdown period 2 (1–2 weeks)	1.085	D	0.81	0.39	0	1
Lockdown period 3 (2–3 weeks)	1.085	D	0.08	0.28	0	1
Employed	1.085	D	0.48	0.50	0	1
Stay at home	1.085	D	0.75	0.43	0	1
In relationship	1.087	D	0.79	0.41	0	1
Children	1.086	D	0.37	0.48	0	1
Physical activity 0	1.086	D	0.31	0.46	0	1
Physical activity 1 (infrequent)	1.086	D	0.42	0.49	0	1
Physical activity 2 (frequent)	1.086	D	0.27	0.45	0	1
Emotional states						
Boredom food	1.086	D	0.43	0.50	0	1
Boredom web	1.086	D	0.79	0.40	0	1
Boredom videogame	1.086	D	0.30	0.46	0	1
Emptiness food	1.086	D	0.37	0.48	0	1
Emptiness web	1.086	D	0.66	0.47	0	1
Emptiness videogame	1.086	D	0.24	0.43	0	1
Stress food	1.084	D	0.37	0.48	0	1
Stress web	1.085	D	0.45	0.50	0	1
Stress videogame	1.085	D	0.19	0.39	0	1
Sadness	1.082	D	0.22	0.42	0	1
Discouragement	1.082	D	0.37	0.48	0	1
Nervousness	1.079	D	0.45	0.50	0	1
Non-creative activities						
Smartphone sms-calls	1.078	D	0.88	0.32	0	1
Smartphone soc-network	1.078	D	0.89	0.31	0	1
Smartphone games	1.078	D	0.41	0.49	0	1
Videogame play	1.083	D	0.45	0.50	0	1
Potentially addictive behaviors						
Eating loss of control	1.085	D	0.26	0.44	0	1
Smartphone usage increase	1.084	D	0.88	0.32	0	1
Videogame play increase	1.083		1.18	1.35	0	3

Supplementary Appendix Table A1. Supplementary Appendix B reports the English translation of the questionnaire.⁷

As for subjects' idiosyncratic features, the sample is gender skewed: 74.7% of respondents were female. Although female

⁶Source Statcounter Global Stats (see <https://gs.statcounter.com/social-media-stats/all/france>): Twitter had the second-highest market share with 13.84% only.

⁷The original questionnaire is in French. In **Supplementary Appendix B**, we report the English translation. The French version is available from the authors upon request.

subjects in the survey period were majoritarian both in the French adult population⁸ and in the French Facebook adult users⁹ during the period of our survey, this does not fully explain the fact that three out of four subjects of our survey respondents were female. The fact that women are more likely to participate in surveys than men is well documented in the literature (see Curtin et al., 2000; Moore and Tarnai, 2002, and Singer et al., 2000 for traditional modes of survey administration, and Smith, 2008 for online surveys). Our guess is that, when receiving our survey invitation for evaluating the impact of the lockdown on the state of psychological health, females participated more than males due to their worse psychological health during the lockdown – which we will document in the section “Results” –, which implied a higher willingness to report it. However, given that the fraction of male responders was high enough (275 subjects), we are confident that results of non-parametric tests of gender differences and odds ratios of gender dummy variables in the regression models in the section “Results” should not depend on the high number of female respondents in our sample.

As for age, the prevailing age ranges correspond to younger generations: 64.49% of our respondents belonged to the 18–35 age group (dummy “Age 1”), 27.87% to the 36–55 age group (dummy “Age 2”), 7.27% to the 56–75 age group (dummy “Age 3”), and the remaining 0.37% were older than 75 (dummy “Age 4”). In the data analysis of section “Results” we will pool Age 3 and Age 4 in a single dummy Age 3–4 because of the negligible number of subjects in the latter category. We acknowledge that our sample is not representative of the wider French population as for age distribution.¹⁰ However, our age distribution is quite representative of social media users in France:¹¹ the significantly higher share of young respondents in our sample is in line with studies showing that younger subjects are more willing to participate in app-based surveys (see, e.g., Mulder and de Bruijne, 2019).

As for the remaining socio-demographic variables, most respondents reported being in a relationship (79%) and being in a good health condition with no pathology (77%, dummy “Health 0”) at the beginning of the lockdown. As expected, given the lockdown restrictions, subjects in our sample mainly stayed at home during the 1st 2 weeks of the lockdown, except for those who had a job outside (25%). The sample is balanced as far as the employment rate is concerned: 48% of people had a job. Some of them were working at home while others were still

working outside homes during the lockdown. Physical activity during the lockdown was smoothly distributed across no activity (31%, dummy “Physical activity 0”), infrequent activity (42%, dummy “Physical activity 0”), and frequent activity (27%, dummy “Physical activity 2”). The modal lockdown period was between 1 and 2 weeks (dummy “Lockdown period 2”).

As far as emotional state variables are concerned, the questionnaire includes two types of items. First, three items that elicit experiencing given emotions – sadness, discouragement, and nervousness – without relating them to specific addictive behavior. Second, three blocks of symmetric items, each of them eliciting the way the respondent managed three other emotions – boredom, emptiness, and stress – through specific non-creative activities. The three blocks refer, respectively to food, internet, and videogame consumption.

The questionnaire also includes three items detailing smartphone dependence, disentangling it among (i) SMS and calls, (ii) social networks, and (iii) games, identified as the main reasons for smartphone usage during the lockdown. These variables capture behavioral levels during the lockdown. The remaining items of addictive behavior linked to alcohol and medicine consumption are not analyzed in our study, since a negligible number of respondents (less than 7% on average over all these items) indicated alcohol or medicine consumption. As anticipated in the Introduction, this was expected, since our survey was run after only 1–2 weeks from the beginning of the lockdown, hence new addiction to alcohol and/or medicines due to the lockdown was unlikely, apart from those subjects already being addicted to alcohol and/or medicine consumption before the lockdown. Our study focuses instead on lighter forms of potential addictions that characterize a “normal” lifestyle – food, smartphones, and videogames. Emerging after less than 1 month of lockdown, these behaviors might become dangerous in the medium-long term – e.g., obesity, muscle pain, social isolation, mood swings, and decreased ideation. These “potentially addictive behaviors” variables capture changes in behavior during the lockdown as compared to the pre-lockdown levels. More precisely, for food consumption we focus on the dummy variable “Eating loss of control,” and for smartphone consumption, we focus on the dummy variable “Smartphone usage increase,” both stated with respect to the pre-lockdown period. For videogame consumption, we focus on the categorical variable “Videogame play increase,” with 0 indicating no activity, 1 indicating decreased activity, 2 indicating stable activity, and 3 indicating increased activity with respect to the pre-lockdown period. Here we assume that subjects declaring that they were not playing videogames during the lockdown were not playing them either before the lockdown (otherwise, they would have indicated decreased or stable activity). This is consistent with statistics on the wider French population: around 45% of our sample reported no videogame activity compared to 48% of French not playing videogames regularly and 39% of them not playing videogames at all.¹²

⁸52.29 females vs. 47.71% males: source INSEE – National Institute of Statistics and Economic Studies (see <https://www.insee.fr/fr/statistiques/2381474>).

⁹51.15 females vs. 48.85% males: source NapoleonCat (see <https://napoleoncat.com/stats/facebook-users-in-france/2020/03/>).

¹⁰Starting from official data from INSEE in the period of our survey (<https://www.insee.fr/fr/statistiques/2381474>) and restricting the official statistics to French citizens aged more than 18, we find an age distribution more skewed to the right (28.41% aged 18–35, 31.04% aged 36–55, 28.99% aged 56–75, 11.56% aged more than 75) than ours (respectively: 64.49, 27.87, 7.27, and 0.37%).

¹¹Weighting the age distribution of French population in 2020 by the age distribution of Facebook users in France in the same period of our survey (March 2020: see <https://napoleoncat.com/stats/facebook-users-in-france/2020/03/>), Facebook French users’ age distribution becomes 46.14% aged 18–35, 35.18% aged 36–55, 14.51% aged 56–75, 4.18% aged more than 75. This distribution is very close to the age distribution of our sample (respectively: 64.49, 27.87, 7.27, and 0.37%), which mirrors the rank of age categories of social media users in France.

¹²Source: SELL (Syndicat des Editeurs de Logiciels de Loisirs), “L’Essentiel du Jeu Vidéo: Les Français et le Jeu Vidéo” (https://www.sell.fr/sites/default/files/essentiel-jeu-video/ejv_novembre_2020_def_web-comprime_0.pdf).

RESULTS

Summary statistics reported in the last section of **Table 1** (“Potentially addictive behaviors”) provide **strong support for Hypothesis 1** as for the significant increase in non-creative activities during the 1st week of COVID-19 lockdown. In fact, after only a few weeks of lockdown: 26% of our sample felt like losing control of their usual diet; 88% of the sample started to use the smartphone more respect to the pre-lockdown period; 64% of those playing videogames reported increased activity respect to the pre-lockdown period, this fraction being significantly higher than the one of those reporting a stable activity (33%) or a decreased activity (3%) consider together, according to a Chi-square test of differences in proportions (p -value < 0.001).

The central section of **Table 1** provides **first support for Hypothesis 3** on increase in non-creative activities being driven by specific negative emotions. Focusing only on boredom, emptiness, and stress, the weight of these three negative emotions seems to be similar for web, food, and videogame consumption, with *boredom*, always being the modal negative emotion that each of the three above-mentioned non-creative activities aims at mitigating. However, while for web and videogame consumption the relative weight of boredom (resp., 41 and 41%) is significantly higher than the one of emptiness (resp., 35 and 33%) and the one of stress (resp., 24 and 26%), for food consumption the three negative emotions have similar relative weights (36% boredom, 32% emptiness, 32% stress). Furthermore, inverting the direction of the analysis by moving from specific emotions to specific non-creative activities, the fraction of respondents managing boredom with web (79%) is significantly higher than the one of those managing boredom with food (43%) or videogame (30%) consumption (Kruskal–Wallis test of differences in distributions, p -value < 0.001). A similar result is found for emptiness and stress, with the fraction of those who managed it with web (resp., 66 and 45%) being significantly higher than the one of those managing it with food (resp., 47 and 37%) or videogame (resp., 24 and 19%) consumption (Kruskal–Wallis test of differences in distributions, p -value < 0.001). Therefore, boredom seems to be the leading negative emotion for non-creative activities during the 1st weeks of lockdown. However, the role of other negative emotions like sadness, discouragement, and nervousness cannot be assessed by looking at the statistics in **Table 1**. The regression analysis in the sections “Eating Loss of Control,” “Smartphone Usage Increase,” and “Videogame Play Increase” will help clarify the relative weight of these other three emotions on the lockdown-related increase in the three non-creative activities we are interested in in this study.

Table 2 reports the results of Mann–Whitney tests on the difference in the medians of the distributions of each variable of **Table 1**, disentangling by female vs. male. Variables for which there is a significant gender difference in favor of the female (resp., male) side are in bold (resp., *Italic*) fonts.

As for socio-demographic variables, we see that in our sample female respondents are significantly older than male ones. Furthermore, significantly more female than male respondents are at home with their partner and/or their children. In the test of Hypotheses 1–4, we will check that none of these three

TABLE 2 | Gender differences in idiosyncratic features, emotional states, and behavior.

	Female	Male	p -value
Socio-demographics			
Age (1 to 4)	1.46 (0.23)	1.36 (0.35)	0.04**
Health (−2 to 0)	−0.25 (0.02)	−0.25 (0.03)	0.90
Lockdown period (1 to 3)	0.97 (0.02)	0.99 (0.03)	0.50
Employed	0.48 (0.02)	0.47 (0.03)	0.77
Stay at home	0.75 (0.02)	0.77 (0.03)	0.43
Living with partner	0.81 (0.02)	0.72 (0.03)	0.00***
Living with children	0.40 (0.02)	0.28 (0.03)	0.00***
Physical activity (0 to 2)	0.97 (0.03)	0.92 (0.05)	0.36
Emotional states			
Boredom food	0.43 (0.02)	0.43 (0.03)	0.92
Boredom web	0.78 (0.01)	0.84 (0.02)	0.03**
Boredom videogames	0.22 (0.01)	0.55 (0.03)	0.00***
Emptiness food	0.38 (0.02)	0.32 (0.03)	0.09*
Emptiness web	0.66 (0.02)	0.68 (0.03)	0.57
Emptiness videogames	0.16 (0.01)	0.47 (0.03)	0.00***
Stress food	0.39 (0.02)	0.32 (0.03)	0.03**
Stress web	0.44 (0.02)	0.47 (0.03)	0.31
Stress videogames	0.13 (0.01)	0.37 (0.03)	0.00***
Sadness	0.24 (0.02)	0.18 (0.03)	0.03**
Discouragement	0.40 (0.02)	0.28 (0.03)	0.00***
Nervousness	0.49 (0.02)	0.32 (0.03)	0.00***
Non-creative activities			
Smartphone smscalls	0.90 (0.01)	0.81 (0.02)	0.00***
Smartphone socnetwork	0.89 (0.01)	0.90 (0.02)	0.73
Smartphone games	0.39 (0.02)	0.44 (0.03)	0.11
Videogame play	0.37 (0.02)	0.71 (0.03)	0.00***
Potentially addictive behaviors			
Eating loss of control	0.29 (0.02)	0.19 (0.02)	0.00***
Smartphone usage increase	0.90 (0.01)	0.83 (0.02)	0.00***
Videogame play increase	1.89 (0.08)	0.94 (0.05)	0.00***

Results of Mann–Whitney test; * p -value < 0.1, ** p -value < 0.05, and *** p -value < 0.01.

socio-demographic variables (age, living with a partner, or with children) have a significant impact on potentially addictive behaviors, to assess that our results are not driven by socio-demographic sample bias.

The gender differences systematically detected as for emotional states variables in the central section of **Table 2** provide **first support for Hypothesis 4**. Women show significantly higher sensitivity than men to unconditional emotions sadness (at the 5% level), discouragement, and nervousness (at the 1% level). Therefore, when sensitivity to negative emotions is elicited without relating them to specific addictive behavior – namely, sadness, discouragement, and nervousness – women disclose a higher sensitivity, thereby showing a more problematic psychological condition during the 1st week of the lockdown. Conversely, men show significantly higher sensitivity than

women to boredom, emptiness, and stress, on average over the three non-creative activities they are aimed at managing (61 vs. 48% for boredom, 49 vs. 40% for emptiness, and 39 vs. 32% for stress, all differences being significant at the 1% level according to a Chi-square test of differences in proportions). Furthermore, disentangling these three negative emotions by the non-creative activity they are aimed at managing, men are more sensitive to all of them when they are related to videogame consumption, while women are more sensitive to two out of these three emotions (emptiness and stress) when related to food consumption. We interpret this as the first proof that the same negative emotion could lead to different potentially addictive behaviors; this difference is explained by the interplay between different gender's sensitivities to these emotions and preferences for non-creative activities.

Finally, looking at the last section of **Table 2**, gender differences detected in the “potentially addictive behaviors” variables provide **first support for Hypothesis 2**. As predicted, women disclose a higher loss of control of food consumption and a higher increase of smartphone usage. Conversely, and again in line with Hypothesis 2, we detect a significantly higher median in males' responses to the “Videogame activity increase” question (0 = no; 1 = decreased; 2 = stable; and 3 = increased activity), suggesting a higher increase in videogame play during the lockdown for males than for females. However, as we will see in the section “Videogame Play Increase,” the latter result is driven by the fixed effect of males playing videogames more than females regardless of the lockdown.

In the next three subsections, we separately test Hypotheses 2 and 3 on each of the three potentially addictive behaviors. More precisely, we present and discuss regression results starting from the problem of overeating (Section “Eating Loss of Control”) and then analyzing smartphone dependence (Section “Smartphone Usage Increase”); the final three regression analyses are dedicated to video gaming (Section “Videogame Play Increase”). Section “Gender-Related Potentially Addictive Behaviors and Gender-Related Emotions” discusses the combination of results of the previous three subsections to test Hypothesis 4.

Eating Loss of Control

“Eating loss of control” is a binary dependent variable [from the questionnaire in **Supplementary Appendix B**): “I feel like I am losing control of my usual diet,” with a “Yes” (1) or “No” (0) answer]. Thus, a logit regression model is used to study the effect of gender (Hypothesis 2) and emotional states (Hypothesis 3) on food overeating. **Table 3** provides the estimation results for the logit regression. We interpret the odds ratios of statistically significant variables only. For all these dummy variables, odds ratios greater (resp., smaller) than 1 indicate that those who responded “1” are more (resp., less) likely to lose control over food consumption.

As for gender, the odds of losing control over food if a person was identified as female was 1.571 times more than of males: women were more likely to lose control overeating than men. Furthermore, the former ones were more likely to develop this potentially addictive behavior if they were working outside the home during the lockdown (odds ratio of “Stay at home”:

TABLE 3 | Logistic regression on eating loss of control.

	Odds ratios	Std. Err.
Female	1.571**	(0.315)
Age 2	1.375	(0.286)
Age 3–4	0.735	(0.276)
Health – 1	0.910	(0.183)
Health – 2	0.919	(0.568)
Lockdown period 1	1.449	(0.400)
Lockdown period 2	1.812	(0.688)
Employed	0.919	(0.197)
Stay at home	0.560**	(0.133)
In relationship	0.659**	(0.132)
Children	0.992	(0.189)
Physical activity 1	1.266	(0.237)
Physical activity 2	0.850	(0.188)
Boredom food	2.012***	(0.408)
Emptiness food	1.813***	(0.380)
Stress food	2.449***	(0.488)
Sadness	2.275***	(0.458)
Discouragement	1.669***	(0.301)
Nervousness	1.085	(0.194)
Cons	0.076***	(0.033)
Observations	1,065	
LR chi ² (15)	244.65	
Prob > chi ²	0.0000	
Pseudo R ²	0.1994	

Odds ratios are reported: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

0.560) and/or if they were not living with a partner during the lockdown (odds ratio of “Living with partner”: 0.659). Therefore, an increase in food consumption was more likely to be developed by women continuing to work outside the home and not having a partner when coming back home after work. All this provides **strong support to Hypothesis 2**.

As for emotional states, all odds ratios of negative emotions are greater than 1, and all but one emotional state variable (nervousness) are significant. Negative emotions which are managed with the help of food consumption all present odds ratios significantly greater than 1: the odds of “Eating loss of control” if a person reported to manage boredom, emptiness, or stress with the help of the food were 2.012, 1.813, and 2.449, respectively, i.e., such a person was more likely to increase food consumption during the lockdown compared to the one who did not report to manage emotions in this way. Furthermore, respondents being sad most of the time (odds ratio 2.275) and/or having a feeling of discouragement about the future (odds ratio 1.669) were more likely to have overeating problems. All this provides **strong support to Hypothesis 3**.

Smartphone Usage Increase

As in the previous model, our dependent variable – “Smartphone usage increase” – is binary (from the questionnaire in **Supplementary Appendix B**): “Do you use your smartphone more?” with a “Yes” (1) or “No” (0) answer). Results of the logistic

regression are presented in **Table 4**. Again, we interpret the odds ratios of statistically significant variables only.

As for gender, the odds of smartphone usage increase for female respondents are 2.253 times higher than for male respondents: women were more likely to increase smartphone usage than men during the lockdown compared to pre-lockdown levels. Furthermore, the former ones were more likely (resp., less likely) to develop this addictive behavior if the smartphone was used for web connection in social networks (resp., the traditional role of sending SMS and making calls). The odds ratio for “Smartphone SMS-calls” is smaller than 1 (0.346), which means that people who used smartphones mainly for phone calls and SMS were less likely to enhance their smartphone dependence. At the same time, the odds of the use of smartphones increase if a person uses a smartphone for social networks were 3.849 times more than those of the ones who did not. All this provides **strong support to Hypothesis 2**.

Given the significant positive impact of web connection to social networks on smartphone usage increase, when looking at the role of negative emotions that are managed with non-creative activities, we consider those that are managed with connection to the web. We find that boredom, stress, and emptiness managed with connection to the web all have odds

ratios greater than 1. However, the positive impact on the increase of smartphone usage is significant for boredom (odds ratio 2.320) and stress (odds ratio 1.783), but not for emptiness. Furthermore, among the three negative emotions elicited independently from a specific non-creative activity – sadness, discouragement, and nervousness –, only the latter has an odds ratio significantly greater than 1 (1.814). Hence, respondents feeling nervous and restless more easily than usual were more likely to increase smartphone usage as compared to pre-lockdown levels, while this was not true for those being sad most of the time and/or having a feeling of discouragement about the future. With this, we can state that **Hypothesis 3 is only partially confirmed**.

Videogame Play Increase

Here, we rely on the categorical variable “Videogame play increase” (from the questionnaire in **Supplementary Appendix B**), where respondents have been asked to indicate one out of no activity (“I do not play,” 0), decreased activity (“I spend less time,” 1), stable activity (“My usage is stable, 2”), or increased activity (“I spend more time,” 3) as for videogame play during the lockdown, in comparison to the pre-lockdown activity (see **Supplementary Appendix Table A1**).

To begin the analysis, we transform the categorical variable “Videogame play increase” of **Table 1** and **Supplementary Appendix Table A1** into a dummy variable which only accounts for increased vs. non-increased videogame play due to the lockdown: value 1 for increased activity and value 0 for decreased, stable or no activity during the lockdown. With this, in **Table 5**, we run for “Videogame Play Increase” dummy the same logit regression analysis as for the other two potentially addictive behaviors assessed as behavioral increases with respect to the pre-lockdown levels (Sections “Eating Loss of Control” and “Smartphone Usage Increase”).

This time for perception convenience **Table 5** presents coefficients rather than odds ratios. This is made to allow a clean comparison between this model and the multinomial logistic regression models in **Tables 6A,B**, which account for the categorical nature of the original variable “Videogame play increase.” Coefficients can be interpreted in the following way: for each predictor, the regression slope is the predicted change in the log odds of falling into the group with increased videogame activity (as compared to the reference group of non-increased activity) per one unit increase on the predictor, holding all other predictors constant.

Results in **Table 5** show that the coefficient for the female gender is – as predicted – negative, although not significant (p -value = 0.119). This suggests that increased videogame play during the lockdown was negatively related to female gender, but not significantly so. It was instead significantly negatively related to age: the increase in videogame play during the lockdown was significantly higher at lower age levels (less than 35 years old). Moreover, according to the negative and significant coefficient of the “Children” variable, respondents who were at home with their children were less likely to increase videogame play, eventually because they (had to) use their time to take care of their children (see, e.g., Shockley et al., 2020).

TABLE 4 | Logistic regression on smartphone usage increase.

	Odds ratios	Std. Err.
Female	2.253***	(0.538)
Age 2	0.688	(0.184)
Age 3–4	0.857	(0.350)
Health – 1	1.628*	(0.481)
Health – 2	1.340	(0.929)
Lockdown period 1	1.358	(0.465)
Lockdown period 2	1.347	(0.658)
Employed	1.065	(0.286)
Stay at home	1.241	(0.385)
In relationship	0.959	(0.256)
Children	0.878	(0.226)
Physical activity 1	0.852	(0.223)
Physical activity 2	1.065	(0.305)
Boredom web	2.320***	(0.639)
Emptiness web	1.166	(0.325)
Stress web	1.783**	(0.500)
Sadness	0.987	(0.342)
Discouragement	1.186	(0.328)
Nervousness	1.814**	(0.463)
Smartphone sms-calls	0.346**	(0.145)
Smartphone soc-network	3.849***	(1.094)
Smartphone games	1.514*	(0.374)
Cons	0.802	(0.554)
Observations	1,056	
LR χ^2 (18)	123.46	
Prob > χ^2	0.0000	
Pseudo R^2	0.1670	

Odds ratios are reported: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Finally, all coefficients of videogame-conditional emotional states – boredom, emptiness, and stress managed by videogame play – are positive, but only those of boredom and emptiness are significant, i.e., people who tended to manage these two negative emotions by the means of videogames were more likely to incur into potentially addictive videogame behavior. Finally, feeling discouraged significantly increased the likelihood of playing videogames more.

