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Human connection as a treatment for addiction

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Human connection as a treatment for addiction

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EDITORIAL
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Editorial: Human Connection as a Treatment for Addiction

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Editorial on the Research Topic

Human Connection as a Treatment for Addiction

The aim of this Research Topic, *Human Connection as a Treatment for Addiction*, is to bring together scholars from various fields to explore the question of whether intentionally increasing meaningful, caring interaction between people may reduce substance and/or non-substance related addictive behaviors. Previous research supports the role that social connection may play in the initiation and maintenance of addiction in both animals and humans (van der Eijk and Uusitalo, 2016; Christie, 2021).

Animal models have shown that neuro-hormonal development, specifically the endogenous opioid and oxytocin systems, is shaped by early experiences possibly explaining the link between early adversity and later substance use patterns (Panksepp, 2004; Machin and Dunbar, 2011; Panksepp and Biven, 2012), and rodents with access to social interaction use fewer substances than those that are isolated (Crofton et al., 2015).

In humans, having a cohesive support/social network and healthy attachments in childhood predict low risk of later addiction (Heilig et al., 2016; Christie, 2021). Treatment and recovery regimens that often foster connection such as 12-step programs and therapeutic communities have shown benefit in reducing substance use (De Leon and Unterrainer, 2020). While having early, close human connection such as maternal/child bonding seems to predict low risk of problematic substance use, lack of such connection often predicts increased risk. Adverse Childhood Experiences (ACEs) including neglect or disruptions in attachment have repeatedly been shown to predict later addiction (Felitti, 2004) and individuals who are addicted to substances are often socially excluded and marginalized, findings which have been supported neurobiologically (Heilig et al., 2016). Individuals decrease pursuit of interpersonal connections and social bonds when they use substances that activate opioid receptors (substances of abuse and treatment medications such as methadone, buprenorphine, and naltrexone) (Inagaki et al., 2015; Torres, 2019; Toubia and Khalife, 2019). Granted, problematic substance use can be initiated or fueled by some types of social interaction, such as affiliation with a substance using social network, thus the investigation of qualitative aspects of human connection is paramount.

With this strong foundation of previous research, a next logical area of research is to investigate whether fostering healthy human connection can actually be used as an intervention or treatment for addiction. Our goal of exploring this question across disciplines was achieved as this issue includes contributions from addiction science, neurobiology, psychology, anthropology, theology, ethics, philosophy, ACEs, science, nursing, psychiatry, criminology, education, chemistry, political science, preventative medicine, and public health. In order to impose structure on this widely varying group of articles, we will group them into three sections according to focus: theoretical, methodological, and empirical.

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SECTION 1: THEORETICAL

Wesselmann and Paris pull together previous research on the relationship between trauma and problematic substance use, recommending that "social exclusion" should be considered a form of trauma. They propose that treatment providers consider social exclusion as trauma and attempt to "treat" the social exclusion as a way to reduce substance (mis)use. Addressing social exclusion as a risk factor for substance (mis)use supports the idea that "social inclusion" or increasing human connection as a treatment may have merit.

A much more narrowly focused theoretical piece by Anugu et al. connects the endogenous opioid system with human connection in autism. Anugu et al. propose that one reason individuals on the autism spectrum avoid interpersonal interaction is because they have high opioid tone, meaning that they either overproduce endogenous opioids or need lower levels of opioids to remain at homeostasis. This case study reports on a trial of naltrexone to block the ability of opioids to activate opioid receptors in an autistic patient. Naltrexone treatment was shown to effectively improve the ability to interact interpersonally.

In the remaining four theoretical articles, the role of social connectedness is addressed from the perspective of neuro-psychoanalytic as well as evolutionary psychology. In humans, as in all mammals, social connectedness can be identified as a very strong negative predictor of mental illness in general, and in addictions in particular. All four papers independently refer to the seminal work of Jaak Panksepp and colleagues.

Alcaro et al. give an evolutionary and neurobiological overview of the development and maintenance of addictions. The authors point out that a shortcoming of most neurobiological explanations of addiction leave out the interpersonal/sociocultural aspects. Giacolini et al. link neurobiological research with both primate and human interpersonal interaction, which is also supportive of the idea that lack of healthy connection contributes to addiction. Ringwood et al. pick up the idea that the SEEKING system is hijacked and that MAT keeps it hijacked. Accordingly, interpersonal relationships are discussed as a potential antidote to addictive disorders. Lastly, Mosri emphasizes social connection (to treatment providers and others) as necessary to address the social, psychological, and neurological problems associated with addiction.

SECTION 2: METHODOLOGICAL

Of the four methodological articles included in this Research Topic, three involve instrument/app development and three involve collaboration with communities of faith or measurement of some aspect of spirituality. Clements et al. report on an initial validation of an instrument used to assess readiness of church congregations to address addiction. If human connection is found to be a viable treatment for addiction, having individuals willing to make such connections is paramount and the faith community is a potential source of such individuals.

A second article by Clements et al. identifies communication challenges among the faith community, the scientific community, and the clinical community. Communities of faith have long been seen as a potential source of social support for those living with addictions as part of their treatment and recovery. The healthcare community currently manages much addiction treatment, thus fostering communication among these constituencies is important. The authors recommend employing trauma informed principles in health communication. They propose that improving faith/science/clinical collaboration to address addiction could increase the availability of people able to develop meaningful, caring relationships with people living with addictions.

The article by Beck et al. begins with an overview of mutual support groups, emphasizing that they are characterized by interpersonal relationship and are typically quite helpful for those in recovery from problematic use of many types of substances. The authors describe a phone app that can be used to monitor activity and aid in evaluating the effectiveness of a particular non-faith-based mutual support recovery program, Self-Management and Recovery Training (SMART) Recovery. Tools such as this can be valuable as the veracity of a theory of connection as treatment for addiction is tested.

Finally, Fuchshuber and Unterrainer report on the development of a short version of the MI-RSWB 48 (Unterrainer et al., 2010), with the number of items reduced from 48 to 12. Therefore, the MI-RSWB 12 includes four subscales (instead of six in the long version of the scale): Hope, Forgiveness, General Religiousness and Connectedness. The instrument should be particularly useful in clinical settings, for example, to further explore the role of spirituality in the treatment of addiction patients.

SECTION 3: EMPIRICAL

Our goal in this Research Topic is ultimately to motivate empirical study that will confirm whether or not improving human connection is a viable treatment for addiction. Nine articles are included that empirically test various aspects of this idea. A few of the papers were very closely aligned with the overall theme of this Research Topic and some investigated very targeted topics that support very specific aspects of the theme. The article by Warren et al., reporting findings from a retrospective Therapeutic Community (TC) chart review, said that TCs are an example of an intervention that attempts to create interpersonal connection to reduce substance use. Although a study of a very specific outcome, type and amount of feedback given after receiving feedback, it does give an excellent overview of the TC model in addressing addiction. TC s are an established addiction treatment intervention that supports interpersonal connection as a way to curtail substance use.

Another fairly focused article by Menglu et al. assessed whether Tai Chi improves fitness and cognition in individuals who use methamphetamine. Rather than approaching Tai Chi as a spiritual practice, the authors treated it as exercise. This well done randomized controlled trial found that the control group declined in both fitness and cognition, but both remained stable for the Tai Chi group. Cognitive deficits are a great risk

of methamphetamine use, so these findings are an encouraging addition to the treatment literature, though the explicit link to human connection is absent.