The multinomial logit regressions of **Tables 6A,B** shed further light on why no significant gender difference in favor of males is found as for videogame play increase due to the lockdown. Here we rely on the original four values of the categorical variable “Videogame play increase,” which disentangles subjects who did not play at all videogames during the lockdown – and who were supposedly not playing them also before – from subjects who did not increase their videogame activity during the lockdown. In the latter category, due to their negligible share, we also include subjects who decreased their videogame activity during the lockdown.¹³ The “stable or decreased activity” category (values 1 and 2 pooled, from now on, “stable activity”) is used as baseline category for both “no play” category “0” and for

¹³Since subjects with decreased videogame activity only represent 1.57% of the sample (17 out of 1,083 responses to this question), results of the multinomial logit regression in **Tables 6, 7** are unchanged if we consider these subjects as a separate category, like in the original version of the “Videogame play increase” variable of **Table 1** and **Supplementary Appendix Table A1**. Results of the multinomial logit regression with four separate categories are available upon request to the authors.

TABLE 5 | Logistic regression on videogame play increase.

	Coefficient	Std. Err.
Female	−0.358	(0.229)
Age 2	−0.585**	(0.279)
Age 3–4	−0.784*	(0.440)
Health 1	−0.064	(0.251)
Health 2	−0.051	(0.731)
Lockdown period 1	−0.021	(0.330)
Lockdown period 2	0.282	(0.448)
Employed	−0.203	(0.255)
Stay at home	0.046	(0.296)
In relationship	0.130	(0.249)
Children	−0.463*	(0.244)
Physical activity 1	−0.238	(0.234)
Physical activity 2	0.008	(0.261)
Boredom videogames	2.631***	(0.243)
Emptiness videogames	1.040***	(0.283)
Stress videogames	0.386	(0.298)
Sadness	0.167	(0.272)
Discouragement	0.539**	(0.229)
Nervousness	−0.009	(0.221)
Cons	−2.023	(0.523)
Observations	1,064	
LR chi ² (15)	567.23	
Prob > chi ²	0.0000	
Pseudo R ²	0.4418	

Coefficients are reported: **p* < 0.1, ***p* < 0.05, and ****p* < 0.01.

“increased activity” category “3.” With this, the regression results of **Table 6A** (resp., **Table 6B**) indicate which of the independent variables significantly predict whether a person falls into the “no play” video gaming activity category (resp., increased activity) vs. a baseline category which includes stable activity. In other words, the regression results of **Table 6A** identify the fixed effect of stable playing (baseline) vs. not playing videogames (comparison group) regardless of the lockdown. The regression results of **Table 6B** identify the increase in videogame play (comparison group) due to the lockdown. As in **Table 5**, each regression slope in **Tables 6A,B** is interpreted as the predicted change in log odds of belonging to the comparison group (relative to the baseline group) per unit increase on the predictor.

For the category “0 – no videogame activity,” the coefficient of the Female dummy in **Table 6A** is positive and significant at the 5% level, hence indicating that being a female rather than a male makes more unlikely to play videogames. This represents a fixed effect of males playing videogames more than females regardless of the lockdown, a further confirmation that videogame play is a male-related non-creative activity.

Moreover, all coefficients of videogame-conditional emotional states – boredom, emptiness, and stress managed by videogame play – are negative and significant, i.e., playing rather than not playing videogames is driven by negative emotions managed

TABLE 6A | Multinomial logistic regression on videogame play increase: category “no activity”.

	Coefficient	Std. Err.
Baseline category “stable activity”		
Female	0.555**	(0.247)
Age 2	−0.307	(0.249)
Age 3–4	−0.654*	(0.350)
Health – 1	−0.037	(0.248)
Health – 2	0.630	(0.784)
Lockdown period 1	0.522*	(0.314)
Lockdown period 2	0.599	(0.478)
Employed	0.144	(0.260)
Stay at home	0.313	(0.291)
In relationship	−0.225	(0.255)
Children	0.034	(0.237)
Physical activity 1	−0.003	(0.245)
Physical activity 2	−0.141	(0.264)
Boredom videogames	−2.884***	(0.404)
Emptiness videogames	−2.257***	(0.564)
Stress videogames	−2.355***	(0.562)
Sadness	−0.104	(0.293)
Discouragement	0.162	(0.246)
Nervousness	0.536**	(0.232)
Cons	0.744	(0.510)
Observations	1,064	
LR chi ² (45)	825.03	
Prob > chi ²	0.0000	
Pseudo R ²	0.3922	

Coefficients are reported: **p* < 0.1, ***p* < 0.05, and ****p* < 0.01.

TABLE 6B | Multinomial logistic regression on videogame play increase: category “increased activity”.

	Coefficient	Std. Err.
Baseline category “stable activity”		
Female	−0.154	(0.238)
Age 2	−0.706**	(0.300)
Age 3–4	−1.107**	(0.457)
Health – 1	−0.061	(0.271)
Health – 2	0.095	(0.850)
Lockdown period 1	0.176	(0.342)
Lockdown period 2	0.493	(0.492)
Employed	−0.193	(0.280)
Stay at home	0.108	(0.324)
In relationship	0.078	(0.276)
Children	−0.429	(0.268)
Physical activity 1	−0.254	(0.256)
Physical activity 2	−0.044	(0.290)
Boredom videogames	1.312***	(0.270)
Emptiness videogames	0.558*	(0.295)
Stress videogames	0.094	(0.292)
Sadness	0.142	(0.313)
Discouragement	0.591**	(0.257)
Nervousness	0.218	(0.245)
Cons	−0.523	(0.566)
Observations	1,064	
LR χ^2 (45)	841.92	
Prob > χ^2	0.0000	
Pseudo R^2	0.3801	

Coefficients are reported: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

through this non-creative activity. An effect of opposite sign is found for nervousness: the log-odds of a case falling into the “no play” category (relative to the “stable” category) is predicted to increase by 0.536 units. Feeling discouraged had no significant impact on videogame play.

For the category “3 – increased videogame activity,” the coefficient of the Female dummy in **Table 6B** is – as predicted – negative, but far from being significant, hence confirming the results of **Table 5**: being a female rather than a male does not make more unlikely to increase videogame play during the lockdown. This is clear by comparing the coefficient of the Female dummy in **Table 5** and **Table 6B** (−0.358 and −0.154): the higher absolute value of the coefficient in **Table 5** is due to the fixed effect of males playing videogames more than females regardless of the lockdown detected in **Table 6A**. Therefore, although videogame play was a male-related activity during the lockdown (**Table 6A**), the gender gap supposedly remained at the pre-lockdown existing levels since the increase in videogame play during the lockdown was unrelated to the player's gender (**Table 6B**).

As for age, the effect detected in **Table 5** is confirmed: compared to stable users only, the increase in videogame play during the lockdown was significantly higher at lower age levels. **Table 6A** also confirms the results in **Table 5** on the significant positive effect for only a few of the negative emotions, i.e., for only two out of the three videogame-conditional emotional states,

namely boredom and emptiness, and, among the unconditional ones, only for discouragement.

With this, we can conclude that the model in **Table 5** and the models in **Tables 6A,B** do not support Hypothesis 2, while they partially support Hypothesis 3. As for Hypothesis 2, the significant gender difference detected in **Table 6A** confirmed that video gaming is a men-related non-creative activity, but the insignificant gender difference found in **Tables 5, 6B** proved that the lockdown did not bring a gender-related increase in such activity. As for Hypothesis 3, among emotional states, only boredom, emptiness and discouragement had a significant impact in increasing videogame play, although discouragement had no significant impact on stable vs. no videogame activity (**Table 6A**). The negative impact of nervousness on stable vs. no videogame activity can be seen as confirmation that the most relevant emotion that is managed by videogame activity is boredom, which usually characterizes subjects who are more relaxed and calmer (Walters et al., 1982).¹⁴

Gender-Related Potentially Addictive Behaviors and Gender-Related Emotions

We conclude the data analysis with the test of Hypothesis 4, i.e., of whether the negative emotions driving the increase of gender-related non-creative activities are themselves gender-related. Recall that as far as emotional states variables are concerned, our questionnaire includes two types of items: emotions elicited without relating them to specific behavior (unconditional: sadness, discouragement, and nervousness) and emotions elicited conditionally to the (non-creative) activity aimed at managing them (conditional: boredom, emptiness, and stress). Relying on **Table 2**, at the beginning of section “Results” we have highlighted that gender differences are systematically detected for each of the six emotional states variables, with women showing significantly higher sensitivity than men to unconditional emotions sadness, discouragement, and nervousness, and men showing significantly higher sensitivity to boredom, emptiness, and stress on average over the three non-creative activities they are aimed at managing. Summarizing the results of **Tables 3–5, 6A,B, 7** reports the signs of the significant impacts of each of the six negative emotions as for the three potentially addictive behaviors (eating loss of control, smartphone usage increase, and videogame play increase) separately, disentangling by female-related (unconditional) vs. male-related (conditional) emotions and by female-related (food and smartphone) vs. male-related non-creative activities (videogames).

Let us first look at the three female-related emotions (sadness, discouragement, and nervousness), i.e., the first three lines of **Table 7**. A similar picture emerges: each of them has a significant positive impact (+ in **Table 7**) on the increase of one of the two female-related non-creative activities (food or smartphone) and a non-significant impact (n.s. in **Table 7**) on the increase of the male-related non-creative activity (videogames). Spearman's tests of rank correlation between

¹⁴This is in line with the theory of psychological reversal (Apter, 1984, 2001), where boredom and relaxation are categorized as emotions with similarly low arousal and opposite hedonic tone, respectively unpleasant and pleasant.

TABLE 7 | Impact of negative emotions on potentially addictive behaviors, disentangled by gender-related emotion, and gender-related non-creative activity.

		Female-related		Male-related
		Food	Smartphone	Videogames
Unconditional (female-related)	Sadness	+	n.s.	n.s.
	Discouragement	+	n.s.	n.s.
	Nervousness	n.s.	+	n.s.
Conditional (male-related)	Boredom	+	+	+
	Emptiness	+	n.s.	+
	Stress	+	+	n.s.

Impacts: “+” significantly positive, and “n.s.” not significant.

specific potentially addictive behaviors and specific negative emotions confirm a significant positive correlation between each female-related negative emotions and the increase in each of the two female-related non-creative activities: for eating loss of control, p -value < 0.000 for any among sadness, discouragement and nervousness, with lowest Spearman’s $\rho = 0.16$; for smartphone usage increase, p -value $= 0.010$ for sadness, 0.003 for discouragement, and <0.000 for nervousness, with lowest Spearman’s $\rho = 0.08$. A non-significant correlation is found as for the increase in the male-related non-creative activity (videogame): p -value $= 0.378$ for sadness, 0.098 for discouragement, and 0.133 for nervousness, with highest Spearman’s $\rho = 0.05$.

Looking at the three male-related emotions, i.e., the last three rows of **Table 7**, a different picture emerges: each of these emotions has a significant positive impact on both male-related and female-related non-creative activities. In confirmation of that, a significant positive correlation is detected not only between male-related negative emotions and videogame increase (p -value < 0.000 for any among boredom, emptiness, and stress managed by videogame, lowest Spearman’s $\rho = 0.54$), but also between male-related negative emotions and the increase in female-related non-creative activities (for eating loss of control, it is p -value < 0.000 for any among boredom, emptiness, and stress managed by food, with lowest Spearman’s $\rho = 0.32$; for smartphone usage increase, it is p -value < 0.000 for any among boredom, emptiness, and stress managed by web, with lowest Spearman’s $\rho = 0.17$).

With this, we conclude that **Hypothesis 4 is verified for women but not for men**: the negative emotions driving the increase of female-related non-creative activities are themselves female-related, while the negative emotions driving the increase of male-related non-creative activities are shared by women too.

DISCUSSION AND CONCLUSION

The sudden outbreak of COVID-19 and the consequent enforcement of the lockdown have abruptly disrupted people’s routines and increased social isolation and financial stress around the world. The psychological impact of this traumatic experience will have short as well as long-run effects. Philosophers and psychologists (e.g., Thomson, 2018) suggest that the presence

of trauma, as well as negative states, such as anxiety and depression, may enhance creativity. In a study comparable with ours (general population in France) run during the same period (1st weeks of the 2020 lockdown), Mercier et al. (2021) report that lockdown, despite the negative outcomes that came out of it, may have fostered creativity due to uncertainty and solitude. However, the influence of negative mood on cognitive creativity and emotional creativity remains elusive (Ying et al., 2020). Failure in engaging in a creative activity to overcome uncertainty and solitude might explain people’s increase in everyday non-creative activities, thereby leading to potentially addictive behaviors. Indeed, we find that 26% of our sample felt like losing control of their usual diet; 88% started to use the smartphone more than in the lockdown period, while 64% of those playing videogames reported increased activity with respect to the pre-lockdown period. This significant increase in non-creative activities occurred after only 2 weeks from the beginning of the first lockdown in France (end of March 2020). While Dubey et al. (2020) find an increase in both new and relapse addictive behaviors during the same period, more interestingly, our study reports that, rather than moving to “new” addictions, people in lockdown stuck to their pre-lockdown habits, by investing the additional free time into the same non-creative activities they were “specialized” before the lockdown.

In our study, we focus on food consumption, smartphone usage, and videogame play, and we find a significant gender effect in the increase of these non-creative activities, with gender differences in favor of women (resp., men) being reported for the first two non-creative activities (resp., the last one) by the literature in psychology before COVID-19 (see, e.g., Davis, 2013 for food, Hong et al., 2012 for smartphones, and King et al., 2012 for videogames). Indeed, in our sample women were about 1.6 times more likely than men to losing control of their usual diet, about 2.3 times more likely than men to use smartphones more, and they showed the same propensity as men to play videogames more with respect to the pre-lockdown activity.

As far as the increase in the usage of smartphones, the significant gender effect detected deserves a more thorough discussion. It was reasonable to expect that in the situation of limited freedom of movement people were more likely to rely on technologies to communicate. Thus, consistently with this prediction, our results indicate that during the period of lockdown people mainly used smartphones for communication.

However, what is interesting is that women were more likely (resp., less likely) to develop potential smartphone addiction if they used the smartphone for web connection to social networks (resp., for the traditional role of sending SMS and making calls). This result provides insight into gender differences in the dependence on the social networks or in expressing social needs.

Gender effects were also present with respect to the use of these three non-creative activities to manage negative emotions, and to the sensitivity to these emotions. We find that during the 1st weeks of the COVID-19 lockdown in France, a considerable proportion of women and men in our sample experienced negative emotions like sadness (resp., 24 and 18%), discouragement (resp., 40 and 28%), and nervousness (resp., 49 and 32%), with women reporting a significantly higher sensitivity to these negative emotions than the one detected for men. This finding is in line with what other studies have reported for the COVID-19 pandemic affecting women more than it has affected men in terms of the psychological impact of confinement (see, e.g., Guadagni et al., 2020; Ausín et al., 2021). However, when we turn to negative emotions managed through the three non-creative activities mentioned above, we find that men show significantly higher sensitivity than women to boredom, emptiness, and stress, on average over the three non-creative activities they are aimed at managing (61 vs. 48% for boredom, 49 vs. 40% for emptiness, and 39 vs. 32% for stress). The different prevalence of experienced emotions (sadness, discouragement, and nervousness vs. boredom, emptiness, and stress) has a different impact on the increase of non-creative activities. In line with Scitovsky's (1999) suggested link between boredom and potentially addictive behavior, boredom was detected to be the modal negative emotion that each of the three non-creative activities under scrutiny aimed at mitigating during the first 2 weeks of 2020 lockdown. Interestingly, a strong emotion-behavior specific link was found between boredom and web activity, with the fraction of respondents managing boredom with a web connection (79%) being significantly higher than the one of those managing boredom with food (43%) or videogame (30%) consumption.

To summarize, our empirical results suggest that during the COVID-19 lockdown the tendency to overcome negative emotions with the help of activity that did not require special or creative skills increased the probability for a person to become addicted to this activity. We found that women used food and the web significantly more than men as a remedy for negative emotional states, thereby developing two harmful behavioral patterns, which both usually lead to an increase in the obesity risk. These results proved to be significant, suggesting that negative emotional states, though to a different extent, can serve as triggers for developing potentially addictive behavior when and if not directed to creative actions. However, one has to keep in mind that differences in eating disorders might also be due to hormonal factors (Beydoun, 2014), while differences in evaluating negative emotions as discouragement, sadness, and nervousness might be due to different abilities to express emotions caused by different sensitivities or more realistically to stereotypes and social expectations (Shields et al., 2006).

Recall that we detected these behavioral patterns and their specific emotional drivers by using data from the 1st 2 weeks of the lockdown. We expect the detected behavioral patterns and the links with negative emotions to have become even stronger during the following weeks of the European lockdown in 2020. This is indirectly confirmed by Sabater-Grande et al. (2021), who detected an average lower levels of daily life satisfaction by females in Spain during spring 2020, although females in their study exhibited a stronger tendency to report higher levels of life satisfaction the longer their lockdown forecast.

Our findings confirm those of other recent studies (e.g., Zacher and Rudolph, 2020) that the COVID-19 pandemic represents not only a major medical and economic crisis, but also has a psychological dimension, as it can be associated with declines in key facets of people's subjective wellbeing. Again, in line with recent studies (e.g., Yan et al., 2021), we report sex differences in emotional reactions and behavioral responses to COVID-19 and related threats. We add to this picture specific findings on gender effects in potentially addictive behaviors and in the negative emotions these behaviors aim at managing. In particular, we show that the negative emotions driving the increase of female-related non-creative activities were themselves female-related, while the negative emotions driving the increase of male-related non-creative activities were shared by women too. This explains the absence of gender differences in the increase of male-related non-creative activities during the lockdown.

As for policy implications, our study suggests once more that designing intervention strategies that account for gender differences in emotional and behavioral responses in facing the COVID-19 pandemic is crucial for these strategies to be effective in the long term. Several other studies have reported evidence implying the need for gender-based public health policies and communication on COVID-19 (see, e.g., Galasso et al., 2020). As for the specific case of potential behavioral addictions, our study suggests that remedies such as sin taxes, legal restrictions, antidepressants, and so on, will be just a symptomatic treatment since the root of the problem is much deeper. Structural reforms in education and economic systems are needed, to help people develop their creative skills and intrinsic motivation for creative behavior, which could prevent us from falling into the vicious circle of the increase of non-creative activities during future lockdown periods that, after COVID-19 outbreaks, do not seem to be so unlikely.

In this regard, an important limitation of our study is worth discussing. The role of developing creative skills as a remedy against the problem of potentially addictive behaviors during the lockdown was not detected as our survey did not contain relevant questions on this issue. This can be the subject for further research on gender differences in COVID-19 side-effects on behavioral addictions.

Another limitation of our study is the unrepresentativeness of our sample as for gender (around 75% of our respondents were female). In the section "Methodology" we hypothesized that the higher online survey participation by females was due to their higher willingness to disclose their psychological health during the lockdown, because of a worse status as compared to males'

one (as our analysis of the section “Results” shows). We leave the test of this explanation of gender unbalance for further research.

Finally, we plan to replicate this study in the future to detect whether our results on gender differences in the impact of COVID-19 lockdown will last after the end of the pandemic, to check whether the detected female-related increases in non-creative activities have become in the meanwhile addictive 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

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

FC had the original idea of the survey. FC and CB contributed to the design and distribution of the survey. GA built the review of

the literature and was the main coordinator of the data analysis and the writing of the manuscript. GA and AM were involved in the writing of the final version of the manuscript. TS made the first data analysis under the supervision of AM and built the tables and was involved in the writing of the initial version of the manuscript. 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.2021.703897/full#supplementary-material>

REFERENCES

- Ahuja, P., Syal, G., and Kaur, A. (2020). Psychological stress: repercussions of COVID-19 on gender. *J. Public Affairs* e2533. doi: 10.1002/pa.2533
- Albrecht, U., Kirschner, N. E., and Grüsser, S. M. (2007). Diagnostic instruments for behavioural addiction: an overview. *GMS Psycho-Soc. Med.* 4, 1–11.
- Alifano, M., Attanasi, G., Iannelli, F., Cherikh, F., and Iannelli, A. (2020). COVID-19 pandemic: a European perspective on health economic policies. *J. Behav. Econ. Policy COVID-19 Special Issue* 4, 35–43.
- Apter, M. J. (1984). Reversal theory and personality: a review. *J. Res. Pers.* 18, 265–288. doi: 10.1016/0092-6566(84)90013-8
- Apter, M. J. (2001). *Motivational Styles in Everyday Life: A Guide to Reversal Theory*. Washington, DC: American Psychological Association, 373. doi: 10.1037/10427-000
- Attanasi, G., Chessa, M., Gallen, S. G., and Llerena, P. (2021). A survey on experimental elicitation of creativity in economics. *Rev. d'Econ. Indust.* 174, 273–324. doi: 10.4000/rei.10448
- Ausín, B., González-Sanguino, C., Castellanos, M. Á., and Muñoz, M. (2021). Gender-related differences in the psychological impact of confinement as a consequence of COVID-19 in Spain. *J. Gender Stud.* 30, 29–38. doi: 10.1080/09589236.2020.1799768
- Bernabe-Valero, G., Melero-Fuentes, D., De Lima Argimon, I. I., and Gerbino, M. (2021). Individual differences facing the COVID-19 pandemic: the role of age, gender, personality, and positive psychology. *Front. Psychol.* 12:595. doi: 10.3389/fpsyg.2021.644286
- Beydoun, M. A. (2014). The interplay of gender, mood, and stress hormones in the association between emotional eating and dietary behavior. *J. Nutr.* 144, 1139–1141. doi: 10.3945/jn.114.196717
- Bianchi, A., and Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *Cyber Psychol. Behav.* 8, 39–51. doi: 10.1089/cpb.2005.8.39
- Canetti, L., Bachar, E., and Berry, E. M. (2002). Food and emotion. *Behav. Process.* 60, 157–164. doi: 10.1016/S0376-6357(02)00082-7
- Carnes, P. (2001). *Out of the Shadows: Understanding Sexual Addiction*. Center City: Hazelden Publishing.
- Chen, B., Liu, F., Ding, S., Ying, X., Wang, L., and Wen, Y. (2017). Gender differences in factors associated with smartphone addiction: a cross-sectional study among medical college students. *BMC Psychiatry* 17:341. doi: 10.1186/s12888-017-1503-z
- Chen, C., Zhang, K. Z., Gong, X., Zhao, S. J., Lee, M. K., and Liang, L. (2017). Examining the effects of motives and gender differences on smartphone addiction. *Comp. Hum. Behav.* 75, 891–902. doi: 10.1016/j.chb.2017.07.002
- Cherikh, F., Frey, S., Bel, C., Attanasi, G., Alifano, M., and Iannelli, A. (2020). Behavioral food addiction during lockdown: time for awareness, time to prepare the aftermath. *Obesity Surg.* 30, 3585–3587. doi: 10.1007/s11695-020-04649-3
- Cummings, J. R., Ackerman, J. M., Wolfson, J. A., and Gearhardt, A. N. (2021). COVID-19 stress and eating and drinking behaviors in the United States during the early stages of the pandemic. *Appetite* 162:105163. doi: 10.1016/j.appet.2021.105163
- Curtin, R., Presser, S., and Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opin. Q.* 64, 413–428. doi: 10.1086/318638
- Davis, C. (2013). A narrative review of binge eating and addictive behaviors: shared associations with seasonality and personality factors. *Front. Psychiatry* 4:183. doi: 10.3389/fpsyg.2013.00183
- De Backer, C., Teunissen, L., Cuykx, I., Decorte, P., Pabian, S., Gerritsen, S., et al. (2020). An evaluation of the COVID-19 pandemic and perceived social distancing policies in relation to planning, selecting, and preparing healthy meals: an observational study in 38 countries worldwide. *Front. Nutr.* 7:621726. doi: 10.3389/fnut.2020.621726
- Derevensky, J., Hayman, V., and Gilbeau, L. (2019). Behavioral addictions: excessive gambling, gaming, internet, and smartphone use among children and adolescents. *Pediatr. Clin. North Am.* 66, 1163–1182. doi: 10.1016/j.pcl.2019.08.008

- Dubey, M. J., Ghosh, R., Chatterjee, S., Biswas, P., Chatterjee, S., and Dubey, S. (2020). COVID-19 and addiction. *Diab. Metab. Synd. Clin. Res. Rev.* 14, 817–823. doi: 10.1016/j.dsx.2020.06.008
- Elhai, J. D., Vasquez, J. K., Lustgarten, S. D., Levine, J. C., and Hall, B. J. (2018). Proneness to boredom mediates relationships between problematic smartphone use with depression and anxiety severity. *Soc. Sci. Comp. Rev.* 36, 707–720. doi: 10.1177/0894439317741087
- Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., and Foucault, M. (2020). Gender differences in COVID-19 attitudes and behavior: panel evidence from eight countries. *Proc. Natl. Acad. Sci. U.S.A.* 117, 27285–27291. doi: 10.1073/pnas.2012520117
- García-Fernández, L., Romero-Ferreiro, V., Padilla, S., David López-Roldán, P., Monzó-García, M., and Rodríguez-Jiménez, R. (2021). Gender differences in emotional response to the COVID-19 outbreak in Spain. *Brain Behav.* 11:e01934. doi: 10.1002/brb3.1934
- Gibbons, J. A., and Bouldin, B. (2019). Videogame play and events are related to unhealthy emotion regulation in the form of low fading affect bias in autobiographical memory. *Conscious. Cogn.* 74:102778. doi: 10.1016/j.concog.2019.102778
- Griffiths, M. (1995). *Adolescent Gambling*. Hove: Psychology Press.
- Griffiths, M. (2000). Internet addiction – time to be taken seriously? *Addict. Res.* 8, 413–418. doi: 10.3109/16066350009005587
- Griffiths, M. (2002). *Gambling and Gaming Addictions in Adolescence*. Oxford: British Psychological Society, Blackwells.
- Griffiths, M. (2005). A ‘components’ model of addiction within a biopsychosocial framework. *J. Substance Use* 10, 191–197. doi: 10.1080/14659890500114359
- Guadagni, V., Umiltà, A. M., and Iaria, G. (2020). Sleep quality, empathy and mood during the isolation period of the COVID-19 pandemic in the Canadian population: females and women suffered the most. *Front. Glob. Women's Health* 1:13. doi: 10.3389/fgwh.2020.585938
- Hong, F.-Y., Chiu, S.-I., and Huang, D.-H. (2012). A model of the relationship between psychological characteristics, mobile phone addiction and use of mobile phones by Taiwanese university female students. *Comp. Hum. Behav.* 28, 2152–2159. doi: 10.1016/j.chb.2012.06.020
- Jackson, S. E., Beard, E., Angus, C., Field, M., and Brown, J. (2021). Moderators of changes in smoking, drinking, and quitting behaviour associated with the first Covid-19 lockdown in England. *medRxiv* [Preprint]. doi: 10.1101/2021.02.15.21251766
- Kidd, J. D., Jackman, K. B., Barucco, R., Dworkin, J. D., Dolezal, C., Nalvala, T. V., et al. (2021). Understanding the impact of the COVID-19 pandemic on the mental health of transgender and gender nonbinary individuals engaged in a longitudinal cohort study. *J. Homosex.* 68, 592–611. doi: 10.1080/00918369.2020.1868185
- King, D. L., Delfabbro, P. H., and Griffiths, M. D. (2012). Clinical interventions for technology-based problems: excessive internet and videogame use. *J. Cogn. Psychother.* 26, 43–56. doi: 10.1891/0889-8391.26.1.43
- Leung, L. (2020). Exploring the relationship between smartphone activities, flow experience, and boredom in free time. *Comp. Hum. Behav.* 103, 130–139. doi: 10.1016/j.chb.2019.09.030
- Loewenstein, G. (1999). “A visceral account of addiction,” in *Getting Hooked: Rationality and Addiction*, eds J. Elster and O. Skog (Cambridge: Cambridge University Press), 235–264. doi: 10.1017/CBO9781139173223.010
- Loton, D., Borkoles, E., Lubman, D., and Polman, R. (2016). Videogame addiction, engagement and symptoms of stress, depression and anxiety: the mediating role of coping. *Int. J. Ment. Health Addict.* 14, 565–578. doi: 10.1007/s11469-015-9578-6
- Lyman, B. (1982). The nutritional values and food group characteristics of foods preferred during various emotions. *J. Psychol.* 112, 121–127. doi: 10.1080/00223980.1982.9923544
- Macht, M. (1999). Characteristics of eating in anger, fear, sadness and joy. *Appetite* 33, 129–139. doi: 10.1006/appe.1999.0236
- Matic, A., Pielot, M., and Oliver, N. (2015). “Boredom-computer interaction: boredom proneness and the use of smartphone,” in *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, Osaka, 837–841. doi: 10.1145/2750858.2807530
- Mehrabian, A. (1980). *Basic Dimensions for a General Psychological Theory: Implications for Personality, Social, Environmental, and Developmental Studies*, Vol. 2. Cambridge, MA: Oelgeschlager, Gunn & Hain.
- Mercier, M., Vinchon, F., Pichot, N., Bonetto, E., Bonnardel, N., Girandola, F., et al. (2021). COVID-19: a boon or a bane for creativity? *Front. Psychol.* 11:3916. doi: 10.3389/fpsyg.2020.601150
- Moore, D. L., and Tarnai, J. (2002). “Evaluating nonresponse error in mail surveys,” in *Survey Nonresponse*, eds R. M. Groves, D. A. Dillman, J. L. Eltinge, and R. J. A. Little (New York, NY: John Wiley & Sons), 197–211.
- Mulder, J., and de Bruijne, M. (2019). Willingness of online respondents to participate in alternative modes of data collection. *Survey Pract.* 12:8356. doi: 10.29115/SP-2019-0001
- Orford, J. (2001). *Excessive Appetites: A Psychological View of Addictions*, 2nd Edn. Chichester: John Wiley & Sons Ltd.
- Patel, K. A., and Schlundt, D. G. (2001). Impact of moods and social context on eating behavior. *Appetite* 36, 111–118. doi: 10.1006/appe.2000.0385
- Pelchat, M. L. (2009). Food addiction in humans. *J. Nutr.* 139, 620–622. doi: 10.3945/jn.108.097816
- Pursey, K. M., Stanwell, P., Gearhardt, A. N., Collins, C. E., and Burrows, T. L. (2014). The prevalence of food addiction as assessed by the Yale food addiction scale: a systematic review. *Nutrients* 6, 4552–4590. doi: 10.3390/nu6104552
- Renou, A. (2020). *Coronavirus: Edouard Philippe Ferme les Lieux Publics «Non Essentiels», Mais Maintient les Municipales*. Paris: Le Parisien.
- Sabater-Grande, G., García-Gallego, A., Georgantzis, N., and Herranz-Zarzo, N. (2021). When will the lockdown end? Confinement duration forecasts and self-reported life satisfaction in Spain: a longitudinal study. *Front. Psychol.* 12:874. doi: 10.3389/fpsyg.2021.635145
- Samaha, M., and Hawi, N. S. (2016). Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Comp. Hum. Behav.* 57, 321–325. doi: 10.1016/j.chb.2015.12.045
- Scitovsky, T. (1992). *The Joyless Economy: The Psychology of Human Satisfaction*. Oxford: Oxford University Press.
- Scitovsky, T. (1999). Boredom – an overlooked disease? *Challenge* 42, 5–15. doi: 10.1080/05775132.1999.11472116
- Shields, S. A., Garner, D. N., Di Leone, B., and Hadley, A. M. (2006). *Gender and Emotion. In Handbook of the Sociology of Emotions*. Boston, MA: Springer, 63–83. doi: 10.1007/978-0-387-30715-2_4
- Shockley, K. M., Clark, M. A., Dodd, H., and King, E. B. (2020). Work-family strategies during COVID-19: examining gender dynamics among dual-earner couples with young children. *J. Appl. Psychol.* 106, 15–28. doi: 10.1037/apl0000857
- Singer, E., van Hoewyk, J., and Maher, M. P. (2000). Experiments with incentives in telephone surveys. *Public Opin. Q.* 64, 171–188. doi: 10.1086/317761
- Smith, G. (2008). Does Gender Influence Online Survey Participation?: A Record-Linkage Analysis of University Faculty Online Survey Response Behavior. ERIC Document Reproduction Service No. ED 501717. San José, CA: San José State University.
- Souty, C., Guerrisi, C., Masse, S., Lina, B., van der Werf, S., Bernard-Stoecklin, S., et al. (2021). Impact of the lockdown on the burden of COVID-19 in outpatient care in France, spring 2020. *Infect. Dis.* 53, 376–381. doi: 10.1080/23744235.2021.1880024
- Terry, A., Szabo, A., and Griffiths, M. (2004). The exercise addiction inventory: a new brief screening tool. *Addict. Res. Theory* 12, 489–499. doi: 10.1080/16066350310001637363
- Thomson, P. (2018). “Trauma, attachment, and creativity,” in *Norton Series on Interpersonal Neurobiology. Play and Creativity in Psychotherapy*, eds M. T. Tarlow, M. Solomon, and D. J. Siegel (New York, NY: W. W. Norton & Company), 167–190.
- Toda, M., Monden, K., Kubo, K., and Morimoto, K. (2006). Mobile phone dependence and health-related lifestyle of university students. *Soc. Behav. Pers.* 34, 1277–1284. doi: 10.2224/sbp.2006.34.10.1277
- Vahedi, Z., and Saipho, A. (2018). The association between smartphone use, stress, and anxiety: a meta-analytic review. *Stress Health* 34, 347–358. doi: 10.1002/smi.2805
- Villani, D., Carissoli, C., Triberti, S., Marchetti, A., Gilli, G., and Riva, G. (2018). Videogames for emotion regulation: a systematic review. *Games Health J.* 7, 85–99. doi: 10.1089/g4h.2017.0108
- Walsh, S. P., White, K. M., Cox, S., and Young, R. M. (2011). Keeping in constant touch: the predictors of young australians’ mobile phone involvement. *Comp. Hum. Behav.* 27, 333–342. doi: 10.1016/j.chb.2010.08.011

- Walters, J., Apter, M. J., and Svebak, S. (1982). Color preference, arousal, and the theory of psychological reversals. *Motiv. Emot.* 6, 193–215. doi: 10.1007/BF00992245
 - Wang, J. L., Wang, H. Z., Gaskin, J., and Wang, L. H. (2015). The role of stress and motivation in problematic smartphone use among college students. *Comp. Hum. Behav.* 53, 181–188. doi: 10.1016/j.chb.2015.07.005
 - West, R. (2013). *EMCDDA Insights Series No 14 – Models of Addiction*. Available online at: https://www.emcdda.europa.eu/attachements.cfm/att_213861_EN_TDXD13014ENN.pdf
 - Witteck, C. T., Finserås, T. R., Pallesen, S., Mentzoni, R. A., Hanss, D., Griffiths, M. D., et al. (2016). Prevalence and predictors of videogame addiction: a study based on a national representative sample of gamers. *Int. J. Ment. Health Addict.* 14, 672–686. doi: 10.1007/s11469-015-9592-8
 - Yan, S., Xu, R., Stratton, T. D., Kavcic, V., Luo, D., Hou, F., et al. (2021). Sex differences and psychological stress: responses to the COVID-19 pandemic in China. *BMC Public Health* 21, 1–8. doi: 10.1186/s12889-020-10085-w
 - Ying, D., Yang, Y., Xie, C., Wang, X., Liu, C., Hu, W., et al. (2020). A positive role of negative mood on creativity: the opportunity in the crisis of the COVID-19 epidemic. *Front. Psychol.* 11:3853. doi: 10.3389/fpsyg.2020.600837
 - Zacher, H., and Rudolph, C. W. (2020). Individual differences and changes in subjective wellbeing during the early stages of the COVID-19 pandemic. *Am. Psychol.* 76, 50–62. doi: 10.1037/amp0000702
 - Zerach, G. (2021). Emptiness mediates the association between pathological narcissism and problematic smartphone use. *Psychiatr. Q.* 92, 363–373. doi: 10.1007/s11126-020-09803-9
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Adapting to Uncertainty: A Mixed-Method Study on the Effects of the COVID-19 Pandemic on Expectant and Postpartum Women and Men

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Detrimental biopsychosocial effects of the COVID-19 pandemic on populations have been established worldwide. Despite research indicating that the transition to parenthood is a vulnerable period for maternal and paternal health, an in-depth examination of the specific challenges the pandemic poses for new mothers and fathers is still lacking. Using a mixed-method design, we investigated individual and relational well-being of women and men who were expecting their first child during the first months of the COVID-19 pandemic in Portugal and its associations with contextual, individual, and relational factors. Adults older than 18 ($n = 316$, 198 women) from early pregnancy to 6-months postpartum completed a cross-sectional online survey assessing sociodemographic, individual (depression, anxiety, perceived stress), and relational (dyadic adjustment, perceived social support) self-report measures. From those, 99 participants (64 women) responded to an open-ended question and reported perceived changes in their couple's relationship due to the pandemic. Men responding during strict lockdown measures reported significantly higher levels of perceived stress relative to those men who were not under lockdown. Overall, women reported higher levels of depression and greater social support than men. Qualitative analyses resulted in two main themes: Individual Changes and Relational Changes. These themes aggregate personal concerns and experiences (e.g., worsening of mental health, uncertainty about the future, lack of freedom) interrelated with relational issues (e.g., increased togetherness, avoidance of physical contact, and increased availability for parenthood during lockdown). The prevalence of negative effects (58.6%) exceeded the described positive effects (28.3%), and 13.1% described both positive and negative effects of the pandemic. Current findings offer grounds for important evidence-based strategies to mitigate the potential adverse effects of the current pandemic on new mothers' and fathers' individual and relational well-being.

Keywords: pregnancy, postpartum, stress, anxiety, depression, couple relationship, COVID-19

INTRODUCTION

Covid-19 came up in my postpartum period, a difficult time of adaptation to a new reality and routine. COVID-19 intensified moments of stress and anxiety, (...) it also shattered some idealization of the moment. The worst is the constant fear of getting sick, both of us and our baby. All this affects our well-being and leads to a lack of [sexual] desire and patience.

CD, female, 3-months postpartum

The coronavirus disease (COVID-19) has been declared a pandemic by the World Health Organization (WHO) on March 12, 2020. The COVID-19 pandemic is now considered a major long-term stressor and its biopsychosocial impacts have been widely established, including increased prevalence of depression and anxiety symptoms in various populations (Bendau et al., 2020; Luo et al., 2020; Pfefferbaum and North, 2020). Nevertheless, there are still a number of unknowns on the impact of COVID-19 on several particularly vulnerable populations. One of such cases refers to individuals transitioning to parenthood, which face one of the most demanding life periods. Pregnancy and postpartum impose several biopsychosocial changes that require individuals to adjust and increase the risk of experiencing psychological and relational problems (Vismara et al., 2016; Doss and Rhoades, 2017; Da Costa et al., 2019). Whether and how these novel demands experienced by new parents affect their individual and/or dyadic well-being depends on the interaction between individual, relational, and contextual factors (Lazarus and Folkman, 1984; Ben-Zur, 2019).

During the COVID-19 pandemic, pregnant women were specifically considered a vulnerable group and were recommended to take additional precautions (Di Mascio et al., 2020; Phoswa and Khaliq, 2020; Wastnedge et al., 2021). Many countries limited non-emergency health care services in order to diminish contact between health care workers and patients as well as to ensure that resources were effectively placed on COVID-19 care provision and, consequently, these measures affected antenatal and postnatal healthcare services. For instance, in Portugal, similarly to what happened in many other countries, many women experienced a reduction or suspension of antenatal and postnatal health care services as their routine consultations were either suspended or replaced with video or telephone consultations. These imposed changes may have caused additional stress to expectant and postpartum women and their partners during an already vulnerable life stage, amplifying the negative impact of the pandemic. Also, expectant women and men may suffer different consequences of the pandemic, as sex- and gender- specific factors are among the most important determinants of health and disease outcomes (Spagnolo et al., 2020) and, as recent studies have started to uncover, are also important determinants of the psychological and emotional effects of COVID-19 (van der Vegt and Kleinberg, 2020; Zamarro and Prados, 2021).

In response to the pandemic, many governments worldwide have imposed a series of confinement and physical distancing measures as an additional attempt to control the spread of the infection. While these measures are effective in preventing

the spread of the disease, isolation measures also pose detrimental effects to the physical and mental health of the populations, including negative effects on psychological and physical health, cognitive functioning, individuals' quality of life and, importantly, interpersonal relationships (Cornwell and Waite, 2009; Barger, 2013; Cacioppo et al., 2015). These physical isolation and social distancing (i.e., "stay at home") measures have resulted in families and couples being confined together at home or, instead, physically isolated from one another to decrease the risk of virus transmission. A series of factors can emerge during and after social isolation periods that pose negative mental health consequences for the individual, including anxiety related to the pandemic and fear of infection (Bai et al., 2004; Desclaux et al., 2017), boredom and absence of social outlets outside the home (DiGiovanni et al., 2004; Cava et al., 2005), or financial insecurity (Mihashi et al., 2009; Jeong et al., 2016).

Although prior studies have focused on the psychological effects of quarantine on individuals, the novel and challenging dynamics induced by the current pandemic (e.g., balancing individual vs. shared time during confinement, novel work-related responsibilities including working from home) may also have critical implications for couples. For instance, a *Global Times* (2020) newspaper article documented a peak in divorce rates in some districts of Xi'an, the capital of Northwest China's Shaanxi province, during March 2020, as an immediate consequence of the COVID-19 outbreak. Preliminary research findings also indicate that the COVID-19 pandemic and related measures are linked to increased relationship conflict and worse psychological well-being among partnered individuals, compared to before the pandemic (Luetke et al., 2020; Yang and Ma, 2020). Nonetheless, emerging evidence also reveals that, in the context of the COVID-19 crisis, both positive and negative repercussions to individuals and couples might occur (Günther-Bel et al., 2020). This mixed picture relates to the fact that, on the one hand, the imposed COVID-19 "stay at home" measures may facilitate conflict and relational distress as couple members experience a sudden disruption to their daily routines and readjust to work and recreational activities; navigate physical distancing/disinfection measures due to concerns of contagion; face financial concerns/job disruption; and spend most or all of their time together in a limited physical space. On the other hand, this proximity can be protective against negative outcomes such as loneliness (e.g., Lauder et al., 2004; Shiovitz-Ezra and Leitsch, 2010; Bruce et al., 2019) and can create opportunities for increased intimacy, closeness, and communal problem-solving. For pregnant and postpartum couples, this experience of proximity and increased time together might be particularly valuable as it can be an opportunity to be highly engaged and establish a deeper bond with their child, which ultimately is beneficial for both individuals' as well as for the child's well-being (Shin et al., 2008; Clowtis et al., 2016).

Whether the COVID-19 crisis, as an intense external stressor, might threaten or strengthen couples' relationships can be better understood through the conceptual framework of the vulnerability-stress-adaptation model (Karney and Bradbury, 1995; Pietromonaco and Overall, 2020). This model suggests that COVID-19 crisis creates a series of related stressors

(e.g., confinement, economic strain, job loss) that have the potential to interfere with the relationship by increasing negative processes within the couple (e.g., hostility, estrangement, less responsive support). The extent to which these effects will negatively impact the relationship depends on each partner's individual vulnerabilities (e.g., anxiety, depression) and on preexisting stressors (e.g., having a lower income or going through a particularly challenging life period such as the postpartum). As such, the presence of greater preexisting contextual vulnerabilities coupled with individual vulnerabilities of one or both partners will exacerbate the impact of pandemic-related stressors. The way in which expectant and postpartum couples particularly perceive the impact of the COVID-19 pandemic, and whether these perceptions are associated with preexisting contextual and individual vulnerabilities, is still currently unexplored. Prior research has found that women and men may respond differently to crisis and stressful events (Spagnolo et al., 2020; van der Vegt and Kleinberg, 2020; Zamarro and Prados, 2021). Recent studies show that, during the COVID-19 pandemic, the burden for mothers increased and remained higher compared for fathers (Del Boca et al., 2020; Farré et al., 2020). Furthermore, women seem to be more worried about their family and friends and tend to report more severe health concerns, such as anxiety and fear, while men are greatly worried about economical and societal concerns (van der Vegt and Kleinberg, 2020). This is also in line with studies demonstrating an overall increased prevalence and severity of depressive, anxious, and posttraumatic symptoms in women in comparison to men, including during the COVID-19 pandemic (Hodes and Epperson, 2019; Liu et al., 2020).

The present study aims to investigate how the current pandemic affects the relationships of women and men at a particularly vulnerable life stage such as pregnancy and postpartum, whether there are significant gender differences in these experiences, and to identify which of these individuals may be most at risk for adverse consequences during the COVID-19 crisis. To our knowledge, no studies have employed qualitative or mixed-methods procedures to answer this research question. Using a mixed-methods approach, we specifically aimed to: (a) describe women's and men's individual (i.e., perceived stress, anxiety, depression) and relational well-being (i.e., dyadic adjustment, social support) using validated self-report measures; (b) describe via qualitative analysis the ways in which women and men felt their relationship with their partner was impacted as consequence of the COVID-19 pandemic; (c) identify contextual (i.e., age, lockdown status, obstetric status) and individual (i.e., anxiety, depression) correlates of perceived individual and relational changes due to the pandemic, with particular attention to variations across gender and stage of pregnancy/postpartum.

MATERIALS AND METHODS

Participants

A total of 316 participants (198 women and 118 men) were recruited as part of a study on psychological well-being during

the transition to parenthood, at regularly scheduled clinical appointments at one of the largest national maternity and child health outpatient units, as well as through social media platforms and completed an online survey during the COVID-19 period in Portugal, between March 27 and November 24, 2020. Eligibility criteria for participation were: (1) age over 18; (2) able to read and write in Portuguese; (3) in a committed romantic relationship with a partner for at least 6 months; and (4) self or partner currently pregnant with their first child or currently up to 6 months postpartum at the time of assessment. All participants resided in Portugal at the time of participation and ranged in age from 19 to 47 years ($M = 31.0$, $SD = 5.16$). Almost all participants were of Portuguese nationality (91.3%). The majority of participants was cohabiting with their partner (93.1%). One-hundred and twenty-two participants (38.6%) responded while Portugal was under strict lockdown measures. Sociodemographic characteristics of the sample are summarized in **Table 1**.

Procedure

This study received approval from the Ethics Committee at the Faculty of Psychology and Educational Sciences of the University of Porto and at the Centro-Materno Infantil do Norte. Participants were administered an online self-reported survey to investigate women's and men's well-being in the context of the COVID-19 pandemic. Before beginning the online survey, all participants received and reviewed information about the purpose and procedures of the study, including assurance of

TABLE 1 | Sociodemographic characteristics of participants ($N = 316$).