Two qualitative studies are included. Snoek et al. concluded, after conducting qualitative interviews with alcohol misusing parents, that the parents would have appreciated having a trusted person intervene in their use. This supports the idea that having close interpersonal relationships could lower drug use. If people who know and care about the substance or alcohol using parent, they may intervene, and the person who is using the substances may feel more apt to listen and thereby curtail use or seek help. Respondents were clear the message should come from a trusted person, implying that a relationship must be developed prior to intervention.

Meulewaeter et al., in a qualitative study of substance-using adults who grew up in a household with parents who were addicted to substances, found several themes. As children, respondents felt lonely, neglected, and stigmatized. Their social connections were influenced by parental addiction. Substances were available in the home and respondents were given great amounts of freedom to go places with friends, many of whom used substances. The parental neglect found aligns with ACEs work (Felitti, 2004) and the attachment insecurity reported by Rübig et al.. Both the lack of supervision and great freedom shows how lack of connection with a caring, guiding adult can lead to problematic substance use.

Yang et al. report by applying structural equation modeling, that perceived social support may increase resilience to perceived stress in addiction patients. Social support could be considered in the future as a potentially beneficial variable for mental health in the treatment of addiction.

Three of the empirical articles directly address the theme of social connection. Best et al. studied 1,313 individuals and found that more human connection and higher quality human connection predicted higher levels of recovery capital and greater growth in recovery capital, thus supporting the idea of human connection as treatment for addiction.

Christie et al. compared non-substance users to substance users who used alcohol, marijuana, methamphetamine, non-prescription opioids, and prescription opioids on social, romantic, and general life satisfaction. Respondents in active addiction reported lower satisfaction across all three variables, but those in recovery from substance use did not differ from non-users. This supports that people can reestablish social connections (social life satisfaction) in recovery.

Finally, two articles examined the relationship between attachment and substance use. Burgkart et al. found that a secure attachment system predicts increased use of appropriate emotion regulation strategies. This finding confirms previous literature that emphasizes the importance of considering the attachment dimension in therapeutic interventions. In contrast, no association with substance use was found in the study. However, it must be said that substance use was very low in this sample. Rübig et al. emphasize the importance of attachment, and suggest that disruptions in attachments may impede treatment effectiveness. They suggest that assessing attachment style prior to therapy initiation is important and that enhancing therapeutic alliance for people with insecure attachment is important. This supports the idea of connection being important in addiction treatment and that having attachment issues could inhibit treatment success.

In summary, the results of our Research Topic of articles point to a significantly positive influence of the feeling of connectedness with people on the treatment of addictive disorders. We have approached the topic very broadly, using a bio-psycho-socio-spiritual model of health and illness to give space to different perspectives. Further work could focus in particular on a more precise characterization of the concept of "human connection" not only in relation to addictive disorders but 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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OPINION
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Exploring the Links Between Social Exclusion and Substance Use, Misuse, and Addiction

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Keywords: social exclusion, trauma-informed approaches, ostracism, interpersonal rejection, substance use

INTRODUCTION

Humans have a central need to belong, their daily efforts predominately focused on forging—and maintaining—stable social connections (Baumeister and Leary, 1995; Lieberman, 2013; Gabriel, 2021). The downside of being inherently social is that interpersonal interactions are not always positive. Situations in which someone feels physically or emotionally separate from others, termed *social exclusion* (Riva and Eck, 2016), are common and aversive. Exclusion often evokes immediate pain sensations (Eisenberger, 2012), unpleasant emotions (e.g., anger, sadness, shame) and threatens core psychological needs beyond belonging, such as needs for positive self-esteem, control, and perceived meaningful existence (Williams, 2009). Excluded individuals often experience loneliness and develop social anxiety, fearing, and expecting future exclusion (Cacioppo and Patrick, 2008). *Chronically* excluded individuals also report experiencing higher levels of depressive symptoms, helplessness, alienation, and perceived existential meaninglessness (Riva et al., 2017). Individuals from stigmatized groups (e.g., immigrants, formerly incarcerated persons) are most likely to experience chronic exclusion (Kurzban and Leary, 2001). In some cases, such as mental illness stigma, specific instances of exclusion may exacerbate symptoms, thus leading to a cycle of further exclusion (Reinhard et al., 2020).

SOCIAL EXCLUSION, TRAUMA, AND SUBSTANCE (MIS)USE

We have argued elsewhere (Wesselmann and Parris, 2020) that these various adverse outcomes suggest chronic social exclusion should be treated as a form of *trauma*: a psychological experience involving intense physical or emotional harm that inflicts lasting damage on one's physical or mental health (Substance Abuse Mental Health Services Administration [SAMHSA], 2014, p. 7). Exclusion-based trauma may also dovetail with trauma from other experiences (e.g., military combat experience; Wesselmann et al., 2018), compounding the individual's suffering. As such, it is important for trauma-focused researchers and therapists to investigate the specific trauma sources to better understand the psychological processes and possible solutions.

Several studies have established a connection between trauma (broadly defined) and substance (e.g., alcohol, narcotics) use and *misuse*, the latter generally involving excessive, often repeated, use in ways that do not align with medical or general usage, causing physical or psychosocial harm to self or others (Substance Abuse Mental Health Services Administration, 2014; Roberts et al., 2015). Related to social exclusion, other studies have established correlations between both loneliness (Cacioppo and Patrick, 2008; DeWall and Pond, 2011; Dyal and Valente, 2015) and stigma-based exclusion with reported substance use/misuse (e.g., Scheim et al., 2017). Still, these links are only indirect. Establishing such links causally is difficult, if not impossible, given the ethical and practical issues with studying misuse behaviorally. To our knowledge, there is only one experiment that

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directly examines substance *use* as a dependent outcome after experiencing social exclusion (Bacon and Engerman, 2018). This study found a marginally significant increase in the amount of alcohol consumed by excluded (vs. included) participants in an online interaction.

However, other studies have examined how the use of analgesic substances affects the immediate psychological impact of exclusion. These studies have built on the general assumption that physical and social pain share similar neurological underpinnings (Eisenberger, 2012). First, researchers demonstrated that participants who ingested acetaminophen (compared to a placebo group) showed reduced reactivity to a social exclusion manipulation (DeWall et al., 2010). Subsequent researchers found that other analgesic substances, such as alcohol (Hales et al., 2015), marijuana (Deckman et al., 2014), and psilocybin (a key chemical in hallucinogenic mushrooms; Preller et al., 2016) also dull the immediate sting of social exclusion. Further, one study found that substance use (i.e., alcohol consumption) is most effective for dulling the pain of exclusion in casual users, whereas heavy users may not receive numbing benefits (Buckingham et al., 2016). Relatedly, neurological research has found heightened activity in brain regions associated with exclusion-related pain and reduced ability in regulating this pain for alcohol-dependent participants (Maurage et al., 2012). Other studies demonstrate differential reactions to exclusion among users of opioids, finding that these individuals can have higher adverse reactions to exclusion than non-users (e.g., Kroll et al., 2019; Carlyle et al., 2020).

Collectively, these studies suggest that individuals who use substances to numb the immediate pain of social exclusion may ultimately face diminishing returns; as they build a tolerance for the substance, they may also experience reduced analgesic effects for dealing with social exclusion, perhaps even heightened sensitivity. Thus, although substance use (no matter how moderate) may be a functional way of dealing with exclusion-related pain in the short-term, it could become habit-forming and lead to addiction.