	Women ($n = 198$)	Men ($n = 118$)
Age, M years $\pm SD$ (min—max)	30.5 \pm 4.94 (19—42)	31.9 \pm 5.42 (21—47)
Obstetric status, n (%)		
First/second trimester	34 (17.2%)	64 (54.2%)
Third trimester	90 (45.5%)	44 (37.3%)
Postpartum	74 (37.4%)	10 (8.50%)
Planned pregnancy (yes) n (%)	151 (77.8%)	88 (74.6%)
Responded during strict lockdown (yes) n (%)	61 (30.8%)	61 (51.7%)
Education level, n (%)		
≤ 12 years	70 (35.4%)	68 (58.1%)
Bachelor's degree	74 (37.4%)	26 (22.0%)
Master's degree	48 (24.2%)	21 (17.8%)
Ph.D.	6 (3.00%)	2 (1.70%)
Working situation, n (%)		
Working from home	37 (18.7%)	35 (29.7%)
Unemployed due to Covid-19	25 (12.6%)	15 (12.7%)
Essential worker	7 (2.8%)	17 (6.8%)
Other (e.g., on leave)	129 (65.2%)	22 (18.6%)
Relationship status, n (%)		
Dating	63 (32.1%)	40 (34.8%)
Married or Civil Union	133 (67.9%)	75 (65.2%)
Relationship duration, M years $\pm SD$	6.65 \pm 4.42	6.87 \pm 4.31
Cohabiting (yes)		
n (%)	116 (58.6%)	101 (85.6%)
M years $\pm SD$	4.13 \pm 3.94	3.62 \pm 3.01

confidentiality, and provided their informed consent before participation. Each participant was compensated with a 10€ gift card as part of the larger study and, after completion of the study, individuals received information on relevant psychological resources during the COVID-19 pandemic.

A mixed-method design was used for this research to examine the ways in which participants describe how COVID-19 influenced their individual and couple functioning. First, participants completed questions on sociodemographics (e.g., age, gender, obstetric status), current pregnancy/obstetric health, as well as a series of previously self-report instruments validated to the Portuguese population on individual and relationship well-being. Then, participants answered an open-ended question eliciting data for qualitative analysis in which they were given the freedom to express and describe perceived changes in their relationships since the beginning of the COVID-19 crisis (*"In your own words, please describe how the COVID-19 pandemic influenced your intimate/couple relationship?"*).

Measures

Demographics

An initial questionnaire was used to collect participants' basic information such as age, gender, obstetric health questions (such as pregnancy weeks/timing of postpartum, and whether the pregnancy was planned). Moreover, the date of participation was used to estimate whether participants were responding under or after national strict lockdown measures.

Depression

The well-validated Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; Matthey et al., 2001) was used as a measure of depressive symptoms. This 10-item scale is a screening tool for depression designed to particularly target populations at pregnancy/postpartum and has been validated for use in women and men with good psychometric properties. Participants were asked to rate the frequency with which they experienced symptoms of depression in the last 7 days with higher scores reflecting a higher presence of depressive symptoms. The Portuguese version of this measure has shown good internal consistency ($\alpha = 0.85$; Figueiredo et al., 2007). Internal consistency of the EPDS in the current study was good ($\alpha = 0.84, 0.82$ for women and men, respectively).

Anxiety

The Anxiety Subscale of the Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983) was used as a measure of anxiety. This widely used and well-validated subscale is comprised of seven items assessing the presence of symptoms of anxiety during the previous week, with higher scores indicating a more severe presence of anxious symptoms. The HADS has been translated to Portuguese and validated for use in Portuguese samples with good internal consistency ($\alpha = 0.76$; Pais-Ribeiro et al., 2007). In the present study, the scale showed good indices of internal consistency ($\alpha = 0.83, 0.82$ for women and men, respectively).

Dyadic Adjustment

The well-validated and widely used Dyadic Adjustment Scale-Revised (DAS-R; Busby et al., 1995) was used as a measure of dyadic adjustment. The DAS-R includes a comprehensive evaluation of different dimensions of adjustment in the dyadic relationship with a partner using 14-items (e.g., "How often do you and your partner calmly discuss something?"). Higher scores reflect higher levels of adjustment. The DAS-R has been validated for the Portuguese population (Costa, 2012) and, in the current study, showed good internal consistency indices ($\alpha = 0.82, 0.78$ for women and men, respectively).

Perceived Stress

The Perceived Stress Scale (PSS; Cohen et al., 1983) was used to assess the degree to which individuals perceive situations in their lives as stressful. The scale includes 14 items asking participants to rate the frequency with which they experienced a given situation or feeling (e.g., "How often have you found that you could not cope with all the things that you had to do?") in the previous month. Higher scores indicate higher perceived stress. The Portuguese version of the PSS yielded good internal consistency ($\alpha = 0.87$; Trigo et al., 2010). In our study, Cronbach's alpha values indicated good internal consistency ($\alpha = 0.89$ for both women and men).

Perceived Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988) was included to assess the perception of social support individuals receive from three sources, each corresponding to a subscale: family, friends, and significant other. This brief measure is composed of 12 items, with higher scores reflecting higher degrees of perceived social support. The Portuguese validation yielded Cronbach's alpha values between 0.85 and 0.95 for all three subscales (Carvalho et al., 2011). In this study, the scale showed excellent internal consistency for all subscales (for women and men, respectively: Family, $\alpha = 0.96, 0.96$; Friends, $\alpha = 0.96, 0.96$; Significant Other, $\alpha = 0.93, 0.91$).

Data Analysis

Given the goal of the current study of providing an in-depth understanding of the effects of the COVID-19 pandemic on the well-being of women and men transitioning to parenthood, we employed a mixed-method approach by combining qualitative and quantitative forms of analysis. The mixed-method approach provides a more comprehensive and ultimately ecologically valid understanding of the research question than each method does when employed by itself (Creswell and Plano Clark, 2011). Thus, we used validated quantitative measurement methods to assess individual and relationship functioning, which were integrated with descriptive, qualitative evidence of individuals' perceived "effects" of the pandemic, resulting from participants' qualitative (written) descriptions of what had changed. The integration of both methodologies offers the opportunity to understand the complexity of the phenomenon in more depth (Teddle and Tashakkori, 2012).

TABLE 2 | Descriptives and Spearman correlation coefficients among the study variables.

	M	DP	1	2	3	4	5
EPDS	6.39	4.15	–				
HADS	4.95	3.49	0.77**	–			
DASR	53.58	7.36	–0.33**	–0.34**	–		
PSS	15.39	6.70	0.77**	0.74**	–0.44**	–	
MSPSS	5.31	0.80	–0.41**	–0.38**	0.37**	–0.46**	–

**Correlation is significant at the 0.01 level.

Qualitative Data Analysis

From our total sample of 316 participants, 217 provided written responses reporting no changes in their couple relationships as a consequence of COVID-19 (e.g., “Everything continues as usual”). After dropping these cases, we used Braun and Clarke’s (2006) method of thematic analysis to code participants’ descriptions of change. After familiarization with the dataset, the thematic analysis involved identifying interesting data features or codes, clustering codes and searching for potential themes, and, finally, naming, defining, and redefining the themes and subthemes according to the six steps proposed by Braun and Clarke (2006). To ensure and increment the research’s validity, two authors (JF and CM) individually coded the raw data in an ongoing consensual review process, and the full team reviewed emerging results to reach a final thematic configuration. During the process of thematic analysis we observed theoretical saturation, which is considered the point at which no additional data are being found that add significant information to the research question (e.g., generate new codes, subthemes, or themes; Guest et al., 2020). Following the principles of qualitative research, reaching theoretical saturation indicates that the sample size is adequate to respond to the research question.

Quantitative Data Analyses

First, we provide descriptive statistics for psychological (depression, anxiety, and perceived stress) and relationship well-being (dyadic adjustment and perceived social support) in the sample focusing on potential differences regarding lockdown status, gender, and obstetric status (early-mid pregnancy vs. late-pregnancy vs. postpartum) of the participants. Many of our participants responded to our study in the first months of the European COVID-19 pandemic situation, hence lockdown status was explored as a potential impactful variable on participants’ indices of individual and relational functioning. Given that the normality assumption for the residuals’ distributions was mostly not confirmed, analyses were performed considering non-parametric tests. Group comparisons were performed using Mann-Whitney tests (for two groups) and Kruskal-Wallis tests (for more than two groups), and Bonferroni corrections for multiple comparisons were applied. Next, and in accordance with mixed-research procedures, we coded the previously defined qualitative change themes (as described above) into dichotomous variables representing the presence or absence of each specific qualitative theme. These dichotomous variables representing presence/absence of the qualitative themes were then used to test

their association with the relevant study variables, permitting us to identify contextual (i.e., gender, obstetric status) and individual (i.e., depression, perceived stress) correlates of the pandemic-related perceived changes through cross-tabulation analysis. For all analyses, a *P*-value less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS, v24.0.

RESULTS

Descriptive statistics and Spearman correlation coefficients among study variables are depicted in Table 2.

Lockdown Impact

We examined whether participants reported different indices of individual and relational well-being depending on whether they responded during or after strict lockdown measures. Male participants reported significantly higher perceived stress if under lockdown measures ($Z = -2.08$, $p = 0.038$, $\eta^2 = 0.02$), while no statistically significant difference was found for female participants during or after strict lockdown measures ($Z = -0.91$, $p = 0.363$, $\eta^2 = 0.04$). No other differences were found for other individual and relational functioning indices (depression, anxiety, perceived social support, and dyadic adjustment; all $p_s > 0.121$).

Differences in Individual and Relational Indices of Well-Being

Gender Differences

Overall, women reported higher levels of depression (EPDS; $Z = -2.82$, $p = 0.005$, $\eta^2 = 0.03$; see Figure 1A) and higher perceived social support (MSPSS; $Z = -2.18$, $p = 0.034$, $\eta^2 = 0.02$; see Figure 1B) than men. More particularly, women reported greater perceived social support than men on the significant other ($p = 0.032$) and friends ($p = 0.026$) subscales, but no differences were found between women and men on the family subscale ($p = 0.082$). No other significant differences were found between women and men on the remaining individual (anxiety, perceived stress) or relational well-being indices (dyadic adjustment), as depicted in Table 3.

Obstetric Status Differences

As can be seen in Table 4, stress, anxiety, and depression rates tended to be higher in participants who were at late pregnancy and at postpartum, while dyadic adjustment and perceived social support were slightly higher for third trimester participants, although these variations were not sufficient to flag significant differences between pregnancy/postpartum periods. Women and men at postpartum reported higher levels of perceived stress when compared to participants at early mid pregnancy ($p = 0.039$) and at late pregnancy ($p = 0.046$; see Figure 2).

When analyzing women and men separately, results indicated that, for men, dyadic adjustment was different according to the obstetric stage they were at [$H(2) = 6.51$, $p = 0.039$, $\eta^2 = 0.04$], such that dyadic adjustment was higher for those men whose partner’s pregnancy was at the third trimester compared to

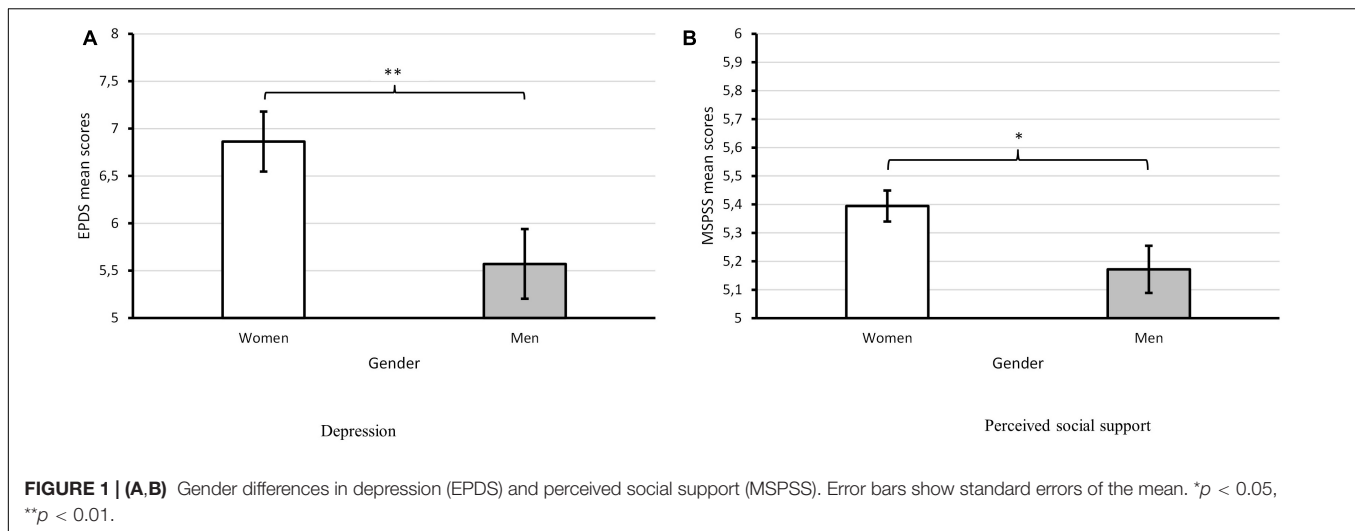


TABLE 3 | Gender differences in depression (EPDS), anxiety (HADS), dyadic adjustment (DASR), perceived stress (PSS), and perceived social support (MSPSS).

	Women				Men				Z	p
	n	Mean	SD	Mean rank	n	Mean	SD	Mean rank		
EPDS	197	6.91	4.25	169.16	118	5.52	3.84	139.37	-2.82	0.005
HADS	197	5.12	3.49	162.21	117	4.67	3.48	149.57	-1.20	0.231
DAS-R	197	53.90	7.57	162.37	117	53.03	6.97	148.00	-1.36	0.174
PSS	183	15.63	6.60	151.66	112	15.00	6.86	142.03	-0.94	0.346
MSPSS	183	5.39	0.74	156.16	112	5.17	0.88	134.67	-2.20	0.034

TABLE 4 | Individual and relational functioning indices according to obstetric status (pregnancy stage and postpartum).

	First/second trimester				Third trimester				Postpartum				H	p
	n	Mean	SD	Mean rank	n	Mean	SD	Mean rank	n	Mean	SD	Mean rank	df = 2	
EPDS	98	6.10	4.24	150.40	134	6.46	4.04	160.90	83	6.63	4.24	162.29	1.02	0.604
HADS	98	4.77	3.74	149.64	133	4.87	3.50	155.38	83	5.30	3.17	170.17	2.45	0.294
DASR	98	53.04	7.09	148.71	132	54.49	6.65	167.20	83	52.76	8.56	150.57	2.93	0.232
PSS	92	14.74	7.06	138.95	126	15.02	6.48	143.00	77	16.78	6.50	167.00	5.30	0.071
MSPSS	92	5.25	0.82	140.26	126	5.36	0.82	154.73	77	5.31	0.74	146.24	1.60	0.448

those whose partner was at early mid pregnancy ($p = 0.013$; see **Figure 3A**).

Women did not show significant differences regarding their indicators of individual and relational functioning according to the moment of pregnancy or postpartum they were at (all $p > 0.157$; see **Figure 3**).

Perceived Changes in Couples' Relationship Due to the COVID-19 Pandemic

Concerning qualitative data, 99 participants described that COVID-19 had a marked impact on their intimate relationships. Compared to those who did not ($n = 216$), they differed in terms of their individual and relationship functioning in such a way that they reported higher depression ($Z = -2.90$, $p = 0.004$, $\eta^2 = 0.03$),

anxiety ($Z = -3.39$, $p = 0.001$, $\eta^2 = 0.04$), and perceived stress rates ($Z = -2.94$, $p = 0.003$, $\eta^2 = 0.06$), while they scored lower on dyadic adjustment ($Z = -2.14$, $p = 0.033$, $\eta^2 = 0.02$) and perceived social support ($Z = -2.73$, $p = 0.006$, $\eta^2 = 0.05$).

Out of those participants who indicated that the COVID-19 pandemic affected their relationships, most participants ($n = 58$, 58.6%) reported a negative impact, followed by 28.3% ($n = 28$) who described a positive impact and by 13.1% ($n = 13$) who considered that the pandemic exerted both a positive as well as a negative impact on their relationships. Three participants assumed that COVID-19 affected their couples' relationship, but they did not describe how (e.g., "It had a positive influence"). For this reason, they were not included in the final thematic analysis ($n_{final} = 96$; 62 women and 34 men).

Two main themes emerged from the qualitative analysis of expectant and postpartum participants' descriptions of

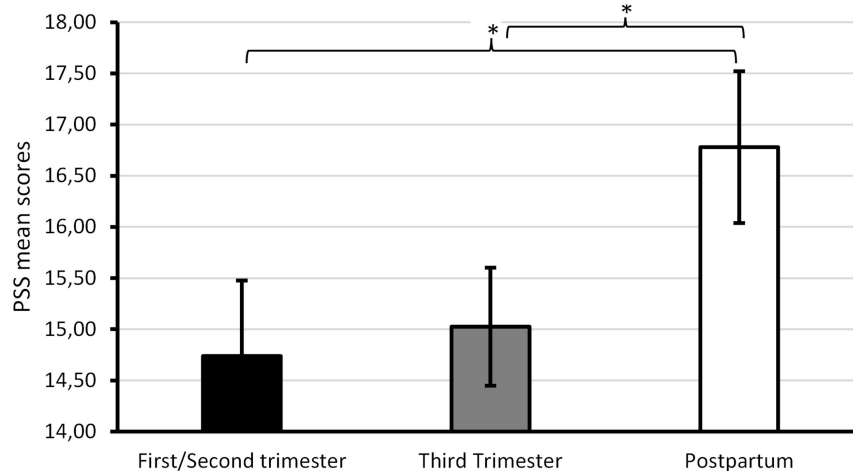


FIGURE 2 | Perceived stress (PSS) scores at each moment of pregnancy/postpartum. * $p < 0.05$.

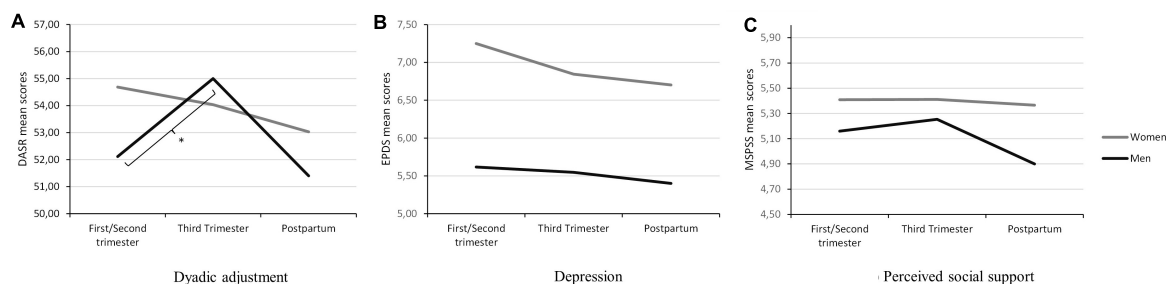


FIGURE 3 | (A–C) Dyadic adjustment (DAS), depression (EPDS), and perceived social support (MSPSS) scores for women and men at each moment of pregnancy/postpartum. * $p < 0.05$.

changes in their intimate relationships due to the COVID-19 pandemic: *Individual Changes* and *Relational Changes*. These two main themes comprised 4 subthemes and 15 codes. **Table 5** includes a complete description of the specific themes, component codes, and illustrative quotes for each. Interestingly, 31.2% of participants reported changes pertaining to the *Individual Changes* theme, 36.5% reported changes pertaining to the *Relational Changes* theme, and 32.3% reported changes pertaining to both themes.

Individual Changes

The central theme **Individual Changes** aggregates responses that identified changes resulting from COVID-19 at an individual level. Many participants clearly differentiated detrimental effects on their personal mental health that were due to pandemic-related stressors (subtheme *Psychological Distress*). Out of the 96 responses, 58 participants (38 women and 20 men) described the experience of psychological distress (60.4%)—generally characterized by the individuals as a negative psychological burden, such as stress and anxiety—and experienced as a direct consequence of several interrelated worries and concerns that emerged during the pandemic.

Participants explained that the COVID-19 pandemic elicited a set of worries that increased their own levels of anxiety,

stress, and sadness (see codes in **Table 5**). This distressful psychological experience was described by most individuals as having an effect on several areas of their lives (e.g., AC, female, 3-months postpartum, “*The stress that resulted from the pandemic has affected us in all sectors of our lives*”). The pandemic-related worries leading to individual psychological distress included general uncertainty about the future, health-related or care-related concerns (e.g., worries about nobody being available to take care of vulnerable family members, lack of child or maternal care), and unsettling concerns regarding economic strain and job loss (e.g., IF, female, third trimester, “*It caused anxiety related to uncertainty about work and our daughter’s safety during birth*”). Being afraid of infection (own or relatives), being isolated, and lacking freedom were also described as causes of individual psychological distress (e.g., HR, male, third trimester, “*I am always afraid of getting infected without knowing it and transmitting it to my wife*”).

Despite the psychological consequences of this challenging situation, two participants (2.1%) perceived an improvement in their emotional well-being (subtheme *Psychological well-being*). For these participants, being confined at home with their partner was experienced as an opportunity to relax and increase enjoyable activities

TABLE 5 | Results of the qualitative thematic analysis ($N = 96$).

Themes	Subthemes	Codes	Representative quotations
Individual changes	Psychological well-being	Restfulness	<i>Because we are at home for longer, the level of personal and emotional fatigue and wear is significantly lower. So, there is more propensity for intimacy (LS, male, first trimester).</i>
		Global negative emotional state	<i>The current situation contains several implications that cause stress, anxiety, and concern about the future, which carries a negative psychological burden that affects all levels of our lives (GM, male, third trimester).</i>
	Psychological distress	Fear of contagion	<i>The worst is the constant fear of being infected, both of us and our baby (CD, female, 3-months postpartum).</i>
		Health/care concerns	<i>The pandemic has affected us because we are concerned about our well-being and our families (MS, female, third trimester).</i>
		Uncertainty about the future	<i>It has a negative influence because it increased sadness and uncertainty about the future (TS, female, third trimester).</i>
		Economic/job concerns	<i>I am concerned about not being able to pay my bills. I can become unemployed without money to buy all the things for my baby and support my wife financially and psychologically (RS, male, first trimester).</i>
		Isolation/Confinement	<i>It negatively influenced everything in our lives since we were isolated without physical contact for 2 months (LA, female, second trimester).</i>
		Lack of freedom	<i>We don't have the freedom to do what we like most (BS, male, first trimester).</i>
Relational changes	Dyadic adjustment	Togetherness	<i>There is more openness, empathy, and commitment to take care of each other and ourselves. There is also more peace and harmony. It was positive, strengthening closeness and affection (AP, female, second trimester).</i>
		Perceived enclosure	<i>Privacy in spaces is reduced (PR, male, second trimester). It did not allow us to miss our partner (AM, female, third trimester).</i>
		Tension and emotional weariness	<i>We are isolated at home for a long time, which resulted in emotional tension/wear sometimes (TS, female, third trimester).</i>
		Parenthood	<i>We are closer and enjoying pregnancy. I think it helped to bond with the baby (JO, male, third trimester).</i>
	Sexual adjustment	Avoidance of physical contact	<i>Because my partner is still working, the baby and I try to keep distance from my partner when he is at home (JR, female, 3-months postpartum). Avoidance of kisses and hugs (MS, female, third trimester).</i>
		Shift in priorities/Sex as secondary	<i>Stress, anxiety, and covid related concerns distanced us from thoughts about our sexual life [...] Decrease of sexual desire (AG, male, third trimester).</i>
		Increased availability for sex	<i>We spend more time at home together and are more available for intimate/sexual relationship (DF, male, second trimester).</i>

with their partners, which ended up promoting their individual as well as their relational well-being. Importantly, participants also consistently described their levels of psychological functioning during the pandemic (whether deteriorated or increased) as a central determinant of the experienced changes in their relationships with their partners and linked to particular changes to their dyadic and sexual adjustment.

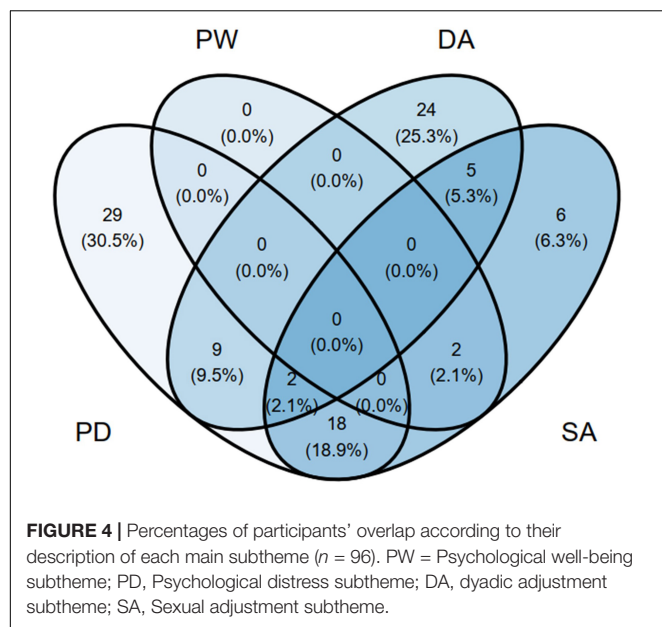
Relational Changes

Changes in the couples' relationship associated with quarantine and COVID-19 restrictions were described in the second main theme **Relational Changes**. Sixty-six participants (68.8%; 44 women and 22 men) reported this theme. Some participants focused their responses on the changes experienced in their romantic relationship with their partner in a broad sense ($n = 33$, 34.4%, subtheme *Dyadic Adjustment*) or on the sexual changes more particularly ($n = 26$, 27.1%, subtheme *Sexual Adjustment*), while others described changes in both of them ($n = 7$, 7.3%).

Out of those participants who perceived changes to their dyadic relationship ($n = 40$; 33 who indicated dyadic changes and 7 who indicated both changes on sexual and dyadic adjustment), most of them referred that the COVID-19 pandemic exerted positive impacts ($n = 21$, 52.5%). Participants noted that, as a consequence of the confinement measures, they enjoyed more

free time with their partner and the baby, because quarantine created opportunities for increased closeness and fostered deeper personal relationships (e.g., JO, male, third trimester, "*We are closer now and enjoying pregnancy. I think it has helped us to bond with the baby*"). Notwithstanding, seven participants (17.5%) also noted negative changes to their relationships, describing that spending all of their time together with their partner created conditions for conflicts and emotional weariness, leading to a possible estrangement (e.g., ES, female, 3-months postpartum, "*We spend all of our time at home and sometimes we argue*").

For sexual adjustment, however, some participants ($n = 23$, 69.7%) reported a decrease in the frequency of sexual contact, desire, and availability for sex due to the pandemic. The COVID-19, as a challenging situation, prompted a change in individuals' current priorities, and made sexual contact less of a priority (e.g., JL, female, third trimester, "*The anxiety that resulted from the pandemic changed my mood and caused anger and demotivation in general, namely in my sexual life*"). Fear of infection was also noted as a reason that led participants to avoid physical/intimate contact. In contrast, some participants ($n = 7$, 21.2%) indicated an increase in availability for sex. Spending and enjoying time together during their confinement period at home also created opportunities for improvement in their sexual lives (e.g., DF, male, second trimester, "*We spend more time at home together, and we are more available for our intimate/sexual relationship*").



Correlates of Perceived Individual and Relational Changes

As is typical of thematic analysis, one individual's description could comprise several distinct codes pertaining to distinct subthemes and, as such, the overlap between the subthemes of the thematic analysis is represented in **Figure 4**. Binomial tests examining whether there were significant differences between individuals in the likelihood of reporting particular themes and subthemes indicated that the proportion of reported individual ($p = 0.010$) and relational ($p < 0.001$) themes was different from chance (1-sided). Regarding the subthemes, the same assumption was true for Psychological Well-being ($p < 0.001$) and Sexual Adjustment ($p = 0.003$), while marginally significant results were found for the Psychological Distress subtheme ($p = 0.052$). The proportion of reported Dyadic Adjustment subtheme was not different from chance ($p = 0.125$). Women did not differ from men on whether they reported each specific theme or subtheme (all $p_s > 0.098$). Likewise, themes and subthemes were not likely to be different for participants with different obstetric status (all $p_s > 0.106$).

The following analyses explored the link between participants' self-reported characteristics and the reported themes and subthemes. As for sociodemographic and contextual factors, chi-square tests indicated that participants who reported that their pregnancy was not planned were more likely to describe *Relational changes* (with 89.5% reporting this theme) than participants with a planned pregnancy (with 63.6% reporting this theme, $p = 0.03$). No differences were found regarding educational level, household income, occupation, and pregnancy risk. As for individual correlates, participants who described Psychological Distress reported higher perceived stress scores (PSS) than participants who did not describe this subtheme ($Z = -2.19$, $p = 0.028$, $\eta^2 = 0.05$). The remaining

indicators of individual and relational functioning (EPDS, DAS-R, MSPSS) were not significant predictors of theme or subtheme selection ($p_s > 0.082$).

DISCUSSION

The current study was aimed at providing a comprehensive examination of women's and men's perceptions of the impact of the COVID-19 pandemic on their intimate relationships, as well as to identify key contextual, individual, and relational aspects relevant to the experience of these experiences of change. Employing a mixed-method approach that combines both quantitative and qualitative methodologies, and with theoretical insights from models on how couples adjust to intense external stressors (e.g., Karney and Bradbury, 1995; Pietromonaco and Overall, 2020), the results of the current study indicated two main interrelated dimensions of change: *Individual Changes* and *Relational Changes*. Transversely to the stage of pregnancy or postpartum they were at, both women and men alike identified particular dimensions of improvement and decline in their individual and relational well-being as a result of the current pandemic. Particular contextual and individual factors (e.g., unplanned pregnancy, greater perceived stress) were significantly linked to negative pandemic-related experiences. These findings provide additional insights on the well-being of individuals who transition to parenthood during the COVID-19 crisis, which are relevant for both clinical and research purposes.

Current COVID-related stressors, compounded with the specific challenges of pregnancy and postpartum, may increase women's and men's vulnerability for negative individual and relational outcomes during an already particularly challenging period for many (Moyer et al., 2020; Ostacoli et al., 2020; Salehi et al., 2020). The current study indicated that, as expected, the impact of the pandemic was not homogenous, with two thirds (69%) of all participants explicitly describing no changes to their intimate lives as a result from the pandemic. This finding is in line with recent research indicating that the effects of the pandemic do not have a marked effect on most individuals and/or couples (Panzeri et al., 2020) and reinforces that a set of factors might protect these couples from these detrimental effects. Comparing to those who identified significant changes in their relationships due to COVID-19, we found that those who did not report such alterations consistently reported higher levels of both individual and relational functioning (i.e., higher levels of depression, anxiety, stress, and lower rates of dyadic adjustment and perceived social support). For those women and men whose relationships were affected due to the current pandemic crisis, our results show a heterogenous pattern of changes. The majority of these male and female participants (58.6%) described negative changes due to the current pandemic, with only 28.3% of participants noting positive changes in their relationships. Interestingly, 13.1% of new parents reported both positive and negative effects. This finding is in accordance with recent studies demonstrating that COVID related stressors might concurrently induce an improvement and a deterioration in several indices of individual's and couple's well-being (Günther-Bel et al.,

2020). Indeed, this mixed picture is distinctly translated in the findings of our qualitative analyses, in which participants refer to experiences such as increased conflict and emotional tension due to the lack of privacy and the constant time together at home, while also noting an improvement in their “togetherness” and availability for intimate and sexual interactions, describing the pandemic as a valuable opportunity to connect and be more present for their newborn baby. The observed pattern of positive, negative, and mixed descriptions of change reinforces the complexity and variability of quarantine ramifications for couples and families (Panzeri et al., 2020; Pietromonaco and Overall, 2020).

The thematic analysis of participants’ descriptions of change due to COVID-19 revealed two major interconnected themes: *Individual Changes* and *Relational Changes*. While a third (31.2%) of women and men reported only individual changes, another third (36.5%) reported only relational changes, and another third (32.3%) of participants described both individual and relational changes due to the pandemic. These findings show that both individual and relationship challenges were triggered by COVID-19, shaping mental health and relationship dynamics. Regarding the first theme, *Individual Changes*, these were closely connected to alterations to own’s mental health as a consequence of COVID-19. Most participants who reported these changes considered the current pandemic as a psychologically distressing period accompanied by negative feelings such as stress, anxiety, and depression (cf. code *Global Negative Emotional State*). These negative feelings were well connected to *health and care concerns* regarding the baby, the partner, other family members, and themselves, decreased perceived safety and stability regarding their jobs and finances (cf. code *Economic/Job Concerns*), increased general *uncertainty about the future*, constant *fear of contagion*, as well as experiences of *isolation* and *lack of freedom* due to the social isolation and confinement measures. Altogether, these interrelated but distinct concerns and worries that emerged during the pandemic for most expectant and postpartum women and men led to personal psychological distress and difficulties adjusting to the current challenges. This is consistent with various studies that have reported predominantly negative psychological effects during the pandemic, including in similar samples (Brooks et al., 2020; Ostacoli et al., 2020).

The described experience of psychological distress had an indirect effect on participants’ interactions with their romantic partner. Particularly, women and men considered that their own fear of contamination and the restrictive measures put in place to prevent COVID-19 infection importantly contributed to relationship difficulties (cf. codes *Avoidance of Physical Contact*, *Perceived Enclosure*). The intense COVID-related concerns and own negative feelings (cf. *Psychological Distress* subtheme, as previously described) were identified as precursors of dyadic and sexual problems (cf. codes *Tension and Emotional Weariness*, *Shift in Priorities/Sex as Secondary*). In other words, as individuals focus and time were increasingly dedicated to pandemic-related stressors, this ultimately imposed negative effects on their romantic and sexual relationship. Indeed, previous literature focusing on the outcomes of quarantine/confinement measures, even in contexts other than the COVID-19 pandemic, indicates

that the personal psychological difficulties due to these measures also pose extended, deleterious effects on their interpersonal and sexual relationships (Cacioppo et al., 2015; Günther-Bel et al., 2020; Panzeri et al., 2020). Notwithstanding, a small number of participants revealed positive changes in individual functioning as a consequence of having more free time and a more harmonious, restful life due to the current pandemic (cf. code *Restfulness*). In these cases, and as opposed to those in which participants reported increased psychological distress (e.g., anxiety, stress), participants adjusted positively to COVID-19 stressors and reported lower levels of fatigue and decreased emotional wear. For these participants, staying at home created opportunities to be more available to their relationship with their partner and with the baby (cf. codes *Togetherness*, *Parenthood*, *Increased Availability for Sex*).

The second major theme, *Relational Changes*, comprises a series of relationship alterations (cf. subtheme *Dyadic Adjustment*) and sexual-related alterations (cf. subtheme *Sexual Adjustment*) resultant from the COVID-19 pandemic. Men and women identified the emergence of novel relationship processes, such as increased communication and openness between partners, commitment, and empathy, which were frequently reported in the current study (cf. code *Togetherness*). For these participants, stay-at-home measures increased their couple-focused time, which influenced their availability, energy, and interest in sexual activity, ultimately resulting in positive dyadic and sexual experiences. Such findings align with prior evidence showing an improvement in couples’ dynamics and increased sexual frequency during the pandemic (Günther-Bel et al., 2020; Yuksel and Ozgor, 2020). The transition to parenthood is a challenging and stressful life transition *per se* and some of these women and men had to face their daily life locked at home without the help of friends or family or with no life distractors (cf. code *Perceived Enclosure*). Novel couple dynamics that emerged because of COVID-19 demands were considered a source of relationship conflict among some participants (cf. codes *Tension and Emotional Weariness*). These individuals experienced low relationship cohesion and high relationship tension, which hampered their dyadic functioning and placed sexual activity as less of a priority due to the emerging conflicts and decreased sexual desire (cf. Code *Shift in Priorities/Sex as Secondary*), congruently with what has been reported in recent studies (Luetke et al., 2020; Panzeri et al., 2020). Sexual changes in their relationship due to the pandemic were identified by the majority of participants (cf. subtheme *Sexual Adjustment*) and included complaints on decreased sexual motivation, sexual desire, and sexual frequency (cf. code *Shift in Priorities/Sex as Secondary*). These women and men considered the pandemic as a predisposing factor for the emergent sexual difficulties, by eliciting fear of contamination during intimate and sexual interactions, by being a mentally exhausting time, or by placing on them several other competing priorities and concerns in their lives. Besides, some of these participants shared their homes with other family members, resulting in perceived lack of privacy and fewer moments of intimacy with the partner. Overall, new parents’ perspectives on their sexual lives during the pandemic show support to previous pandemic evidence by indicating that,

for some, there might be a decrease of sexual behaviors, while others experience an increase in sexual connection and intimacy (Jacob et al., 2020; Luetke et al., 2020).

Altogether, the identified dimensions of change put forward a heterogeneous and multidimensional description of the impacts of COVID-related stressors, confinement and social isolation measures, changes to maternal healthcare during the pandemic, as well as the particular dyadic and parenting challenges that arose for new parent couples. In effect, an interesting and novel finding of our study is the observed overlap between particular dimensions of change in new parents' individual and relational lives. For instance, changes in couples' sexual adjustment were particularly interconnected with experiences of personal distress (18.9% of participants concomitantly reported both subthemes), rather than with experiences of personal well-being (2.1% of participants concomitantly reported both subthemes). A central question of the current study was to identify which particular subsets of individuals might be at heightened risk for the potential deleterious effects of the pandemic. We identified several correlates of poorer intrapersonal and interpersonal functioning. First, both women and men who were at postpartum showed greater levels of perceived stress than those who were at pregnancy during the pandemic. Whereas women demonstrated overall higher levels of depression and increased social support than men, an increased level of stress was found for men, but not women, who were under lockdown measures. Increased stress postpartum is associated with decreased sensitivity to and engagement with a newborn's cues (Shin et al., 2008; Clowtis et al., 2016) and to mothers' and fathers' postpartum depression (Vismara et al., 2016; Da Costa et al., 2019). Stress has also been found to hinder couples' relationship functioning and longevity (Randall and Bodenmann, 2017). Given these detrimental effects, it is critical that future research and clinical efforts consider key aspects such as stress management strategies for men under lockdown (e.g., duration of confinement, efforts to maintain social support while socially distanced) and postpartum experiences for women and men (e.g., stress regulation strategies during postpartum).

Conversely, we also identified factors which were associated with better levels of individual and relational functioning for women and men. When connecting their contextual and individual characteristics and their verbal written descriptions of COVID-19 effects, we found that those participants with a planned pregnancy were less likely to describe relational changes (with 63.6% reporting this theme vs. 89.5% of those with an unplanned pregnancy reporting this theme), underscoring the effects of an unintended pregnancy on the well-being of women and couples (Barton et al., 2017). Unsurprisingly, for those who described pandemic-related psychological distressful outcomes, perceived stress was significantly higher than for those who did not experience such outcomes. Given the negative effects of stress on important physical and psychological indices of health (Larzelere and Jones, 2008), and considering the particular challenging character of the transition to parenthood, our study's findings offer grounds for evidence-based strategies to mitigate the potential adverse effects of stress related to the current crisis on individual and relational well-being. Effective strategies

to manage stress during and after lockdown, to sustain social support, and to better navigate postpartum-specific challenges during COVID-19 may help new mothers and fathers to successfully maintain their individual and relationship well-being during the current pandemic.

This study contributes to a much-needed area of research during the current pandemic, but its findings should be considered in light of some limitations. Although the study is sustained in prior theoretical and empirical research (e.g., Karney and Bradbury, 1995; Pietromonaco and Overall, 2020), this study was correlational and did not follow individuals over time as the pandemic unfolded. Future longitudinal studies should explore the temporal associations of the observed findings. Data were collected online, which limited participation to couples with access to online resources and might have prevented us from capturing deep responses. These would be possible using interviews instead of discrete items but using interviews would be less suitable in the context of a pandemic, possibly increasing non-compliance. Also, the current study mirrors new mothers' and fathers' personal perspectives but does not inform on interdependency of perspectives with participants' respective partners. All individuals who participated in this study were in intimate, mixed-sex relationships, and were transitioning to parenthood for the first-time. It is unknown whether results generalize to more diverse samples or to those who are faced with additional stressors (e.g., same-sex couples, adoptive parents, parents to an infant born preterm) and this might be explored in future research. Despite these limitations, this study offers a novel, comprehensive perspective on the impact of COVID-19 on expectant and postpartum women and men. Resulting from the integration of both quantitative and qualitative results, the current findings can guide researchers and clinicians in targeting the specific challenges which have emerged during the pandemic for these individuals and to the development of effective strategies to promote new mothers' and fathers' well-being.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article are available upon reasonable request from the corresponding author IMT.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee at the Faculty of Psychology and Educational Sciences of the University of Porto and at the Centro Materno-Infantil do Norte. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

IT, JF, and MC: conceptualization. IT, JF, CM, and MC: methodology and writing—original draft. IT, JF, PN, and

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REFERENCES

- Bai, Y. M., Lin, C. C., Lin, C. Y., Chen, J. Y., Chue, C. M., and Chou, P. (2004). Survey of stress reactions among health care workers involved with the SARS outbreak. *Psychiatr. Serv.* 55, 1055–1057. doi: 10.1176/appi.ps.55.9.1055
- Barger, S. D. (2013). Social integration, social support and mortality in the US national health interview survey. *Psychosom. Med.* 75, 510–517. doi: 10.1097/PSY.0b013e318292ad99
- Barton, K., Redshaw, M., Quigley, M. A., and Carson, C. (2017). Unplanned pregnancy and subsequent psychological distress in partnered women: a cross-sectional study of the role of relationship quality and wider social support. *BMC Pregnancy Childbirth* 17:44. doi: 10.1186/s12884-017-1223-x
- Bendau, A., Plag, J., Kunas, S., Wyka, S., Ströhle, A., and Petzold, M. B. (2020). Longitudinal changes in anxiety and psychological distress, and associated risk and protective factors during the first three months of the COVID-19 pandemic in Germany. *Brain Behav.* 11:e01964. doi: 10.1002/brb3.1964
- Ben-Zur, H. (2019). “Transactional Model of Stress and Coping” in *Encyclopedia of Personality and Individual Differences*. eds V. Zeigler-Hill and T. Shackelford (Germany: Springer). 72–75.
- Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Q. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp063oa
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8
- Bruce, L. D. H., Wu, J. S., Lustig, S. L., Russell, D. W., and Nemecek, D. A. (2019). Loneliness in the United States: a 2018 National Panel Survey of Demographic, Structural, Cognitive, and Behavioral Characteristics. *Am. J. Health Promotion* 33, 1123–1133. doi: 10.1177/0890117119856551
- Busby, D. M., Christensen, C., Crane, D. R., and Larson, J. H. (1995). A revision of the Dyadic Adjustment Scale for use with distressed and nondistressed couples. *J. Mar. Fam. Ther.* 21, 289–308.
- Cacioppo, J. T., Cacioppo, S., Capitanio, J. P., and Cole, S. W. (2015). The neuroendocrinology of social isolation. *Annu. Rev. Psychol.* 66, 733–767. doi: 10.1146/annurev-psych-010814-015240
- Carvalho, S., Pinto-Gouveia, J., Pimentel, P., Mala, D., and Mota-Pereira, J. (2011). Características psicométricas da versão portuguesa da Escala Multidimensional de Suporte Social Percebido (Multidimensional Scale of Perceived Social Support - MSPSS). *Psicologica* 54, 309–358.
- Cava, M. A., Fay, K. E., Beanlands, H. J., McCay, E. A., and Wignall, R. (2005). The experience of quarantine for individuals affected by SARS in Toronto. *Public Health Nurs.* 22, 398–406. doi: 10.1111/j.0737-1209.2005.220504.x
- Clowtis, L. M., Kang, D. H., Padhye, N. S., Rozmus, C., and Barratt, M. S. (2016). Biobehavioral factors in child health outcomes the roles of maternal stress, maternal-child engagement, salivary cortisol, and salivary testosterone. *Nurs. Res.* 65, 340–351. doi: 10.1097/NNR.0000000000000172
- Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A Global Measure of Perceived Stress. *J. Health Soc. Behav.* 24:385. doi: 10.2307/2136404
- Cornwell, E. Y., and Waite, L. J. (2009). Social disconnectedness, perceived isolation, and health among older adults. *J. Health Soc. Behav.* 50, 31–48. doi: 10.1177/002214650905000103
- Costa, P. (2012). “Desenvolvimento da Escala Revista de Ajustamento Diádico (RDAS) com casais do mesmo sexo,” in *VIII Congresso Iberoamericano de Avaliação Avaliação Psicológica*. Lisboa.
- Cox, J. L., Holden, J. M., and Sagovsky, R. (1987). Detection of Postnatal Depression: development of the 10-item Edinburgh Postnatal Depression scale. *Br. J. Psychiatry* 150, 782–786. doi: 10.1192/bjp.150.6.782
- Creswell, J. W., and Plano Clark, V. L. (2011). *Designing and Conducting Mixed Methods Research* 2nd Edn. United States: Sage.
- Da Costa, D., Danieli, C., Abrahamowicz, M., Dasgupta, K., Sewitch, M., Lowensteyn, I., et al. (2019). A prospective study of postnatal depressive symptoms and associated risk factors in first-time fathers. *J. Affect. Disord.* 249, 371–377. doi: 10.1016/j.jad.2019.02.033
- Del Boca, D., Oggero, N., Profeta, P., and Rossi, M. (2020). Women’s and men’s work, housework and childcare, before and during COVID-19. *Rev. Econom. Household* 18, 1001–1017. doi: 10.1007/s11150-020-09502-1
- Desclaux, A., Badji, D., Ndione, A. G., and Sow, K. (2017). Accepted monitoring or endured quarantine? Ebola contacts’ perceptions in Senegal. *Soc. Sci. Med.* 178, 38–45. doi: 10.1016/j.socscimed.2017.02.009
- Di Mascio, D., Khalil, A., Saccone, G., Rizzo, G., Buca, D., Liberati, M., et al. (2020). Outcome of coronavirus spectrum infections (SARS, MERS, COVID-19) during pregnancy: a systematic review and meta-analysis. *Am. J. Obstet. Gynecol.* 2:100107. doi: 10.1016/j.ajogmf.2020.100107
- DiGiovanni, C., Conley, J., Chiu, D., and Zaborski, J. (2004). Factors influencing compliance with quarantine in Toront. *Strat. Pract. Sci.to* during the 2003 SARS outbreak. *Biosec. Bioterr. Biode* 2, 265–272. doi: 10.1089/bsp.2004.2.265
- Doss, B. D., and Rhoades, G. K. (2017). The transition to parenthood: impact on couples’ romantic relationships. *Curr. Opin. Psychol.* 13, 25–28. doi: 10.1016/j.copsyc.2016.04.003
- Farré, L., Fawaz, Y., González, L., and Graves, J. (2020). How the Covid-19 lockdown affected gender inequality in paid and unpaid work in Spain. *IZA Dis. Pap.* 13434, 1–36.
- Figueiredo, B., Pacheco, A., and Costa, R. (2007). Depression during pregnancy and the postpartum period in adolescent and adult Portuguese mothers. *Arch. Womens Ment. Health* 10, 103–109. doi: 10.1007/s00737-007-0178-8
- Global Times (2020). *Chinese City Experiencing a Divorce Peak as a Repercussion of COVID-19*. Available online at: <https://www.globaltimes.cn/content/1181829.shtml> (accessed February 15, 2021).
- Guest, G., Namey, E., and Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLoS One* 15:e0232076. doi: 10.1371/journal.pone.0232076
- Günther-Bel, C., Vilaregut, A., Carratala, E., Torras-Garat, S., and Pérez-Testor, C. (2020). A mixed-method study of individual, couple, and parental functioning during the state-regulated COVID-19 lockdown in Spain. *Fam. Process* 59, 1060–1079. doi: 10.1111/famp.12585
- Hodes, G. E., and Epperson, C. N. (2019). Sex differences in vulnerability and resilience to stress across the life span. *Biol. Psychiatry* 86, 421–432. doi: 10.1016/j.biopsych.2019.04.028
- Jacob, L., Smith, L., Butler, L., Barnett, Y., Grabovac, I., McDermott, D., et al. (2020). Challenges in the Practice of Sexual Medicine in the Time of COVID-19 in the United Kingdom. *J. Sex. Med.* 17, 1229–1236. doi: 10.1016/j.jsxm.2020.05.001
- Jeong, H., Yim, H. W., Song, Y.-J., Ki, M., Min, J.-A., Cho, J., et al. (2016). Mental health status of people isolated due to Middle East Respiratory Syndrome. *Epidemiol. Health* 38:e2016048. doi: 10.4178/epih.e2016048
- Karney, B. R., and Bradbury, T. N. (1995). The longitudinal course of marital quality and stability: a review of theory, methods, and research. *Psychol. Bull.* 118, 3–34. doi: 10.1037/0033-2909.118.1.3