DISCUSSION

When someone seeks treatment for substance misuse or addiction, a therapist taking a trauma-informed approach should identify to what degree social exclusion contributes to their presenting concerns. Social exclusion may be the *primary* cause (i.e., chronic social exclusion was the main trauma elicitor), or it may be a *secondary* cause; perhaps their initial trauma elicitor was something other than exclusion, and their subsequent substance misuse has led their previous social support network to exclude them. Trauma-informed treatment approaches often focus on social support as a key factor in trauma recovery (Substance Abuse Mental Health Services Administration, 2014). The therapeutic alliance offers an important source of social support for clients throughout treatment, likely increasing their sense of belonging (Baumeister and Leary, 1995). Further, therapists should consider integrating multiple forms of social support when determining treatment modality and access (e.g., group counseling, visitation during hospitalization) to maintain clients' sense of belonging as much as possible (Riva, 2016).

Unfortunately, not all social support is beneficial. People who misuse substances may surround themselves with others who misuse both to receive validation and satisfy their need for belonging (DeWall and Pond, 2011; Mead et al., 2011, Experiment 4). Thus, therapists may want to address the dual nature these enablers can have on clients, because both aspects likely contribute to any resistance to adjusting clients' social networks.

Additionally, therapists could encourage clients to pursue alternative ways of coping with exclusion (Riva, 2016). For example, people can recover from exclusion by engaging in self-affirmation tasks (Knowles et al., 2010; Hales et al., 2016). However, the effectiveness of self-affirmation can depend upon the source of the exclusion. One study (Stock et al., 2018) examined race-based exclusion, finding that Black participants who were excluded by White computer-controlled players in an online game showed increased vulnerability to substance use, but this effect was mitigated when they could affirm their racial identity. A general self-affirmation task did not have the same protective effect, unfortunately. Other research has found that religious/spiritual interventions can be useful in helping people recover from substance addiction, at least partially through fostering a general sense of interpersonal connectedness (e.g., Piedmont, 2004). Germane to social exclusion research, one study found that prayer can help excluded individuals recover, but that it has its strongest effect for people who are most committed to their religion (Hales et al., 2016); this approach is less helpful for less-religious people. We caution that these studies have examined the utility of these various interventions in laboratory settings only; thus, more research needs to assess their effectiveness within the therapeutic context.

The degree to which current trauma-informed programs address social exclusion is unclear. Most programs (e.g., Jaycox et al., 2012) provide *opportunities* for the therapist to address specific trauma-related concerns, but do not explicitly target clients' experiences with social exclusion. Thus, it is incumbent upon the therapist to ensure assessing the specific impact and salience of social exclusion is included in treatment. This can include helping clients repair damage to social relationships resulting from substance misuse, creating new opportunities for substance-free social inclusion outside the therapeutic context, and ensuring alignment with clients' cultural values, identities, and experiences when exploring group counseling as a means of socially inclusive therapy.

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CASE REPORT
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Autism Case Report: Cause and Treatment of "High Opioid Tone" Autism

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Introduction: Neurobiological systems engineering models are useful for treating patients. We show a model of "high opioid tone" autism and present a hypothesis about how autism is caused by administration of opioids during childbirth.

Main Symptoms: Clinical diagnosis of autism in a 25 year old man was confirmed by a Social Responsiveness Scale (SRS) self-rating of 79, severe, and a Social Communications Questionnaire (SCQ-2) by the patient's father scoring 27. Cold pressor time (CPT) was 190 seconds—unusually long, consonant with the high pain tolerance of autism.

Therapeutic Intervention and Outcomes: At naltrexone 50 mg/day SRS fell to 54 and SCQ-−2–9; both non-significant. CPT fell to 28, repeat 39 s. Improved relatedness was experienced ambivalently, understood as feelings never before experienced—causing pain. Non-compliance with naltrexone was followed by cutting open his palm and drinking alcoholically. Transference focused psychotherapy has helped him remain naltrexone—compliant while he works on issues of identity and relatedness.

Conclusion: The model suggests studies that could be conducted to both prevent and treat this form of autism.

Keywords: autism, neurobiological systems engineering, case report, opioid tone, cold pressor test

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INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by poor social skills, repetitive behaviors and nonverbal communication. The cause is obscure. The genetics are complex with gene-wide association studies showing many biomarkers. (Grove et al., 2019).

A "three hit" model of autism posits:

- A genetic neurodevelopmental vulnerability. Common and rare genetic variants contribute to ASD etiology. There are differences in polygenic architecture across clinical subtypes. Genome-wide association studies show five loci on chromosomes 1, 3, 5, and 7 (Grove et al., 2019).
- An environmental stressor that interacts with the genetic vulnerability.
- With these in place, development is adversely affected (Hendren, 2020).

Panksepp et al. discovered autism features high circulating C-terminal beta endorphin. Sixty-seven children with autism had levels that were broadly distributed but averaged 10 times higher than normal controls (Leboyer et al., 1994). Treatment with naltrexone to block opioid receptors was first carried out by Panksepp et al. Results indicated a reversal in autistic behaviors and gaze aversion

at doses of 0.5, 1.0, and 2.0 mg/kg. (Lensing et al., 1995) There was no consensus regarding the optimal dose. (Campbell et al., 1989) The few published reports on naltrexone for autism found benefit for some patients but not for others (Campbell et al., 1993).

Endogenous opioids circulate through the blood. Receptors exist on white blood cells, keratinocytes, synovial cells, gut, and multiple sites in the central nervous system (Johnson et al., 2014). Endogenous opioids regulate human closeness (Panksepp et al., 1997).

On our Addiction Medicine Service at Upstate Medical University we use neurobiological engineering models to guide treatment (Johnson, 2018). Psychoanalytic models are built on clinical interactions. Neuropsychoanalysis uses neuroscience as the basic science of psychoanalysis (Johnson and Flores Mosri, 2016). Neuropsychoanalytic models should be congruent with both psychoanalytic clinical observations and when available, neuroscience (Solms and Turnbull, 2002; Johnson, 2008). A "system" as defined by the International Council on Systems Engineering is, "A construct or collection of different elements that together produce results not obtainable by the elements alone" (International Council on Systems Engineering, 2006). Neurobiological systems engineering combines complex neuroscience, abstract and simplified models based on use of neuroscience, psychoanalytic concepts, and social awareness such as the immense profit obtained by selling addictive drugs legally, to build models that guide clinical interventions (Johnson, 2018).

We will give an example next of an updated model that provides an explanation for vulnerability to development of addictive illness, autistic unrelatedness during opioid use, and symptoms of the genetic variant of autism that features high circulating C-terminal beta endorphin. This model employs a quadratic equation to schematically show our understanding of pleasure-pain and human closeness regulating endogenous opioid tone. An underlying principal is calculus seems to describe the natural world (Strogatz, 2019).

Pleasure $(x) = 4 - (x-3)^2$

$x =$ opioid tone, limit $x = 0 < x < 6$

This equation represents our clinical observations as follows:

- When healthy persons feel the distress of loneliness they seek comfort through the proximity of others to increase opioid tone. It feels good.
- Prolonged intense contact causes discomfort. Healthy humans seek solitude to reduce high opioid tone to a pleasant level.
- Human contact is used to modulate opioid tone between 2 and 4 on **Figure 1**. Healthy persons can engage and disengage flexibly.
- Autism's high endogenous tone, between 5 and 6 on **Figure 1**, causes ordinary human contact to be uncomfortable. Autistic persons reduce their opioid tone to a less painful level by seeking solitude from ordinary interactions. Healthy individuals contact with each other by looking at each other, talking to each other, and touching each other, while gaze avoidance, lack of social engagement, and repetitive behaviors meant to disengage characterize autism. Autistic patients don't want to be touched.