- Larzelere, M. M., and Jones, G. N. (2008). Stress and Health. *Prim. Care* 35, 839–856. doi: 10.1016/j.pop.2008.07.011
- Lauder, W., Sharkey, S., and Mummery, K. (2004). A community survey of loneliness. *J. Adv. Nurs.* 46, 88–94. doi: 10.1111/j.1365-2648.2003.02968.x
- Lazarus, R., and Folkman, S. (1984). *Stress, Appraisal and Coping*. Germany: Springer Publishing Company Inc.
- Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921
- Luetke, M., Hensel, D., Herbenick, D., and Rosenberg, M. (2020). Romantic Relationship Conflict Due to the COVID-19 Pandemic and Changes in Intimate and Sexual Behaviors in a Nationally Representative Sample of American Adults. *J. Sex Mar. Ther.* 46, 747–762. doi: 10.1080/0092623X.2020.1810185
- Luo, M., Guo, L., Yu, M., and Wang, H. (2020). The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – A systematic review and meta-analysis. *Psychiatry Res.* 291:113190. doi: 10.1016/j.psychres.2020.113190
- Matthey, S., Barnett, B., Kavanagh, D. J., and Howie, P. (2001). Validation of the Edinburgh Postnatal Depression Scale for men, and comparison of item endorsement with their partners. *J. Affect. Disord.* 64, 175–184. doi: 10.1016/S0165-0327(00)00236-6
- Mihashi, M., Otsubo, Y., Yinjuan, X., Nagatomi, K., Hoshiko, M., and Ishitake, T. (2009). Predictive Factors of Psychological Disorder Development During Recovery Following SARS Outbreak. *Health Psychol.* 28, 91–100. doi: 10.1037/a0013674
- Moyer, C. A., Compton, S. D., Kaselitz, E., and Muzik, M. (2020). Pregnancy-related anxiety during COVID-19: a nationwide survey of 2740 pregnant women. *Arch. Womens Ment. Health* 23, 757–765. doi: 10.1007/s00737-020-01073-5
- Ostacoli, L., Cosma, S., Bevilacqua, F., Berchialla, P., Bovetti, M., Carosso, A. R., et al. (2020). Psychosocial factors associated with postpartum psychological distress during the Covid-19 pandemic: a cross-sectional study. *BMC Pregnancy Childbirth* 20:703. doi: 10.1186/s12884-020-03399-5
- Pais-Ribeiro, J., Silva, I., Ferreira, T., Martins, A., Meneses, R., and Baltar, M. (2007). Validation study of a Portuguese version of the Hospital Anxiety and Depression Scale. *Psychol. Health Med.* 12, 225–237. doi: 10.1080/13548500500524088
- Panzeri, M., Ferrucci, R., Cozza, A., and Fontanesi, L. (2020). Changes in Sexuality and Quality of Couple Relationship During the COVID-19 Lockdown. *Front. Psychol.* 11:565823. doi: 10.3389/fpsyg.2020.565823
- Pfefferbaum, B., and North, C. S. (2020). Mental Health and the Covid-19 Pandemic. *N. Engl. J. of Med.* 383, 510–512. doi: 10.1056/NEJMp2008017
- Phoswa, W. N., and Khaliq, O. P. (2020). Is pregnancy a risk factor of COVID-19? *Eur. J. Obstetr. Gynecol. Reprod. Biol.* 252, 605–609. doi: 10.1016/j.ejogrb.2020.06.058
- Pietromonaco, P. R., and Overall, N. C. (2020). Applying Relationship Science to Evaluate How the COVID-19 Pandemic May Impact Couples' Relationships. *Am. Psychol.* 76, 438–450. doi: 10.1037/amp0000714
- Randall, A. K., and Bodenmann, G. (2017). Stress and its associations with relationship satisfaction. *Curr. Opin. Psychol.* 13, 96–106. doi: 10.1016/j.copsyc.2016.05.010
- Salehi, L., Rahimzadeh, M., Molaei, E., Zaheri, H., and Esmaelzadeh-Saeieh, S. (2020). The relationship among fear and anxiety of COVID-19, pregnancy experience, and mental health disorder in pregnant women: a structural equation model. *Brain Behav.* 10, 1–8. doi: 10.1002/brb3.1835
- Shin, H., Park, Y. J., Ryu, H., and Seomun, G. A. (2008). Maternal sensitivity: a concept analysis. *J. Adv. Nurs.* 64, 304–314. doi: 10.1111/j.1365-2648.2008.04814.x
- Shiovitz-Ezra, S., and Leitsch, S. A. (2010). The role of social relationships in predicting loneliness: the national social life, health, and aging project. *Soc. Work Res.* 34, 157–167. doi: 10.1093/swr/34.3.157
- Spagnolo, P. A., Manson, J. A. E., and Joffe, H. (2020). Sex and Gender Differences in Health: what the COVID-19 Pandemic Can Teach Us. *Ann. Inter. Med.* 173, 385–386. doi: 10.7326/M20-1941
- Teddle, C., and Tashakkori, A. (2012). Common “Core” Characteristics of Mixed Methods Research: a Review of Critical Issues and Call for Greater Convergence. *Am. Behav. Sci.* 56, 774–788. doi: 10.1177/0002764211433795
- Trigo, M., Canudo, N., Branco, F., and Silva, D. (2010). Estudo das propriedades psicométricas da Perceived Stress Scale (PSS) na população portuguesa. *Psychologica* 53, 353–378. doi: 10.14195/1647-8606_53_17
- van der Vegt, I., and Kleinberg, B. (2020). “Women Worry About Family, Men About the Economy: gender Differences in Emotional Responses to COVID-19” in *Social Informatics*. eds S. Aref, K. Bontcheva, M. Braghieri, F. Dignum, F. Giannotti, F. Grisolia, et al. (Germany: Springer International Publishing). 397–409.
- Vismara, L., Rollé, L., Agostini, F., Sechi, C., Fenaroli, V., Molgora, S., et al. (2016). Perinatal parenting stress, anxiety, and depression outcomes in first-time mothers and fathers: a 3-to 6-months postpartum follow-up study. *Front. Psychol.* 7:738. doi: 10.3389/fpsyg.2016.00938
- Wastnedge, E. A. N., Reynolds, R. M., van Boeckel, S. R., Stock, S. J., Denison, F. C., Maybin, J. A., et al. (2021). Pregnancy and COVID-19. *Physiol. Rev.* 101, 303–318. doi: 10.1152/physrev.00024.2020
- Yang, H., and Ma, J. (2020). How an Epidemic Outbreak Impacts Happiness: factors that Worsen (vs. Protect) Emotional Well-being during the Coronavirus Pandemic. *Psychiatry Res.* 289:113045. doi: 10.1016/j.psychres.2020.113045
- Yuksel, B., and Ozgor, F. (2020). Effect of the COVID-19 pandemic on female sexual behavior. *Int. J. Gynecol. Obstetr.* 150, 98–102. doi: 10.1002/ijgo.13193
- Zamarro, G., and Prados, M. J. (2021). Gender differences in couples' division of childcare, work and mental health during COVID-19. *Rev. Econom. Household* 19, 11–40. doi: 10.1007/s11150-020-09534-7
- Zigmond, A. S., and Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatr. Scand.* 67, 361–370. doi: 10.1111/j.1600-0447.1983.tb09716.x
- Zimet, G. D., Dahlem, N. W., Zimet, S. G., and Farley, G. K. (1988). The Multidimensional Scale of Perceived Social Support. *J. Pers. Assess.* 52, 30–41. doi: 10.1207/s15327752jpa5201_2

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Stability of Risk Preferences During COVID-19: Evidence From Four Measurements

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This article studies the stability of risk-preference during the COVID-19 pandemic. The results differ between risk-preference measurements and also men and women. We use March 13, 2020, when President Trump declared a national state of emergency as a time anchor to define the pre-pandemic and on-pandemic periods. The pre-pandemic experiment was conducted on February 21, 2020. There are three on-pandemic rounds conducted 10 days, 15 days, and 20 days after the COVID-19 emergency declaration. We include four different risk-preference measures. Men are more sensitive to the pandemic and become more risk-averse based on the Balloon Analogue Risk Task (BART). Women become more risk-averse in the Social and Experience Seeking domains based on the results from the Domain-Specific Risk-Taking (DOSPERT) and Sensation Seeking Scales (SSS). Both men's and women's risk-preference are stable during COVID-19 based on a Gamble Choice (GC) task. The results match our hypotheses which are based on the discussion about whether the psychological construct of risk-preference is general or domain-specific. The differential outcomes between incentivized behavioral and self-reported propensity measures of risk-preference in our experiment show the caveats for studies using a single measure to test risk-preference changes during COVID-19.

Keywords: gender differences, risk preferences, COVID-19 pandemic, psychological construct of risk-preference, risk-preference measures, JEL Codes: C9, D81, J1

1. INTRODUCTION

Risk preferences are a key component of individual decision-making and behavior. The question of whether risk preferences are stable over time or under different contexts has received a great deal of attention in previous literature (Anderson and Mellor, 2009; Schildberg-Hörisch, 2018). COVID-19 emerged in December 2019. Since then, it has spread to more than 200 countries. COVID-19 is arguably one of the deadliest pandemics in human history (Zoumpourlis et al., 2020). COVID-19 may change people's preferences or expectations in various aspects of daily life (Barrios and Hochberg, 2020; Binder, 2020; Chan et al., 2020; Guenther et al., 2021). The purpose of this article focuses on individuals' risk-preference changes during COVID-19.

Based on classical economic theories, preferences (including risk preferences) are stable and unaffected by experience over time (Stigler and Becker, 1977). However, evidence from empirical studies shows that people's risk attitudes can be affected by negative shocks (Bogliacino et al., 2021),

such as natural disasters (Eckel et al., 2009; Page et al., 2014; Hanaoka et al., 2018; Kahsay and Osberghaus, 2018; Abatayo and Lynham, 2020), financial crisis (Jetter et al., 2020), and violent events (Callen et al., 2014; Jakiela and Ozier, 2019). COVID-19 has affected the global economy substantially. Many people lost their jobs and business during COVID-19 (Kawohl and Nordt, 2020). Thus, COVID-19 may change the background risk for people by changing the living and working environment and bringing more uncertainties to the life (Gollier and Pratt, 1996; Quiggin, 2003; Guiso and Paiella, 2008). The change in background risk may bring changes in the risk-taking behavior of people (Eeckhoudt et al., 1996; Tsetlin and Winkler, 2005; Lee, 2008). More recently and related to this article, studies on risk-preference comparisons between pre-COVID-19 and on-COVID-19 show mixed results. Angrisani et al. (2020), Lohmann et al. (2020), and Drichoutis and Nayga (2021) find no significant change in risk preferences during COVID-19; Gassmann et al. (2020) and Shachat et al. (2021b) suggest less risk aversion or increased risk tolerance during COVID-19; the results from Harrison et al. (2020) and Li et al. (2021), however, exhibit more risk aversion of subjects under COVID-19; Shachat et al. (2021a) find decreased risk tolerance in the loss domain and less risk aversion in the gain domain. All of these studies use only one (type) measurement of risk-preference, and they all use experiments conducted in 2019 as a pre-pandemic baseline. The subjects are all students.

We advance the literature in three major aspects. First, we use four elicitation methods of risk-preference which are widely used in economics and psychology studies: Balloon Analogue Risk Task (BART) developed by Lejuez et al. (2002), the Gamble Choice (GC) developed by Eckel and Grossman (2008), Domain-Specific Risk-Taking (DOSPERT) developed by Blais and Weber (2006), and Sensation Seeking Scale (SSS) developed by Zuckerman et al. (1964). BART and GC are incentivized behavioral measures, and DOSPERT and SSS are self-reported propensity measures. Frey et al. (2017) found a substantial gap between revealed risk-preference by behavioral measures and stated risk-preference by self-reported measures. Frey et al. (2017) acknowledge that the vast majority of past empirical work on risk-preference has typically used single measures of risk-preference, and suggest that using several instruments to measure risk-reference may reduce measurement error for future empirical work.

Second, we believe the timeline of our study can reflect the most immediate and salient changes in risk preferences by the COVID-19 shock. We implemented an online experiment to verify the robustness of Zhang and Palma (2021) on February 21, 2020, that serves as a baseline (pre-pandemic)¹. The experiment was about risk-taking behavior with insurance, and it consists of the four risk-preference elicitation methods mentioned above. On March 13, 2020, President Trump declared a national state of emergency. We use March 13, as a time anchor and implemented three rounds of parallel experiments conducted online on March

23, 2020, March 28, 2020, and April 2, 2020, respectively. The three dates were selected to be 10, 15, and 20 days after the state of emergency declaration. Note that on February 21, the effects of COVID-19 had not yet spread widely in the United States, and there were only 19 daily confirmed cases based on the Centers for Disease Control and Prevention (CDC) data tracker. Starting March 13, the number of COVID-19 cases in the U.S. increased exponentially. The new daily confirmed cases on our on-pandemic rounds are 11,400, 20,820, 30,157, respectively (refer to **Appendix 7** for the trend of daily cases from February 21 to April 2). We argue that the rounds of our experiment reflect the pre and on-pandemic times. Third, we implement an online experiment with more a general population than students as subjects. All four rounds were conducted using Amazon Mturk. The average age of subjects in our experiment is 41, and all subjects are located in the United States. Subjects of the pre and on-pandemic are from the same population. We do not find significant differences in demographic characteristics between pre and on-pandemic rounds, except that there are only marginal significant differences in age and household size (refer to **Appendix 8**). In regressions in the result section, we control for those demographic variables.

The original experiment in Zhang and Palma (2021) was conducted in November 2016 to investigate risk-taking behavior under different insurance schemes. The main measurement used to assess risk-taking behavior was the BART. We also included three other risk preferences elicitation methods to validate BART as a measurement of risk-taking behavior. The original experiment contains three treatments varying in the insurance types set in BART. For the pre-pandemic round on February 21, 2020, we implemented the entire original experiment with three treatments; we only ran the “Voluntary Insurance” treatment for the other three on-pandemic rounds. The reason is that the focus of this article is risk-preference changes instead of insurance. For the on-pandemic rounds, we added a question at the end of the experiment about whether participants were in self-isolation or not. Around 81% of subjects answered “Yes.” This to some extent confirms that our subjects were experiencing COVID-19 impacts when they were participating in our on-pandemic rounds.

Gender differences in risk preferences is a well documented phenomenon in the economics literature (Eckel and Grossman, 2008). Economists have tried to use the gender gap in risk preferences to explain persistent gender differences in other domains such as willingness to compete and occupation choice (Niederle and Vesterlund, 2007; Marianne, 2011; Shurchkov and Eckel, 2018). Our results also focus on the heterogeneous effects of COVID-19 on men and women’s risk preferences. We do not obtain consistent results across all four risk-preference elicitation methods. Based on the BART results, men are more sensitive, and become more risk-averse during COVID-19; there is no change in women’s risk-preference according to BART. We find a gender gap in risk preferences in the pre-pandemic period based on BART, however, this difference disappears during the pandemic. In both DOSPERT and SSS, women respond more to COVID-19 compared to men and become more risk-averse in the specific Social and Experience Seeking domains. There are no changes in risk-preference for both men

¹The pre-pandemic data was part of another project (Zhang and Palma, 2021). Since we obtained a baseline at that time, this data served as the motivation for this study.

and women according to a GC task (Eckel and Grossman, 2008).

The results are in line with our hypotheses about the stability of risk-preference during COVID-19. The debate about whether risk-preference is general or domain-specific has a long history in psychology and economics (Mata et al., 2018). Recent study shows that the psychological construct of risk-preference includes both general and domain-specific components (Frey et al., 2017). We provide our hypotheses based on the discussion of the nature of risk-preference and different psychological traits captured by different measures in our experiment. We elaborate on the hypotheses in Section 3.

Our results provide new insights to the literature about the stability of risk-preference during shocks from two perspectives. First, different risk-preference measures provide differential results and this depends on what psychological traits (general or domain-specific) the measures captured. Second, there is a gender difference in the stability of risk-preference during shocks.

The rest of the article is organized as follows. Section 2 introduces the four risk-preference measures in detail. Section 3 provides the hypotheses. Section 4 present the experimental design and procedures. Section 5 shows the results. Section 6 discusses the correlations of risk-preference measured by the four methods in our experiment, and Section 7 concludes.

2. RISK-PREFERENCE MEASURES

The methods for measuring risk preferences date back to the last century (Officer and Halter, 1968; Dillon and Scandizzo, 1978). Well-established instruments both in psychology and economics (Holt and Laury, 2002; Eckel and Grossman, 2008; Dohmen et al., 2011; Charness et al., 2013; Crosetto and Filippin, 2016) have been designed to prevent potential negative outcomes associated with behavior under risk and uncertainty. In this article, we use four risk-preference elicitation methods: BART, GC, DOSPERT, and SSS.

Balloon Analogue Risk Task Participants are presented with a balloon on separate computer screens and they are asked to pump

the balloon from 1 to 128 times. The balloon may explode at some point. Participants receive a monetary reward for each successful pump. However, if the balloon explodes, they receive nothing. This means a higher number of pumps carries higher potential earnings but also a higher probability of an explosion. Therefore, a higher number of pumps indicates more risk-taking behavior, and hence BART is able to assess risk-taking behavior by using the average number of pumps. Please refer to the **Appendix** for the explosion probability algorithm for each balloon. BART allows for the calculation of the risk coefficient for each pump choice under the assumption of constant relative risk aversion (CRRA) (Zhang and Palma, 2021). According to the risk coefficient, risk-averse, risk-neutral, risk-loving individuals choose less than 64, 64, and more than 64 pumps, respectively. In this article, we use the automatic version of BART (Pleskac et al., 2008) in which participants input the number of pumps into a box and the balloon is pumped automatically². Subjects see the process of pumping and the outcome of the balloon before they proceed to the next balloon.

The advantage of BART is that participants do not need extra knowledge to understand the game. The disadvantage of BART is that it needs to be computerized, and there is ambiguity about the probability of explosion (Charness et al., 2013; Crosetto and Filippin, 2013). Thus, we inform subjects that the maximum number of pumps for each balloon is 128 in order to reduce potential ambiguity.

Gamble Choice is designed as a simple set of lottery choices that produce enough variance to allow for the estimation of utility parameters and risk preferences. Participants are presented with six gambles and they are asked to choose the one that they would like to play. In **Table 1**, each of the gambles involves a 50% chance of receiving a high payoff and a 50% chance for a low payoff. The first gamble in our experiment has a certain payoff of 10 cents³. For gambles 1-5, both the expected payoffs and SD (risk) increase linearly. Note that gamble 6 has the same expected payoff as gamble 5 but with a higher variance. Under the CRRA assumption, each gamble implies an interval for the risk coefficient with the utility function ($u(x) = x^{1-r}$). Risk-averse subjects with $r > 0$ choose gambles 1-4 where the variance is lower. Risk-neutral subjects with $r = 0$ choose gamble 5, which has the highest expected return. Risk-seeking subjects with $r < 0$ choose gamble 6, which has higher expected payoff and a higher variance.

Domain-Specific Risk-Taking was developed to take into account that risk attitudes may vary across different domains. For example, people differ in the way they resolve finance-related or health-related decisions in which risk attitudes play a key role. DOSPERT assesses risk-taking behavior in five different content domains: financial, health, recreational, ethical, and social decisions. Financial decisions contain two subcategories:

TABLE 1 | Gamble choice (GC) task.

Gamble choice	The event	Probability(%)	Payoff (cents)
1.	A	50	10
	B	50	10
2.	A	50	18
	B	50	6
3.	A	50	26
	B	50	2
4.	A	50	34
	B	50	-2
5.	A	50	42
	B	50	-6
6.	A	50	44
	B	50	-8

²The automatic version solves the data truncation problem of the original version in which the potential risk-taking behavior cannot be observed for the explosions. Pleskac et al. (2008) show that the automatic version does not change the validity of BART as an assessment of risk-taking.

³Our experiment was conducted on Amazon Mturk, and hence the payment of each task in our experiment is cent based.

investing and gambling. DOSPERT contains 30 questions in total. Participants are asked to rate the likelihood that they would engage in the specific risky activities for each question using a 7-point rating scale from 1 (extremely unlikely) to 7 (extremely likely). The self-reported risk-taking measures in DOSPERT have been documented to be significantly correlated with risk-taking behavior in the real world in a variety of domains (Farnham et al., 2018; Shou and Olney, 2020). The full questionnaire is shown in the **Appendix**.

Sensation Seeking Scale consists of 40 forced-choice items designed to measure sensation seeking traits as a psychological instrument. A sample item includes “A. I often wish I could be a mountain climber. B. I can’t understand people who risk their necks climbing mountains.” Participants must choose one of the two options for each item. The SSS yields one total score and four primary sub-scales with 10 items for each sub-scale: (1) Thrill and Adventure Seeking (TAS, desire to engage in sports or activities involving speed and danger; e.g., mountain climbing), (2) Experience Seeking (ES, desire to experience through the mind and senses, travel, and a non-conforming lifestyle; e.g., dressing in strange ways), (3) Disinhibition (DIS, desire for social and sexual disinhibition; e.g., “uninhibited” parties), and (4) Boredom Susceptibility (BS, aversion to repetition, routine, and dull people; e.g., preference for unpredictable friends). The SSS has been shown to be reliable across cultures, ages, and genders (Zuckerman et al., 1978). The concept of sensation seeking is presumed to account for differences in people’s willingness to participate in risky activities across a wide range of behaviors (Zuckerman, 1994). Higher scores in SSS indicate higher risk-taking. The self-reported risk-taking measures in SSS have been found to be associated with risky behavior in different settings (Zaleski, 1984; Wong and Carducci, 1991; Zuckerman, 2007). The description of the scales and item loadings are listed in the **Appendix**.