Increasing opioid prescribing is correlated with increasing autism. In our 2014 review of obstetric literature, moving from the "natural childbirth" ideal of the 1970s to the American College of Obstetrics and Gynecology encouraging opioid administration during childbirth in the 2000s, we suggested opioids were resetting endogenous opioid tone and causing autism in genetically vulnerable newborns. (Johnson et al., 2014) We offer this as a possible cause while appreciating that correlation does not require causation.

We have updated findings from the 2014 paper, now covering from 1991 until 2014 and still find the correlation between the Centers for Disease Control prevalence of autism and millions of opioid prescriptions in the United States $p < 0.001$ (**Figure 2**, **Table 1**).

We show the use of the neurobiological systems engineering model of **Figure 1** in a case report.

CASE DESCRIPTION

A, a 25-year-old man with alcohol use disorder, presented with a chief complaint of feeling "lonely and frustrated." His father was his sober support person.

Birth was reported difficult with more than 12 h of labor and use of opioids for analgesia. Past psychiatric history was significant for ADHD, and "anxiety, and depression," his pediatrician had diagnosed when he was 16. He described family as "disconnected" since his parents' divorce. He felt "trapped" while living with his mother. Therefore he relocated and has lived with his father, "Since some time just after [high school] graduation." He described distant sibling relationships "because they all hate my dad for some reason. Because I'm the only one giving him a chance they don't talk to me."

A described a long history of poor communication and difficulty socializing. Throughout his education he was in "special classes" that he feels were stigmatizing and responsible for "making it really difficult to have friends at school. Everyone looked at us like we were weird and didn't want to be seen with us." After high school, A worked as a custodian for a few months at a college until, for unclear reasons, he was terminated and barred from the campus. A stated, "I just decided that being alone all the time, at work and at home, wasn't good for me and never went back." This was his only significant work in the seven years since high school graduation.

He spent much of his time indulging in alcohol, tobacco, and cannabis and avoiding social interactions. Alcohol consumption had been responsible for a hospital admission for withdrawal, an inpatient rehab followed by six months in a half-way house, and a drinking dream, suggestive of alcohol changing his ventral tegmental dopaminergic SEEKING system to produce alcohol craving (Johnson, 2001, 2003).

During the initial interview he described feeling nauseous and agitated as we discussed his relationship with addicting substances. His mental exam was remarkable for tense posture, marked fidgeting, and gaze avoidance. His thought process was illogical regarding emotions and relationships. Affect

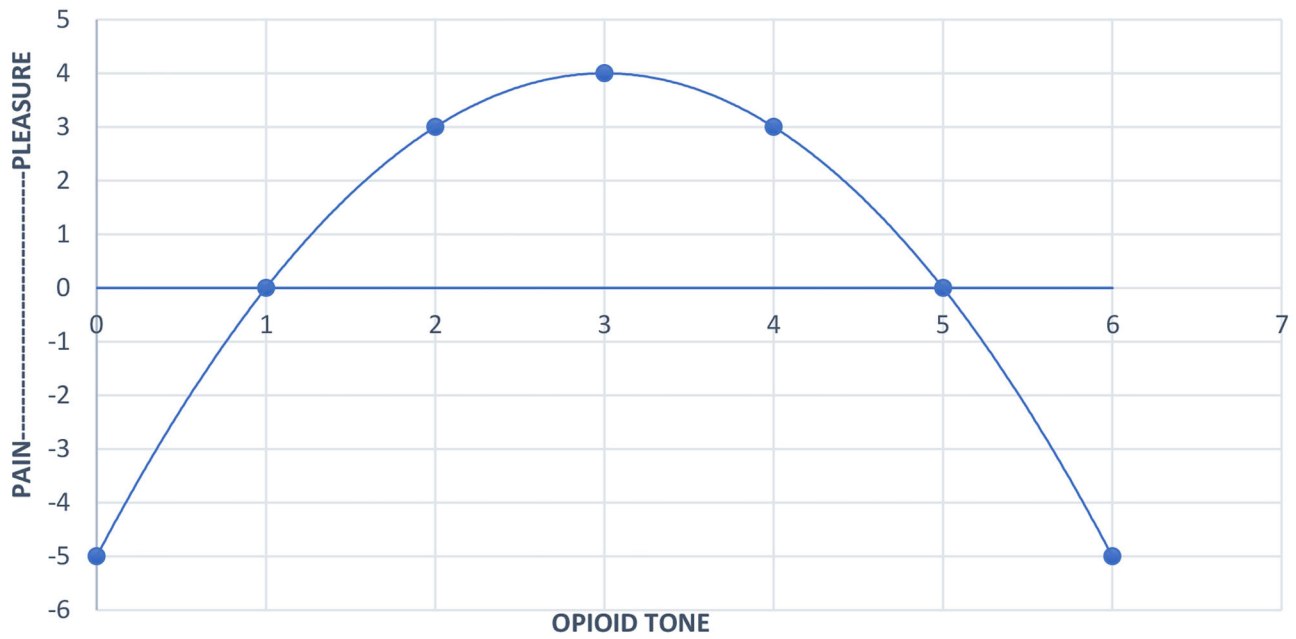

FIGURE 1 | Neurobiological systems engineering model of the relationship of pain, pleasure and opioid tone.

was remarkable for dysphoria and irritability. His mood was described as "confused." Insight and judgment were poor.

Hamilton Rating Scale for Depression was 21, severe. A's SCID-2 screen for Borderline Personality was positive with 8/15 items checked. DSM5 criteria were ADHD positive for six inattentive and four hyperactive symptoms. Expired carbon monoxide was 8 part per million reflecting current cigarette use. Cognitive function was perfect. Diagnoses were Major Depressive Disorder, ADHD, Inattentive Type, Tobacco, Cannabis, and Alcohol Use Disorder.

We gave A and his father rating scales. The SRS-2 is validated for adults (Chan et al., 2017). The patient self-rates with a score above 75 indicating severe autism. The SCQ is observer rated; a score of 23.08 is the standardized mean for a diagnosis of autism (Rutter et al., 2003). A scored 79 on the SRS-2. The father rated 27 on the SCQ with a threshold for diagnosis of ASD being 15.

On day 8 cold pressor time (CPT), an ice water bath measuring pain tolerance by timing duration of forearm submersion, was 190 s. Our control average using support persons is 113 s. The withdrawal at 190 s seemed more from annoyance at feeling confined and controlled by remaining stationary rather than intolerable pain. A trial of naltrexone at 25 mg (0.39 mg/kg) was discussed.

A was reluctant to begin naltrexone but provided no reason for his objection. On day 21, A reported improvement in ADHD and depression with twice a week transference focused psychotherapy and bupropion 450 mg/day. After showing these signs of clinical improvement a trial of naltrexone was revisited.

A was apprehensive. He demonstrated an odd rationale about how naltrexone might injure him. We find autistic patients express pride at being autistic, as A did. They speak as if among many frustrations of their life they possess one outstanding quality—being autistic. We clarified his concerns and interpreted rationalizations regarding avoiding treatment. A agreed to begin naltrexone.

On day 28 A started 25 mg naltrexone with improvement in relatedness and odd thinking by day 35. We felt the therapeutic effects of naltrexone 25 mg had plateaued. We increased the dose to 50 mg. A felt significantly better with improved relatedness and clearer thinking.