3. HYPOTHESES

The four elicitation methods used in our experiment belong to two different measurement traditions of risk preferences in psychology and economics (Charness et al., 2013; Mata et al., 2018). BART and GC are incentivized behavioral measures eliciting the revealed risk preferences. DOSPERT and GC are self-reported propensity measures accessing the stated risk preferences. The question about whether risk-preference should be conceptualized as a general psychological construct, or as domain-specific construct, or as a combination of both has received a great deal of attention in psychology and economics (Zhong et al., 2009; Benjamin et al., 2012; Highhouse et al., 2017). If the nature of risk-preference is a general construct, then risk-preference should be a stable psychological trait across time and domains; if risk-preference is domain-specific, then it includes various traits in different domains such as finance, health, and experience. Frey et al. (2017) used 39 risk-preference measures to study the psychometric structure of risk-preference, and they suggest that the construct of risk-preference contains both general and domain-specific components, with

a general factor of risk-preference explaining half of the variance and a series domain-specific factors explaining the other half.

Frey et al. (2017) also suggest a substantial gap between behavioral and propensity risk-preference measurement traditions. Both Frey et al. (2017) and Mata et al. (2018) argue a primacy of self-reported propensity measures over behavioral measures by studying the *temporal stability*, *convergent validity*, and *predictive validity* of the measures.

COVID-19 affects various aspects of life and work with different levels of degree. For example, people are required to self-isolate and keep social distance during COVID-19, and many companies lay off workers and freeze hiring. People have lower expectations about careers due to COVID-19. Thus, COVID-19 may have stronger effects of those experiences and social-related aspects of life. Different risk-preference measures may capture different psychological traits Mata et al. (2018). In our experiment, the behavioral measures (BART & GC) are more likely to capture a unitary psychological trait that is stable across domains; DOSPERT and SSS contains sub-domains, and they are more likely to capture various domain-specific traits. Thus, we have the following hypotheses.

Hypothesis 1. Risk-preference tends to be stable during COVID-19 when it is measured by BART and GC.

Hypothesis 2. The risk-preference measured in specific domains by DOSPERT and SSS which are likely to be affected by COVID-19 changes during COVID-19.

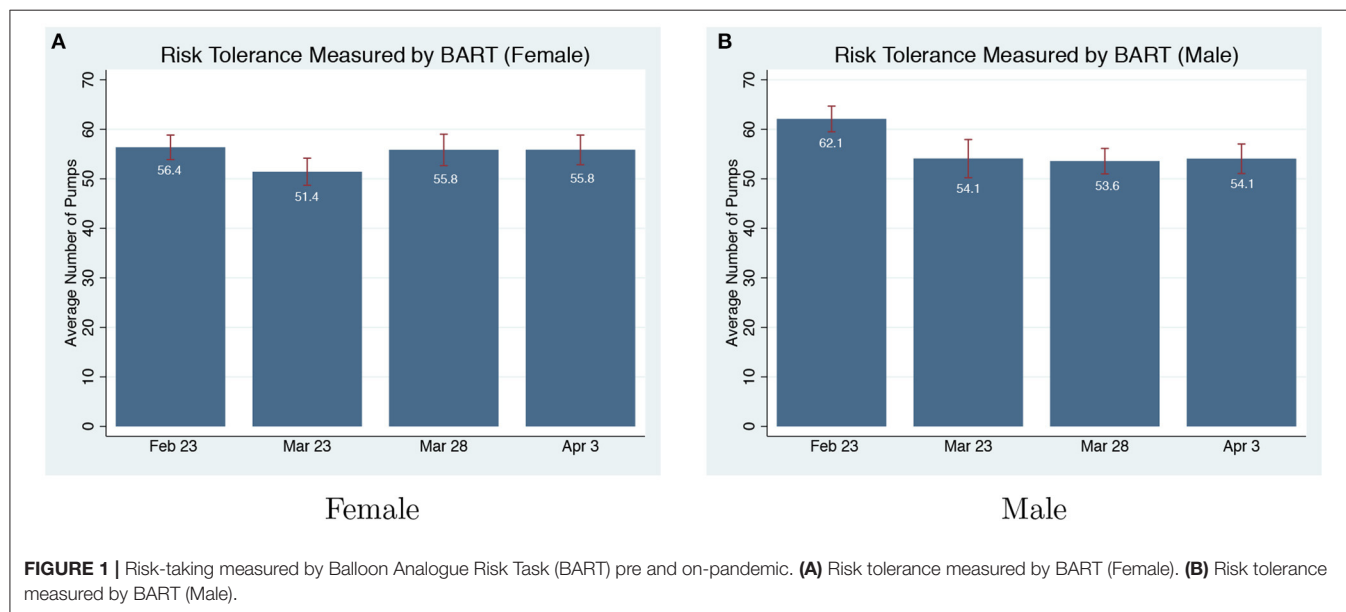
4. EXPERIMENTAL DESIGN

The experiment was conducted on Amazon’s Mechanical Turk (MTurk), an online labor market platform where businesses and individuals can post tasks and workers perform the tasks in exchange for a payment. We published a Human Intelligence Task (HIT) on MTurk. The HIT provided instructions about the type, length, payment, and IRB information for the experiment. The workers on MTurk decided whether they want to participate or not after reading the instruction⁴. The experiment was computerized in Inquisit (Inquisit, 2016). Interested workers were instructed to click on a link included in the HIT that took them to the experiment implemented by the Inquisit web lab. The first page of the experiment was the electronic consent form. Participation was voluntary and workers could decide to quit at any time. For those who completed the experiment, a unique random ID was generated on the last page of the experiment. Workers were required to submit their code through MTurk. We later used these ID- codes to make the payments by linking the codes recoded on our experiment to the workers’ MTurk account. Workers’ earnings included a fixed participation fee and a bonus from the incentivized BART and GC tasks during the experiment. The average payment was \$2.

⁴Mturk allows requesters to specify qualifications of workers for the HIT published. We required the location of workers to be in the United States, and the HIT approval rate and the number of HITs approved to be greater than 95% and 5,000, respectively.

TABLE 2 | Summary of each round.

	Treatment	BART	DOSPERT	SSS	GC	No. Subjects
Feb 21rd	All three treatments (only data from Voluntary insurance is used)	Middle 28 balloons	30 items	40 items	6 lotteries	84
Mar 23rd	Voluntary insurance	Middle 28 balloons	30 items	40 items	6 lotteries	82
Mar 28th	Voluntary insurance	Middle 28 balloons	30 items	40 items	6 lotteries	75
Apr 2nd	Voluntary insurance	Middle 28 balloons	30 items	40 items	6 lotteries	81

**TABLE 3** | Distribution of men in pump range.

	Pumps [1, 32]	Pumps (32, 64]	Pumps (64, 96]	Pumps (96, 128]
Pre-pandemic 0	53.7%	41.5%	4.9%	
On-pandemic 14.2%	58.5%	25.5%	1.9%	

The experiment consists of four rounds. The first round was conducted on February 21, 2020, which we refer to as the pre-pandemic round. For the pre-pandemic round, we use the entire between-subject treatments in Zhang and Palma (2021). The original design in Zhang and Palma (2021) was between-subjects with three treatment groups varying in insurance schemes set in the BART: Voluntary Insurance, Compulsory Insurance, and Mixed Insurance. In each treatment group, participants were asked to work on the tasks in the following order: BART, DOSPERT, SSS, and GC. A demographic survey was included at the end of the experiment. Each subject was only allowed to participate in one treatment, and hence there is no income or order effect concerns.

Having risk preference data for the pre-pandemic period serves as motivation for this article. Since the focus of this article is about risk-preferences, we only implemented the “Voluntary Insurance” treatment for the on-pandemic rounds. When we compare the pre-pandemic and on-pandemic outcomes, only

data of the “Voluntary Insurance” treatment in the pre-pandemic round is used. The three on-pandemic rounds were conducted on March 23, 2020; March 28, 2020; and April 2, 2020.

In BART, subjects played 30 sequential balloons. Subjects received €1 for each successful pump for each balloon. For the **first** and **last** balloon, there was an insurance option with a premium of €40 and coverage of €64. Subjects can voluntarily choose to buy the insurance or not⁵. For the middle **28** balloons, subjects play BART without an insurance option. At the end of the experiment, three balloons are randomly selected to determine the earnings for BART. In this article, we only focus on the middle 28 balloons where risk is measured without insurance options. Note that all four rounds had identical procedures, thus allowing us to make comparisons across rounds.

In total there were 331 subjects. We removed data from 9 subjects who chose 128 in some of the balloons. Choosing 128 pumps guarantees an explosion. Hence, we treat them as not understanding the BART task or not paying attention to the instructions. Thus, the final sample consists of 322 subjects. **Table 2** summarizes the experiment and the number of

⁵Although this is not the focus of this paper, there were no differences in the insurance purchasing rates across all four rounds.

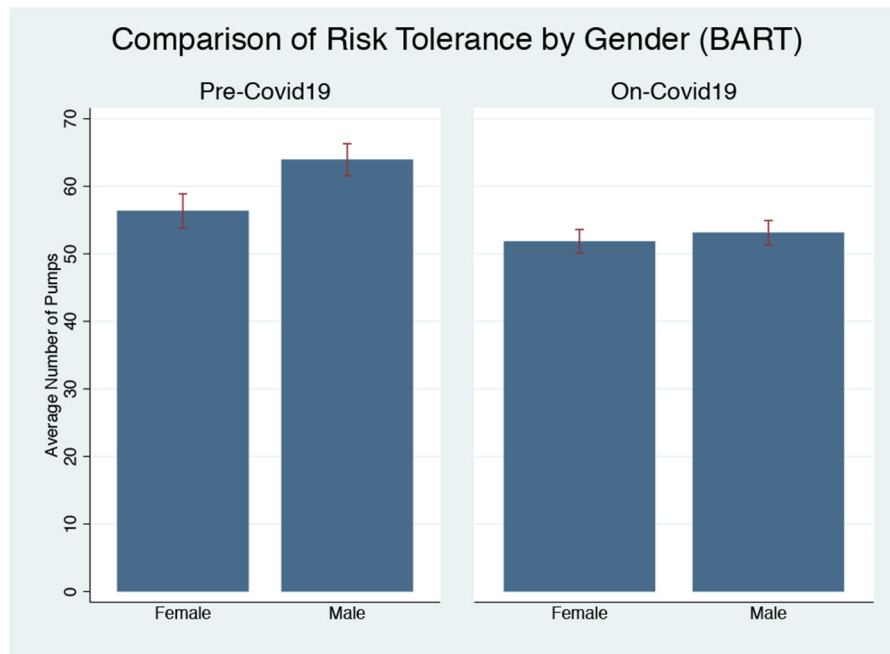


FIGURE 2 | Gender differences in risk-taking by BART pre and on-pandemic.

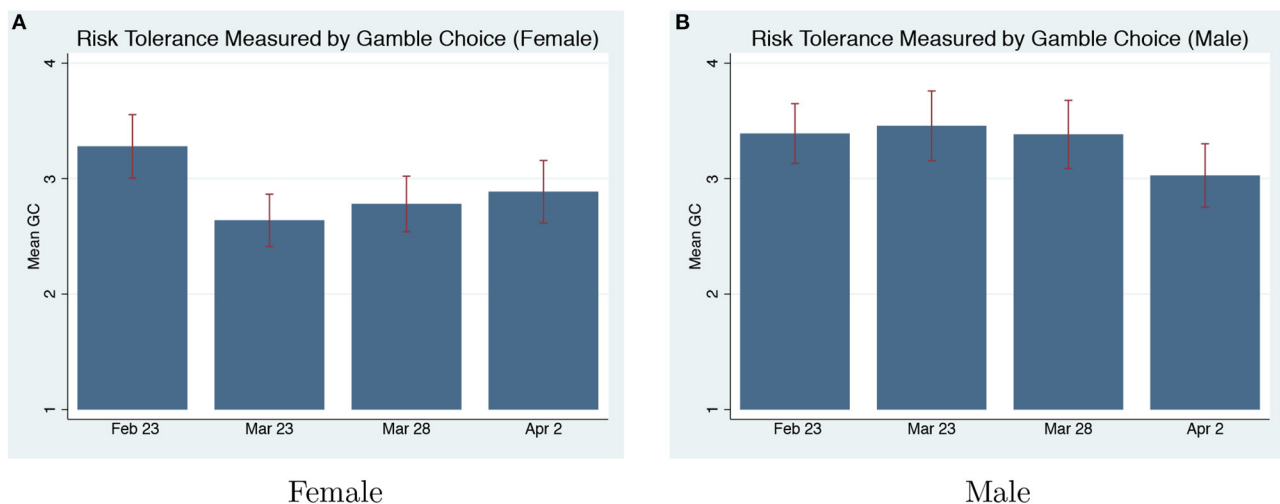


FIGURE 3 | GC pre and on-pandemic. **(A)** Risk tolerance measured by gamble choice (Female). **(B)** Risk tolerance measured by gamble choice (Male).

observations for each round. The instructions are available in the **Appendix**.

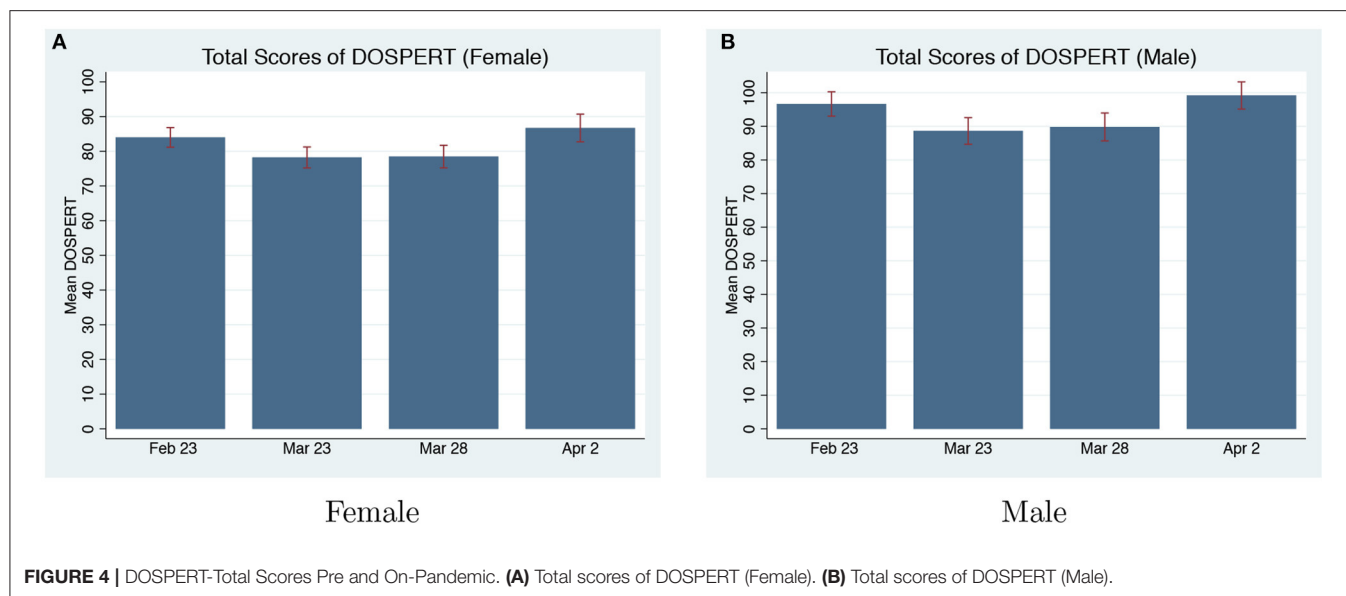
5. RESULTS

In this section, we show the results of the four elicitation methods separately starting with the incentivized tasks.

Balloon Analogue Risk Task. In BART, subjects play with insurance options in the first and last balloon, and they play the

normal balloon without insurance for the middle 28 balloons. Thus, we focus on the average number of pumps of the middle 28 balloons to analyze the risk-taking behavior measured by BART. We find participants become more risk-averse during COVID-19. The average number of pumps in the pre-pandemic round is 60.06, and it is 52.41 in the on-pandemic rounds (Mann-Whitney U-Test, $p = 0.002$).

We find that the change in risk-preference measured by BART is mainly contributed by changes in the risk-taking



of man. **Figure 1** shows that the risk-taking behavior of women does not change during the on-pandemic rounds compared to the pre-pandemic round ($p = 0.236$). However, men become significantly more risk-averse during the first on-pandemic round, and the changes are persistent for the remaining on-pandemic rounds. The difference in risk-taking behavior for men between the pre and on-pandemic rounds is significant ($p = 0.001$). We further find the change in men's risk-taking is overall swift, instead of just from a small subgroup. **Table 3** compares the distribution of men in each pump range between pre-pandemic and on-pandemic rounds⁶. There is swift from pumps over 64 to pumps less than 64.

Figure 2 shows that the gender gap in risk-taking behavior assessed by BART is present before COVID-19, with women being more risk averse than men (Mann-Whitney U-Test, $p = 0.048$). However, due to the reaction of men to COVID-19, the gender gap in risk aversion disappears during the on-pandemic rounds ($p = 0.790$). We further show that there are no significant differences by age ($p = 0.612$), education ($p = 0.523$), race ($p = 0.443$), or income ($p = 0.342$) between men and women. Thus, we argue that based on the BART results, men are more sensitive to COVID-19 in terms of the increased risk aversion compared to women.

Gamble Choice. We code the lottery 1 to 6 in the GC task as 1, 2, 3, 4, 5, 6 with 1 indicating extreme risk-aversion and 6 indicating risk-loving. We do not find any changes in risk attitudes elicited by the GC task for men (χ^2 test, $p = 0.854$) or women ($p = 0.381$). **Figure 3** shows the only

change in risk-attitudes elicited by the GC is that women become more risk-averse during the first on-pandemic round, but the difference is only marginally significant ($p = 0.097$).

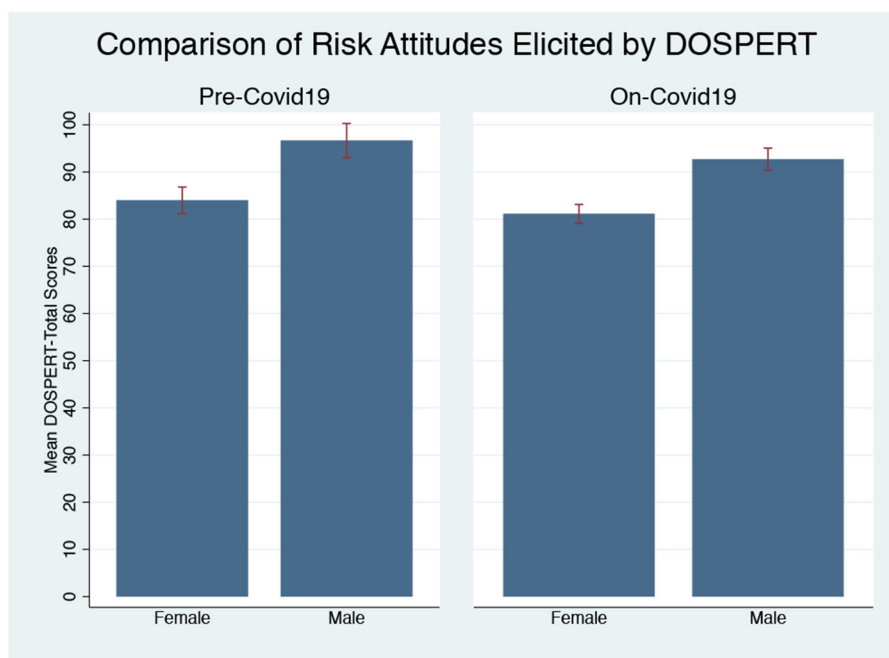
Domain-Specific Risk-Taking. **Figure 4** presents the DOSPERT-total scores of each round for both men and women. The only difference we find is between the score of the first on-pandemic round and the score of the pre-pandemic round for women, but the difference is marginal (Mann-Whitney U-Test, $p = 0.076$). In the following two on-pandemic rounds, women's DOSPERT-total scores returned to the pre-pandemic level ($p = 0.176$, $p = 0.922$). There are no differences in men's risk-taking between pre-pandemic and on-pandemic rounds based on DOSPERT-total scores ($p = 0.105$, $p = 0.270$, $p = 0.814$). When we combine the scores of all the three on-pandemic rounds and compare it with pre-pandemic, we do not find changes for both men and women ($p = 0.309$ for men; $p = 0.209$ for women).

We then test for differences for each sub-domain. **Table 4** summarizes DOSPERT-total and sub-domain scores pre and on-pandemic separately by gender. The only statistical significant difference we find is women's scores on the Social domain. Women become more risk-averse during the pandemic in the Social domain ($p = 0.003$), with the changes starting in the first on-pandemic round ($p = 0.042$) and persistent for the remaining two on-pandemic rounds ($p < 0.001$, $p = 0.099$). In addition, the change is an overall swift of the distribution of females in each score range (refer to **Appendix 9**). The Social-domain in DOSPERT tests for the willingness to challenge social norms or social risky behavior such as confronting coworkers or family members. Social-domain in DOSPERT contains six items. We find the changes in women's risk-preference mainly come from two items "Choosing a career that you truly enjoy over a more prestigious one" and "Starting a new career in

⁶We separate the selected number of pumps into four ranges, as risk-neutral subjects would choose 64 pumps in BART by theory.

TABLE 4 | DOSPERT scores by gender.

	Total	Ethical	Financial	Health/Safety	Recreational	Social
Men (pre-pandemic)	96.66	13.73	18.37	18.56	16.39	29.61
Men (on-pandemic)	92.70	13.25	16.81	17.01	13.36	29.27
Women (pre-pandemic)	84.00	11.00	14.37	13.81	13.93	30.88
Women (on-pandemic)	81.12	11.58	14.04	13.95	14.03	27.52

**FIGURE 5 |** Gender differences in risk-taking by DOSPERT pre and on-pandemic.

your mid-thirties.” During COVID-19, many companies started to lay off workers, freeze hiring, and cut bonuses. The worries about losing jobs or being not able to find new jobs during the pandemic may cause people to become more risk-averse in the Social domain, especially for women based on our results. This is also in line with the literature about the gender layoff gap in the labor market during COVID-19 (Lin-Sperry, 2021).

Figure 5 shows the comparisons of DOSPERT-Total scores by gender. Based on the risk-attitudes elicited by DOSPERT, women are more risk-averse than men before COVID-19 (Mann-Whitney U-Test, $p = 0.009$). Since we only find changes in the Social sub-domain for women, and there is no significant change in the total score of men and women during COVID-19, there is still a gender gap in risk-attitudes elicited by DOSPERT during COVID-19 ($p = 0.001$).