His CPT was 28 s on 50 mg of naltrexone with a repeat CPT of 39 s a week later. CPT falling from 190 s to 28 or 39 s is thought to represent decreased central nervous system opioid tone, moving A toward the top of the inverse parabolic function in **Figure 1**. Closeness caused pleasure rather than pain. But A could also feel the pain of emotional responses to relationship problems.

On day 55, A lost his naltrexone prescription. We did not hear about this until inquiring about worsening gaze avoidance, confused thinking, and deterioration of relatedness. At his psychotherapy hour he smelled foul as if self-care had deteriorated.

One evening soon after he cut his left palm with a knife so deeply that the wound required 11 sutures. It was as if A had decided, "I needed to feel pain." This may have been an attempt to upregulate pain drivers to balance high opioid tone. Again there was reluctance to take medication as his odd thinking prevented

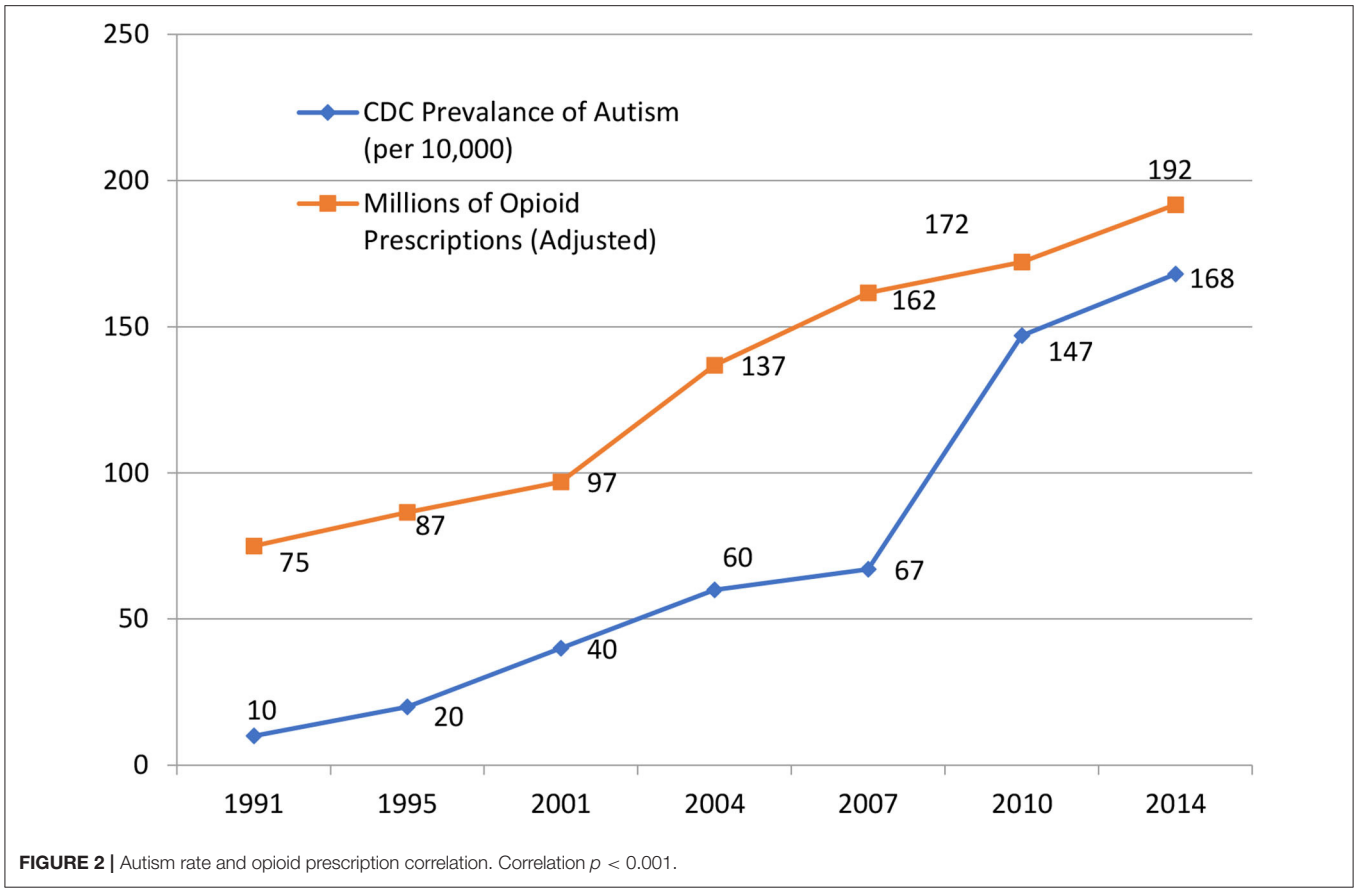

FIGURE 2 | Autism rate and opioid prescription correlation. Correlation $p < 0.001$.

TABLE 1 | Population-adjusted rates of autism and opioid prescribing in the United States *adjustment based on 1991 population.

Days	**0**	**8**	**28**	**35**	**42**	**49**	**55**	**65**	**98**
Intervention	Assessment	CPT	Naltrexone 25 mg	Naltrexone 50 mg				Resumed naltrexone	
Result	MDD	190 s	Better	Even Better	CPT	CPT	Lost naltrexone	Again better	Hired full time
	ADHD BPD Alcohol, Cannabis, Tobacco use disorder				28 s	39 s	Cut open palm—11 sutures to close wound		

appreciation of naltrexone's benefits. His father came to his psychotherapy hour and it was agreed A would restart naltrexone.

On day 65, A returned with vast improvement in mental status on 50 mg of naltrexone. On day 74, A decided to increase naltrexone to 75 mg (1.17 mg/kg). Initially, he felt better. However, after a few days, with no discussion in psychotherapy, he returned to 50 mg. A stated, "At 75 mg I didn't feel like I was on anything." This is consistent with 75 mg pushing A out of the 2–4 range of **Figure 1**, and into the 0–1 range of opioid tone where pain is identical to the 5–6 autistic range of opioid tone.

Overall, A felt marked improvement at naltrexone 50 mg. He said, "I can watch a basketball game now with my father without losing interest or wanting drugs or alcohol." He stopped alcohol, tobacco, and cannabis. Although we attributed the cessation of drug use to his psychotherapy, it may be that naltrexone also made a contribution. Naltrexone is an approved drug for Alcohol Use Disorder. On day 85, A's father rated him a 9 on the SCQ—not consistent with autism. A rated himself 54 on the SRS-2, considered normal.

On day 98, A was hired for a job loading trucks, full time at $14 per hour, and had purchased a new car. He reported positive interactions with coworkers. Soon after he terminated psychotherapy.

On day 166, A had again stopped his naltrexone. He got drunk, crashed his car, and lost his driver's license for a year. A has re-engaged in psychotherapy. Its focus has become negotiating

painful relationships including the relational difficulties he encounters with his therapist.

Two years into his psychotherapy A has been working full-time since day 98. He talks mostly about his work relationships. Like other patients with major mental illness, sharing drugs becomes a way of engaging with others. He has resumed inhaling tobacco. He described with great pleasure asking a supervisor for a cigarette. "We walked the whole length of the warehouse to his office. He said, 'I wouldn't do this for any deadbeat but you work hard so I'll happily give you one of mine.'" Coworkers who inhale tobacco with him on breaks are characterized as, "Good, social people with a lot going on."

Figures of external authority, such as law enforcement and physicians who, "Always have such a serious look on their face," are associated with projected judgment and feeling inadequate, evoking guilt and shame. "Court is the worst because everyone is serious. Everyone looks at you like there's something wrong with you." A's reflective accounts of school are often externalizations he experiences as pondering other people's thoughts of him. He questions whether people past and present were/are honest about their perceptions. This identity question is part of A's transference and a focus of his continuing psychotherapy.

The paranoid thinking about external judgments and malevolence has consistently been examined in the transference, "Are we judging you?" By two years into treatment the paranoia is gone. A is working on developing relationships that he now desires.

DISCUSSION

Mindful that autism is a heterogeneous disorder with genetic variation, and that there is a range of C-terminal beta endorphin levels in autism, we have presented a neurobiological systems engineering model of "high opioid tone" autism that accounts for many of its features. We have found using the cold pressor test (CPT) to identify autistic persons with presumed high circulating opioids (until measuring C-terminal beta endorphin becomes a routine clinical test) and blocking down pain tolerance using subjective report of feeling better combined with objective lowering of pain tolerance as shown by CPT makes our autistic patients more related and more functional. As shown in this case report, patients who may have gone their whole life with the dysphoria of high opioid tone, face another kind of difficulty when ordinary relatedness, newly experienced, includes the pain induced by having trouble being close to others.

We return to the "three hit model" of autism and describe how our understanding fits the paradigm.

1. The engineering model has nothing to do with genetic predisposition.
2. The second hit, the environmental trigger that interacts with genetic predisposition, is administration of opioids during childbirth. There is no need to administer opioids during childbirth. An epidural block using a non-opioid such as bupivacaine would be adequate. We speculate that the pain of childbirth has a function of setting opioid tone. Administering exogenous hormone disrupts the endogenous opioid system. Producing autism would be another unfortunate, unintended consequence of opioid analgesia.
3. High opioid tone provides an explanation for the diversity of findings in autism.

    a. Development is influenced by aberrantly high pain that human interactions provoke. Looking, touching and speaking augment tone which worsens pain, forming the basis of social withdrawal, lack of speech mastery, and gaze avoidance.
    b. Parents are in an impossible position. They seek empathic connections ignorant of the reality that empathy relies on everyone having similar brains. Conventional acts of parental love create pain in the child. Any parent would react with confusion when their child recoils from their loving ministrations. Different brains create different responses to human contact.
    c. Intestinal problems could be a direct effect of opioids on the gut; analogous with opioid-induced constipation. There is an additional effect of opioids on immune functions located in the gut to prevent bacterial infection that toll-like receptors and opioids modulate. (Rose et al., 2018) High opioid tone may turn on inflammatory cytokines that disrupt gut function.
    d. Glial cells in the brain also have toll-like receptors. Endogenous opioids and inflammatory cytokines co-regulate at the toll-like receptors, type 4 (TLR4) (Araldi et al., 2019). High opioid tone may evoke inflammatory cytokines, accounting for brain inflammation in autism (Onore et al., 2012).
    e. Endogenous opioids inhibit norepinephrine function in the locus coeruleus that fuel stimulation of corticostriatal pathways (Scavone et al., 2013). Inhibited norepinephrine secretion may result in the high prevalence of ADHD in autism.
    f. Disordered sleep is ubiquitous in opioid-maintained persons (Khazie et al., 2016). High opioid tone would account for a similar symptom in autism.
    g. Anxiety is a signal that one is distant from loving persons (Watt and Panksepp, 2009). Relationship avoidance to prevent pain creates distance, fitting the high prevalence of anxiety in autism. Autistic persons avoid the pain of closeness at the price of anxiety generated by separation.

If this preliminary model is accepted as having some credence, a new set of investigations is indicated.

1. C-terminal beta endorphin assay is not widely available. Only a few research laboratories measure it. CPT is a stopgap until n-terminal beta endorphin testing becomes commercially available. Naltrexone dose would be determined by amount needed to block down n-terminal beta endorphin into the normal range.
2. Psychotherapy for autism would be tailored to the patient's age/duration of uncorrected high opioid tone.

3. A randomized, double blind evaluation of childbirth with and without opioid analgesia would be undertaken with assessment of gaze-avoidance at an early age, perhaps 12 months. This would confirm or disconfirm the need to discourage opioid administration during childbirth. A broader period of gestation might also be examined, in case opioid tone is set earlier than parturition.
4. Trials of naltrexone with C-terminal beta endorphin assay at different ages during childhood would be undertaken to see if early intervention minimized the damage of high opioid tone to development and relationships.

The authors wish to be clear this is a preliminary hypothesis about the subset of autism high opioid tone may cause. It has the virtue of a parsimonious explanation of a diverse set of attributes of autism.

PATIENT PERSPECTIVE

The patient read the manuscript and gave written permission to use it with some disguising of biographical details but did not care to comment.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

VA wrote the first draft. JR wrote the case report. BJ invented the novel concepts in the paper. All authors approved the final work.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.657952/full#supplementary-material

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The SEEKING Drive and Its Fixation: A Neuro-Psycho-Evolutionary Approach to the Pathology of Addiction

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Neuro-ethological studies conducted by Panksepp and his colleagues have provided an understanding of how the activity of the mesolimbic dopaminergic (ML DA) system leads to the emotional disposition to SEEK/Explore, which is involved in all appetitive motivated behavior and mental activity. In pathological addiction phenomena, this emotional disposition "fixes" itself on certain obsessive-compulsive habits, losing its versatility and its natural predisposition to spontaneous and unconditioned activation. Overall, the result is a consistent disinterest in everything that is not the object of addiction. From a neuro-psycho-evolutionary point of view, the predisposition to develop addictive behavior can be attributed to a loss of "functional autonomy" of the SEEKING/Explorative disposition. Indeed, as shown by animal and human studies, the tendency to be conditioned by situations and contexts that provide an immediate reward can be closely related to a deficit in the tonic endogenous activity of the ML DA-SEEKING system.

Keywords: SEEKING, dopamine, mesolimbic, addiction, compulsive, habit, exploration, drive

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INTRODUCTION

According to the American Society of Medicine (American Society of Addiction Medicine, 2011), "Addiction is a treatable, chronic medical disease involving complex interactions among brain circuits, genetics, the environment, and an individual's life experiences. People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences." The literature on this phenomenon is immense and reviewing that comprehensively is beyond the scope of this article, which is to conceptually analyze the potential contribution to the understanding of addiction of the neuro-psycho-evolutionary approach to the SEEKING drive and its fixation.

From a neuro-psycho-evolutionary perspective, SEEKING is a neurobiologically based and evolutionarily conserved emotional drive (Ikemoto and Panksepp, 1999; Alcaro et al., 2007; Alcaro and Panksepp, 2011). Such drive is thought to be involved in all the appetitively motivated behaviors and play an essential role in stimulating mental activity. Addiction can be conceptualized as

the result of SEEKING becoming "fixated" upon compulsive habits, thereby losing its versatility and spontaneous activation to novelty, regardless of the presence of other reinforcements. This fixation results in a lack of interest in everything other than the target of addiction. Environments that provide plentiful and accessible conditioned rewards, while not stimulating unconditioned exploration toward novel and unpredictable settings, further exacerbated the loss of "functional autonomy" of the SEEKING drive.

Substance-related addictions, such as those to alcohol or drugs, almost always have clear and recognizable signs. Usually, the addicted tend to isolate themselves or restrict their acquaintances to a small circle of people with whom they share the same drug-related habits (McAlaney et al., 2021). Such social maladjustment often leads to marginalization and antisocial behavior (Fox et al., 2013). In contrast, non-substance-related forms of addiction, such as those to the Internet, food, gambling, sex, work, etc., are often more challenging to identify because they arise as common behaviors within everyday social contexts. They are more subtle and devious, and it can be complicated to determine whether you are dealing with addictive behavior (Alavi et al., 2012).