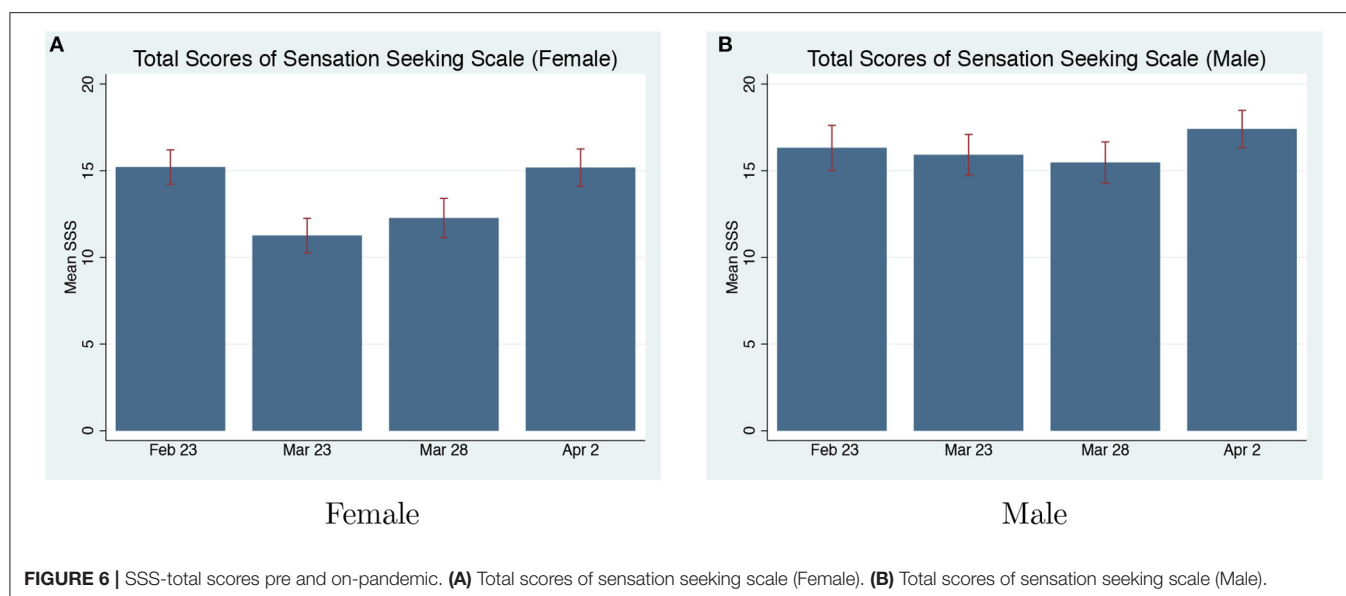
Sensation Seeking Scale. The total score of SSS for women is significantly lower during the pandemic rounds compared to the pre-pandemic round (Mann-Whitney U-Test, $p = 0.038$). There is no significant change in men’s SSS-Total or any sub-scale scores

TABLE 5 | SSS scores by gender.

	Total	TAS	ES	DIS	BS
Men (pre-pandemic)	16.32	3.83	5.07	4.51	2.90
Men (on-pandemic)	16.29	3.75	5.47	4.33	2.75
Women (pre-pandemic)	15.21	3.42	5.95	3.60	2.23
Women (on-pandemic)	12.88	3.00	4.42	3.17	2.29

between the pre and on-pandemic rounds (refer to **Table 5**). The change in SSS-Total scores for women is mainly contributed by the sub-scale “Experience Seeking” ($p < 0.001$). “Experience Seeking” measures the desire to experience through travel and non-conforming lifestyles. COVID-19 makes women more risk-averse in the “Experience Seeking” aspect.

Figure 6 shows that the effects of COVID-19 on women’s risk-preference assessed by SSS are persistent for 2 weeks. There is a significant change when comparing women’s risk-preference

**TABLE 6 |** Regression results by gender.

	Female On-Pandemic vs. Pre-Pandemic	Male On-Pandemic vs. Pre-Pandemic
BART	-2.93 (3.45)	-11.04(3.34)***
GC	-0.29 (0.19)	-0.02 (0.20)
DOSPERT(total scores)	-1.92 (3.79)	-2.59 (4.45)
SSS(total scores)	-2.05 (1.24)	0.45 (1.33)
DOSPERT(social scores)	-3.23(1.22)***	-0.44 (1.21)
SSS(es scores)	-1.44(0.37)***	0.55 (0.43)
No. Observation	175	147

All regressions are controlled for age, education, income, and household size. Standard errors are in parentheses. * $p < 10\%$, ** $p < 5\%$, *** $p < 1\%$.

between the pre-pandemic and the first on-pandemic round ($p = 0.005$), and between the pre-pandemic and the second on-pandemic round ($p = 0.033$). On the third on-pandemic round (April 2), women's risk-preference returned to the level before the pandemic ($p = 0.939$). Based on the self-reported SSS propensity measures, women become more risk-averse during COVID-19. However, after they get used to it, their risk-preference returns to the pre-pandemic level (refer to **Appendix 10** for detailed changes in the distribution of women in each score range).

In **Table 6**, we estimate 6 regressions for the female and male separately (12 regressions in total). All regressions have the same dummy independent variable "On-pandemic." We code the three on-pandemic rounds as 1, and the pre-pandemic round as 0. The dependent variable of each regression shown in each row of **Table 6** is the measured outcomes by each method: the average number of pumps in BART, the choice in

GC, and scores of DOSPERT and SSS. For BART, DOSPERT, and SSS, the regression models used are OLS; for GC, we use an ordered probit model. We control for age, education, income, and household size for all regressions⁷. The first four rows of **Table 6** suggest that COVID-19 only has impacts on men's risk-preference measured by BART. We further investigate the sub-domains of DOSPERT and SSS, and we only find women become more risk-averse in the "Social" domain of DOSPERT and "Experience Seeking" scale of SSS during COVID-19, which are shown in the last two rows of **Table 6**. All of these regression results are in line with the results presented above.

To sum up, we find that based on GC, DOSPERT, and SSS total scores, both men's and women's risk-preference are stable during COVID-19. When we further investigate sub-domains/scales of DOSPERT and SSS, we find women become more risk-averse in the Social domain and the Experience Seeking scale. These results match our hypotheses about the stability of risk-preference based on different measures. The only result which conflicts our hypothesis is the increased risk aversion of men measured by BART. One possible explanation is that BART measures risk-taking by averaging choices over 30 balloons, instead of only based on one choice as in GC. The process of pumping repeated 30 balloons can be dynamic with the choice being affected by outcomes of previous balloons⁸. When different measuring processes interact with the pandemic,

⁷The coefficients of "age" in the regressions for DOSPERT(total) and SSS(total) are negative and significant for both women and men. This means older people are more risk-averse based on DOSPERT and SSS measures. The coefficients of all the other control variables in all the regressions are not significant.

⁸In our automatic version, after entering the number of pumps, subjects need to wait to see the process of pumping (the balloon becoming larger and larger) and the outcome of the current balloon before they proceed to the next balloon.

TABLE 7 | Spearman's ρ of the correlations of risk-preference measured by four measures.

	BART	Gamble choice	DOSPERT	SSS
BART	1	0.211***	0.084	0.134**
Gamble Choice		1	0.089	0.144***
DOSPERT			1	0.688***
SSS				1

We use total scores for DOSPERT and SSS. * $p < 10\%$, ** $p < 5\%$, *** $p < 1\%$.

we may have different results regarding the stability of risk preferences. Thus, we suggest that more consideration needs to be given to the difference of measures within the same measurement tradition.

6. CORRELATION OF RISK-PREFERENCE MEASURED BY DIFFERENT METHODS

Risk preference evaluations have been shown to be context-dependent and low convergent validity across different elicitation techniques (refer to Reynaud and Couture, 2012; Crosetto and Filippin, 2016; Frey et al., 2017). **Table 7** shows that in our experiment risk-preference measured by BART is positively correlated with risk-preference measured by the GC and SSS. The correlation of risk-preference measured by BART and DOSPERT total scores is not significant; however, the risk-preference measured by the Social sub-domain is significantly correlated with risk-preference measured in BART (Spearman's $\rho = 0.107$, $p = 0.055$). We find similar outcomes for risk-preference elicited by the GC, and it is significantly correlated with the risk-preference measured by the Financial sub-domain in DOSPERT (Spearman's $\rho = 0.178$, $p = 0.001$). The risk-preference measured by SSS is significantly correlated with all other three methods.

We further test the degree of correlations in **Table 7**, and we have three arguments. First, all the correlations are positive, and this to some extent provides evidence of the validity of each method for assessing risk-preference. Second, the correlation between self-reported risk-preference (measured by DOSPERT and SSS) is stronger than the correlation between revealed risk-preference (elicited by BART and GC). This result is in line with the suggestions about lower convergent validity of revealed behavioral measures compared to self-reported propensity measures in both Frey et al. (2017) and Mata et al. (2018). Third, the correlations between two different types of measures are the weakest (BART/GC & DOSPERT/SSS), which is also suggested by Frey et al. (2017).

7. CONCLUSION

The COVID-19 pandemic is the worst crisis since World War II. It has affected and changed the life and work style of people all around the world. We believe people's risk-taking behavior is one of the most likely to be affected by the COVID-19 pandemic. We use four rounds of parallel experiments to

test and track the dynamic changes in risk-preference during COVID-19. The first round was conducted around 1 month before COVID-19 started spreading in the United States, while the other three rounds were conducted after a state of emergency was declared.

We include four measures of risk-preference in each round. Two of them are revealed behavioral measures (BART and GC), and the other two are self-reported propensity measures (DOSPERT and SSS). The results are not consistent across all the four elicitation methods, and we also find heterogeneous effects for men and women. Men are more sensitive to the pandemic, and they become more risk-averse when measured by BART. The total score of DOSPERT and SSS show the stability of risk-preference for both men and women during COVID-19. We further test each sub-domain/scale of DOSPERT and SSS. We find that women become more risk-averse in the Social domain of DOSPERT and Experience Seeking scale of SSS. The GC does not show any changes in risk-preference for men or women. These results are in line with our hypotheses which are based on the discussion about the psychological construct of risk-preference. Our results show the caveat of testing risk-preference changes during COVID-19 using a single measure.

Our study provides new insights into the stability of risk-preference under pandemic shocks. In general, individuals' risk-preference is stable during COVID-19. However, when the measures capture risk-taking in some specific life domains and COVID-19 has stronger impacts on those domains (e.g., the social domain), the measures detect changes in risk-preference during COVID-19. This result differs by gender.

A limitation of our study is that we only track the changes through April 2, 2021. We find that women's risk-attitudes elicited by SSS returned to the original level during the third on-pandemic round after becoming more risk-averse in the first two on-pandemic rounds. Future study may track the dynamic risk-preference changes for a longer period of time. The differential results suggested by BART and GC show that the same type of measures may also capture different factors of risk-preference. The heterogeneous effects between gender show women and men react differentially to the shock in terms of the changes of risk-taking behavior, or it suggests that the sensitivity of capturing risk-preference factors of measures might differ by gender. Future study about the construct of risk-preference should take differences between the same type of measures and gender into considerations.

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 IRB Administration Texas A&M University. The

patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PZ and MP: research idea and design and data analysis and interpretation, results, and manuscript drafting and writing. PZ: data collection and revisions. MP: language editing and

appropriateness. Both 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.2021.702028/full#supplementary-material>

REFERENCES

- Abatayo, A. L., and Lynham, J. (2020). Risk preferences after a typhoon: an artefactual field experiment with fishers in the Philippines. *J. Econ. Psychol.* 79:102195. doi: 10.1016/j.joep.2019.102195
- Anderson, L. R., and Mellor, J. M. (2009). Are risk preferences stable? comparing an experimental measure with a validated survey-based measure. *J. Risk Uncertainty* 39, 137–160. doi: 10.1007/s11166-009-9075-z
- Angrisan, M., Cipriani, M., Guarino, A., Kendall, R., and Ortiz de Zarate, J. (2020). *Risk Preferences at the Time of COVID-19: An Experiment With Professional Traders and Students*. FRB of New York Staff Report 927.
- Barrios, J. M., and Hochberg, Y. (2020). *Risk perception through the lens of politics in the time of the COVID-19 pandemic*. Technical report, National Bureau of Economic Research.
- Benjamin, D. J., Cesarini, D., Van Der Loos, M. J., Dawes, C. T., Koellinger, P. D., Magnusson, P. K., et al. (2012). The genetic architecture of economic and political preferences. *Proc. Natl. Acad. Sci. U.S.A.* 109, 8026–8031. doi: 10.1073/pnas.1120666109
- Binder, C. (2020). Coronavirus fears and macroeconomic expectations. *Rev. Econ. Stat.* 102, 721–730. doi: 10.1162/rest_a_00931
- Blais, A.-R., and Weber, E. U. (2006). A domain-specific risk-taking (dosPERT) scale for adult populations. *Judgm. Decis. Mak.* 1, 33–47.
- Bogliacino, F., Codagnone, C., Montealegre, F., Folkvord, F., Gómez, C., Charris, R., et al. (2021). Negative shocks predict change in cognitive function and preferences: assessing the negative affect and stress hypothesis. *Sci. Rep.* 11, 1–10. doi: 10.1038/s41598-021-83089-0
- Callen, M., Isaqzadeh, M., Long, J. D., and Sprenger, C. (2014). Violence and risk preference: experimental evidence from afghanistan. *Am. Econ. Rev.* 104, 123–148. doi: 10.1257/aer.104.1.123
- Chan, H. F., Skali, A., Savage, D. A., Stadelmann, D., and Torgler, B. (2020). Risk attitudes and human mobility during the COVID-19 pandemic. *Sci. Rep.* 10, 1–13. doi: 10.1038/s41598-020-76763-2
- Charness, G., Gneezy, U., and Imas, A. (2013). Experimental methods: eliciting risk preferences. *J. Econ. Behav. Organ.* 87, 43–51. doi: 10.1016/j.jebo.2012.12.023
- Crosetto, P., and Filippin, A. (2013). The bomb risk elicitation task. *J. Risk Uncertain.* 47, 31–65. doi: 10.1007/s11166-013-9170-z
- Crosetto, P., and Filippin, A. (2016). A theoretical and experimental appraisal of four risk elicitation methods. *Exp. Econ.* 19, 613–641. doi: 10.1007/s10683-015-9457-9
- Dillon, J. L., and Scandizzo, P. L. (1978). Risk attitudes of subsistence farmers in northeast brazil: a sampling approach. *Am. J. Agric. Econ.* 60, 425–435. doi: 10.2307/1239939
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: measurement, determinants, and behavioral consequences. *J. Eur. Econ. Assoc.* 9, 522–550. doi: 10.1111/j.1542-4774.2011.01015.x
- Drichoutis, A. C., and Nayga, R. M. (2021). On the stability of risk and time preferences amid the COVID-19 pandemic. *Exp. Econ.* doi: 10.1007/s10683-021-09727-6. [Epub ahead of print].
- Eckel, C. C., El-Gamal, M. A., and Wilson, R. K. (2009). Risk loving after the storm: a bayesian-network study of hurricane katrina evacuees. *J. Econ. Behav. Organ.* 69, 110–124. doi: 10.1016/j.jebo.2007.08.012
- Eckel, C. C., and Grossman, P. J. (2008). Forecasting risk attitudes: an experimental study using actual and forecast gamble choices. *J. Econ. Behav. Organ.* 68, 1–17. doi: 10.1016/j.jebo.2008.04.006
- Eeckhoudt, L., Gollier, C., and Schlesinger, H. (1996). Changes in background risk and risk taking behavior. *Econometrica* 64, 683–689. doi: 10.2307/2171866
- Farnham, A., Ziegler, S., Blanke, U., Stone, E., Hatz, C., and Puhan, M. A. (2018). Does the dosPERT scale predict risk-taking behaviour during travel? a study using smartphones. *J. Travel Med.* 25, tay064. doi: 10.1093/jtm/tay064
- Frey, R., Pedroni, A., Mata, R., Rieskamp, J., and Hertwig, R. (2017). Risk preference shares the psychometric structure of major psychological traits. *Sci. Adv.* 3, e1701381. doi: 10.1126/sciadv.1701381
- Gassmann, X., Malézieux, A., Spiegelman, E., and Tisserand, J.-C. (2020). *Preferences after pandemics: Time and risk in the shadow of COVID-19*. Technical report, Working Paper.
- Gollier, C., and Pratt, J. W. (1996). Risk vulnerability and the tempering effect of background risk. *Econometrica* 64, 1109–1123. doi: 10.2307/2171958
- Guenther, B., Galizzi, M. M., and Sanders, J. G. (2021). Heterogeneity in risk-taking during the COVID-19 pandemic: evidence from the uk lockdown. *Front. Psychol.* 12:852. doi: 10.3389/fpsyg.2021.643653
- Guiso, L., and Paiella, M. (2008). Risk aversion, wealth, and background risk. *J. Eur. Econ. Assoc.* 6, 1109–1150. doi: 10.1162/JEEA.2008.6.6.1109
- Hanaoka, C., Shigeoka, H., and Watanabe, Y. (2018). Do risk preferences change? evidence from the great east japan earthquake. *Am. Econ. J.* 10, 298–330. doi: 10.1257/app.20170048
- Harrison, G. W., Lau, M. I., and Yoo, H. I. (2020). Risk attitudes, sample selection, and attrition in a longitudinal field experiment. *Rev. Econ. Stat.* 102, 552–568. doi: 10.1162/rest_a_00845
- Highhouse, S., Nye, C. D., Zhang, D. C., and Rada, T. B. (2017). Structure of the dosPERT: Is there evidence for a general risk factor? *J. Behav. Decis. Mak.* 30, 400–406. doi: 10.1002/bdm.1953
- Holt, C. A., and Laury, S. K. (2002). Risk aversion and incentive effects. *Am. Econ. Rev.* 92, 1644–1655. doi: 10.1257/000282802762024700
- Inquisit (2016). *Computer Software*. Available online at: <http://www.millisecond.com>.
- Jakiela, P., and Ozier, O. (2019). The impact of violence on individual risk preferences: evidence from a natural experiment. *Rev. Econ. Stat.* 101, 547–559. doi: 10.1162/rest_a_00763
- Jetten, M., Magnusson, L. M., and Roth, S. (2020). Becoming sensitive: Males? risk and time preferences after the 2008 financial crisis. *Eur. Econ. Rev.* 128:103512. doi: 10.1016/j.eurocorev.2020.103512
- Kahsay, G. A., and Osberghaus, D. (2018). Storm damage and risk preferences: panel evidence from germany. *Environ. Resour. Econ.* 71, 301–318. doi: 10.1007/s10640-017-0152-5
- Kawohl, W., and Nordt, C. (2020). COVID-19, unemployment, and suicide. *Lancet Psychiatry* 7, 389–390. doi: 10.1016/S2215-0366(20)30141-3
- Lee, J. (2008). The effect of the background risk in a simple chance improving decision model. *J. Risk Uncertain.* 36, 19–41. doi: 10.1007/s11166-007-9028-3
- Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., et al. (2002). Evaluation of a behavioral measure of risk taking: the balloon analogue risk task (bart). *J. Exp. Psychol.* 8, 75. doi: 10.1037/1076-898X.8.2.75
- Li, Z., Lin, P.-H., Kong, S.-Y., Wang, D., and Duffy, J. (2021). Conducting large, repeated, multi-game economic experiments using mobile platforms. *PLoS ONE* 16:e0250668. doi: 10.1371/journal.pone.0250668
- Lin-Sperry, E. (2021). *Covid19 Recession: Gender Layoff Gap Explodes*. Berkeley, CA: University of California.
- Lohmann, P., Gsottbauer, E., You, J., and Kontoleon, A. (2020). *Social Preferences and Economic Decision-Making in the Wake of COVID-19: Experimental Evidence From China*. Available at SSRN 3705264.

- Marianne, B. (2011). New perspectives on gender. *Handbook Labor Econ.* 4, 1543–1590. doi: 10.1016/S0169-7218(11)02415-4
- Mata, R., Frey, R., Richter, D., Schupp, J., and Hertwig, R. (2018). Risk preference: a view from psychology. *J. Econ. Perspect.* 32, 155–172. doi: 10.1257/jep.32.2.155
- Niederle, M., and Vesterlund, L. (2007). Do women shy away from competition? do men compete too much? *Q. J. Econ.* 122, 1067–1101. doi: 10.1162/qjec.122.3.1067
- Officer, R. R., and Halter, A. N. (1968). Utility analysis in a practical setting. *Am. J. Agric. Econ.* 50, 257–277. doi: 10.2307/1237541
- Page, L., Savage, D. A., and Torgler, B. (2014). Variation in risk seeking behaviour following large losses: a natural experiment. *Eur. Econ. Rev.* 71, 121–131. doi: 10.1016/j.eurocorev.2014.04.009
- Pleskac, T. J., Wallsten, T. S., Wang, P., and Lejuez, C. (2008). Development of an automatic response mode to improve the clinical utility of sequential risk-taking tasks. *Exp. Clin. Psychopharmacol.* 16, 555. doi: 10.1037/a0014245
- Quiggin, J. (2003). Background risk in generalized expected utility theory. *Econ. Theory* 22, 607–611. doi: 10.1007/s00199-002-0311-x
- Reynaud, A., and Couture, S. (2012). Stability of risk preference measures: results from a field experiment on french farmers. *Theory Decis.* 73, 203–221. doi: 10.1007/s11238-012-9296-5
- Schildberg-Hörisch, H. (2018). Are risk preferences stable? *J. Econ. Perspect.* 32, 135–154. doi: 10.1257/jep.32.2.135
- Shachat, J., Walker, M. J., and Wei, L. (2021a). How the onset of the COVID-19 pandemic impacted pro-social behaviour and individual preferences: Experimental evidence from china. *J. Econ. Behav. Organ.* 190, 480–494. doi: 10.1016/j.jebo.2021.08.001
- Shachat, J., Walker, M. J., and Wei, L. (2021b). The impact of an epidemic: Experimental evidence on preference stability from wuhan. *AEA Pap. Proc.* 111, 302–306. doi: 10.1257/pandp.20211002
- Shou, Y., and Olney, J. (2020). Assessing a domain-specific risk-taking construct: a meta-analysis of reliability of the DOSPERT scale. *Judg. Decis. Mak.* 15, 112–134.
- Shurchkov, O., and Eckel, C. C. (2018). *Gender Differences in Behavioral Traits and Labor Market Outcomes*. Oxford, UK: Oxford University Press.
- Stigler, G. J., and Becker, G. S. (1977). De gustibus non est disputandum. *Am. Econ. Rev.* 67, 76–90.
- Tsetlin, I., and Winkler, R. L. (2005). Risky choices and correlated background risk. *Manag. Sci.* 51, 1336–1345. doi: 10.1287/mnsc.1050.0414
- Wong, A., and Carducci, B. J. (1991). Sensation seeking and financial risk taking in everyday money matters. *J. Bus. Psychol.* 5, 525–530. doi: 10.1007/BF01014500
- Zaleski, Z. (1984). Sensation-seeking and risk-taking behaviour. *Pers. Individ. Dif.* 5, 607–608. doi: 10.1016/0191-8869(84)90039-4
- Zhang, P., and Palma, M. A. (2021). Compulsory versus voluntary insurance: an online experiment. *Am. J. Agric. Econ.* 103, 106–125. doi: 10.1111/ajae.12120
- Zhong, S., Chew, S. H., Set, E., Zhang, J., Xue, H., Sham, P. C., et al. (2009). The heritability of attitude toward economic risk. *Twin Res. Hum. Genet.* 12, 103–107. doi: 10.1375/twin.12.1.103
- Zoumpourlis, V., Goulielmaki, M., Rizos, E., Baliou, S., and Spandidos, D. A. (2020). [comment] the COVID-19 pandemic as a scientific and social challenge in the 21st century. *Mol. Med. Rep.* 22, 3035–3048. doi: 10.3892/mmr.2020.11393
- Zuckerman, M. (1994). *Behavioral Expressions and Biosocial Bases of Sensation Seeking*. Cambridge: Cambridge University Press.
- Zuckerman, M. (2007). Sensation seeking and risky behavior. *Am. Psychol. Assoc.* doi: 10.1037/1155-5-000
- Zuckerman, M., Eysenck, S. B., and Eysenck, H. J. (1978). Sensation seeking in england and america: cross-cultural, age, and sex comparisons. *J. Consult. Clin. Psychol.* 46, 139. doi: 10.1037/0022-006X.46.1.139
- Zuckerman, M., Kolin, E. A., Price, L., and Zoob, I. (1964). Development of a sensation-seeking scale. *J. Consult. Psychol.* 28, 477. doi: 10.1037/h0040995

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