Consider, as a paradigmatic example, the following clinical sketch. A few weeks ago, a woman decided for the first time to consult a psychotherapist about a problem she was having with her 17-year-old daughter. The daughter had been behaving atypically for several months: she would lock herself in her room for hours, stay awake at night, and catch up on lost sleep after returning from school in the afternoon. Questioned by her mother, the girl claimed to spend all time in the room, in front of the computer or on her mobile phone, "chatting" with friends or browsing various social networks. Are we facing the symptoms of true Internet addiction, or can we consider the girl's smartphone overuse in line with her lifespan and socio-cultural context without overemphasizing it?

Although dependent habits are widespread, we need to develop a better distinction between behaviors that resemble addiction but do not compromise the individual's overall functioning and psychophysical health, and maladaptive, compulsive rituals, which require intervention. To this aim, it may be helpful to view addiction from an evolutionary perspective, using the contributions from comparative research on animal brains and behavior. Such studies have identified the mesolimbic DAergic system as the neural substrate fundamental to establishing and maintaining all forms of addiction (for review Kuhn et al., 2019). Over the years, a more extensive corticolimbic circuit model has been developed that now includes other brain regions involved in compulsion and decision-making processes (e.g., the orbitofrontal cortex). This extended model can better capture the often-stochastic transition toward compulsive use, integrating the genetic and epigenetic information underlying vulnerability to addiction (Volkow et al., 2019; Lüscher and Janak, 2021). However, the dopamine-mesolimbic motivation-reward-reinforcement cycle remains the most coherent physiological theory in addiction (Popescu et al., 2021). Abundant animal and human studies have shown that the predisposition to develop addictive behaviors can be closely related to a deficit in the endogenous tonic activity of the ML DA system (George et al., 1995; Marinelli and White, 2000; Chefer et al., 2003; Alcaro et al., 2007).

Interestingly, although the neurobiological processes responsible for the development and maintenance of dependent behaviors are common to both humans and many animal species, the phenomenon of pathological addiction only manifests itself under certain conditions where predisposing factors result in vulnerability, suggesting an interaction between biological and socio-cultural factors (Westermeyer, 1999).

Based on this premise, we propose a hypothesis that attempts to identify a psycho-biological substrate for individual vulnerability to the development of pathological addiction and connect such predisposition to specific environmental, cultural, and socio-economic factors that characterize our contemporary world.

THE ML DA-SEEKING SYSTEM

Studies of the neurobiological processes involved in the establishment of addictive behavior converge with the dominant role played by the ML DA system and its associated areas and circuits (Wise and Bozarth, 1987; Di Chiara and Imperato, 1988; White, 1996, but see Alcaro et al., 2007 for a summary on the subject). The activation of this system is indeed responsible for the behaviorally incentivizing effects of rewarding stimuli and influences learning, conditioning the incentive value attributed to the stimuli and behaviors associated with the process of reinforcement (classical conditioning and operant conditioning) (Robinson and Berridge, 2001, 2003, 2008; Salamone and Correa, 2002; Everitt and Robbins, 2005). Traditionally referred to as the "reward circuit" (Wise, 2002), the ML DA system, therefore, plays a fundamental role in acquiring compulsive habits and in the frequent reactivation of these habits by conditioned stimuli.

To explain this phenomenon, Robinson and Berridge proposed the incentive-sensitization theory more than 20 years ago (1993). According to this theory, repeated exposure to artificial reinforcers, such as drugs of abuse, sensitize the ML DA system to these reinforcers and to the associated conditioned stimuli, thereby enhancing their motivational value (Vanderschuren and Pierce, 2010). Subsequently, the frequent repetition of behaviors that have produced these reinforcements gradually shapes cognitive and motor procedural schemata, which in turn become actual compulsive habits (Robbins and Everitt, 1999).

Following a highly simplified sketch, we can hypothesize that the ML DA system acts as a link between the representation of specific stimuli and environmental contexts, associated with reinforcements by some limbic structures, such as the amygdala or hippocampus, and a series of procedural sequences (cognitive and motor) processed within the frontal cortico-subcortical circuits (see Alcaro et al., 2007 for a summary).

From a neuro-ethological perspective dealing with the unconditional factors that influence learning (Lorenz, 1965; Panksepp, 1998), we can understand how the ML DA system

is the neurobiological substrate of a primary emotional drive known as the SEEKING/Exploration disposition. It is an intrinsic psycho-behavioral function of the brain that has evolved to make animals explore and seek all kinds of stimuli necessary for survival and reproduction (Ikemoto and Panksepp, 1999; Alcaro et al., 2007; Alcaro and Panksepp, 2011). To be precise, SEEKING is the instinctive basis for all motivated behavior in the appetitive phase (e.g., the search for distal stimuli) which anticipates the second phase of consumption (regarding proximal stimuli) (Wise and Bozarth, 1987; Berridge and Robinson, 1998; Salamone and Correa, 2012).

The SEEKING drive perspective connects with another enormous research fields: the one about intrinsic vs. extrinsic motivation (e.g., Santucci et al., 2019), which – in turn – relates to the information-SEEKING research topic (e.g., Horan et al., 2019). Although there are many interpretations about the roles of the ML DA system (e.g., Bromberg-Martin et al., 2010; FitzGerald et al., 2015; Schultz, 2015), the SEEKING drive theory has the advantage of subsuming all other functions within a single basic psycho-behavioral disposition (see Alcaro et al., 2007 for a review). From a behavioral perspective, the SEEKING disposition expresses itself as locomotion, sensory exploration, orientation reflexes, and approach movements. From a subjective point of view, however, this disposition is accompanied by feelings of enthusiasm, desire, interest, curiosity, and trust, as well as mental states of expectation that anticipate the existence of future rewards (Alcaro and Panksepp, 2011; Cruciani et al., 2011; Conversi et al., 2014).

From a neuro-psychoanalytical perspective, the ML DA system has been identified with the cerebral substrate of libido, considered not only as sexual energy but also as a source of outwardly directed energy investment (Kaplan-Solms and Solms, 2000; see **Appendix A**).

Remarkably, invertebrates also have a SEEKING/Exploration disposition, which is regulated by neurochemical processes like those of mammals. For example, the administration of cocaine and amphetamines, drugs that act directly on DA transmission, can influence the behavior of freshwater crayfish in very similar ways to that of mammals (Alcaro et al., 2011). Crayfishes are invertebrates that, in a familiar environment and without specific stimulation, spend most of their time in a state of complete inactivity. However, as soon as psychostimulants are administered into their circulatory system, they activate and begin exploring the surroundings as if it has suddenly become new and interesting. Activating effects even stronger arise by administering the psychostimulants directly into the ganglion of the head, the brain equivalent in vertebrates (Alcaro et al., 2011).

The results suggest that these animals are susceptible to the incentive effect of these drugs of abuse. Moreover, they prefer drug-associated environments and learn to act to obtain their administration (Søvik and Barron, 2013; Zhu et al., 2014; Engleman et al., 2016; Kaun and Rothenfluh, 2017; Huber et al., 2018). Thus, the addiction phenomenon seems to be rooted in psycho-neuro-behavioral functions that are very ancient from a phylogenetic perspective and are indeed related to the SEEKING/Exploration emotional disposition.

DIRECTED VS. UNDIRECTED SEEKING

The SEEKING emotional disposition typically strives toward specific objects. When recruited by basic biological impulses, such as hunger, thirst, sexuality, the need to find shelter, etc., it promotes exploration to achieve a specific purpose, which coincides with a particular goal-object or environmental condition capable of satisfying the urge. SEEKING ceases when the organic conditions that led to the recruitment of the drive end.

While recruited by basic biological drives and conditioned by homeostatic-visceral regulatory mechanisms, the SEEKING/Exploration system retains some functional autonomy. Indeed, the electrical stimulation of the SEEKING/Exploration circuits activate motivated behaviors related to eating, drinking, or hunting, depending on the environmental contexts in which it is administered (Valenstein et al., 1969). Moreover, under conditions where reinforcing cues or stimuli are absent, the electrical stimulation produces generalized excitation and unspecific exploratory behaviors (Gallistel, 1974; Panksepp, 1998). Thus, unspecific exploration and appetitive motivation may be the purest expressions of SEEKING disposition (Ikemoto and Panksepp, 1999; Alcaro et al., 2007; Alcaro and Panksepp, 2011).

However, through learning, the autonomous expression of SEEKING can be narrowed down, restricting the boundaries of its operation, and directing exploration to specific objects and particular procedures. In this case, the activation of the SEEKING emotional disposition is channeled to a specific sequence of activities aimed at achieving a particular stimulus reinforcement (food) and stops when the environmental conditions that led to its activation are no longer present. For example, a rat that has learned to walk through a maze to obtain food will execute a particular sequence of movements along the tunnels of the experimental apparatus until reaching the goal. The learning process, both in terms of stimulus (classical conditioning) and behavior (operant conditioning), determines a gradual and progressive removal of the functionally autonomous component of the SEEKING/Exploration system, linked to the ventromedial cortico-striatal areas of the DA system and a greater recruitment of the dorsal-lateral regions of the same circuits (Everitt and Robbins, 2005; Alcaro et al., 2007). Through reiteration, this process leads to an increasingly automated execution of SEEKING-driven behavioral and mental activities, structuring them into complexes of habits that can occur with low consciousness and intentionality. In the next section, we will investigate the extent to which such habits could play a decisive role in addiction.

FROM CONDITIONING TO HABITS

The initial experimental research on addiction explained it as a neurochemical imbalance due to repeated drug use motivated to avoid withdrawal symptoms (Solomon, 1977). Over time, however, it has become increasingly clear that, while withdrawal symptoms disappear in a few weeks, addicts

remain prone to "craving," i.e., a hard-to-repress urge that drives them to act compulsive behaviors, triggered by drug-associated cues even after a long abstinence. Since then, research has increasingly focused on craving-induced relapse and its underlying mechanisms (Shaham et al., 2003; Hyman, 2005).

In the last thirty years, the primary focus of theoretical and experimental investigation has become the phenomenon of craving, which is explained by two interrelated processes, one general and one specific. The general process comprises deficits in impulses' inhibition and cognitive control, i.e., reflectively weighing up the consequences of one's actions (Volkow and Fowler, 2000; Jentsch et al., 2014). The specific process involves the conditioning through which mental and behavioral processes come under the control of certain kinds of memories and habits that relate to the contexts of addiction-associated stimuli and behaviors (White, 1996; Everitt and Robbins, 2005; Hyman et al., 2006). For example, such memories could relate to bars or gambling halls for a slot machine player, certain sounds and images associated with slot machines, and the gestures performed while playing.

In this paragraph, we will specifically address the second of these processes: the specific one, postponing the discussion of the general one to the next section. Although distinct, the two processes are deeply interrelated: it is easier to succumb to cue-induced craving when the capacity for reflective self-regulation is diminished, while being subjected to powerful conditioned associations can, over time, weaken the ability for reflective self-regulation.

Neurobiological research based on animal models of drug addiction has shown that the intake of abused substances leads to a gradual functional reorganization of the brain from the molecular to the systemic-circuit level (Nestler, 2002, 2014). The neurobiological and psycho-behavioral processes identified by these studies turn out to be broadly similar in other forms of addiction that do not involve drugs. What has emerged from this research is that addiction implies a process of maladaptive learning, characterized by the progressive acquisition of compulsive habits, which plunge the individual into a cyclical spiral of anguish and despair (Koob and Le Moal, 1997, 2001, 2008). Forming a constricting nexus, the set of memories and compulsive habits end up dominating, increasingly exclusively, the needs, motivations, and desires of the addict. Parallelly, all other activities and contexts lose their ability to stimulate even the minimum interest.

From an Affective Neuroscience viewpoint (Panksepp, 1998; Alcaro and Panksepp, 2011), addictions can be characterized by narrowing and tightening of the SEEKING disposition, which is activated only in certain contexts and channeled through specific sequences of procedural activities. All this can be orchestrated by a form of top-down control exerted by superior cortical and limbic structures on the subcortical centers' activity, especially the ML DA system (Alcaro et al., 2007). Such top-down control may reflect increased glutamatergic transmission in nodal centers of cortical-striatal circuits (Pennartz et al., 2009), underlying the sensitization process by which addiction memories gain disproportionate incentive power over behavior (Steketee and Kalivas, 2011). In turn, increased descending excitatory transmission may suppress the endogenous activity of SEEKING/Exploration systems, thus compromising its functional autonomy. The loss of functional autonomy of the SEEKING system may constitute the common root of all forms of addiction. Nevertheless, different addictive behavior depends on the action of distinct memory complexes.

INDIVIDUAL VULNERABILITY AS AN ENDOGENOUS DEFICIT OF THE ML DA-SEEKING SYSTEM

There is widespread agreement that vulnerability to addiction involves epigenetic regulation of so-called endophenotypes (Nestler, 2013; Walker and Nestler, 2018). Originating from the research conducted by Panksepp and his collaborators, it has been possible to characterize these endophenotypes based on the organization and expression of the basic emotional systems (Panksepp, 2006). Among the addiction-related endophenotypes, here, we focus specifically on an endogenous deficit in the ML DA-SEEKING system, although we do not exclude the intervention of anomalies in other emotional systems.

The loss of functional autonomy of the ML DA-SEEKING system is almost certainly accelerated and reinforced by the conditioning experiences that gradually lead to addiction. However, it is plausible that the system is already vulnerable to addiction even before such events. Such a hypothesis would explain why some people are fascinated by situations and environments where it is easy to develop an addiction, while others stay away from or are not attracted to them. From this point of view, the development of a specific addiction may reflect an exacerbation of existing tendencies and individual susceptibilities to conditioning.

Indeed, animal models of addiction have shown that the tonic hypofunctionality (the lowered tonic background activity) of the ML DA system is a crucial factor in both the predisposition to addiction and the maintenance of compulsive behaviors. From a neurochemical point of view, tonic DA transmission extends outside the synaptic space and changes slowly, because it is relatively independent of nerve impulses (Grace, 2000). As a result of inhibitory regulatory processes mediated by DA autoreceptors, DA's tonic levels inhibit the readiness for the electrical discharge of DA neurons (Grace, 2000; Schmitz et al., 2003). Tonic DA levels also appear to promote an increase in phasic DA release from each single firing pulse (Alcaro et al., 2007). Therefore, the tonic levels of DA express the ratio between discharge potency (the number of DA molecules released by each impulse) and electric excitability of DA neural cells. Tonic DA concentrations represent the degree of functional autonomy of the ML DA system and its independence from excitatory (glutamatergic) stimulation. Coherently, animal models have confirmed that subjects vulnerable to drug addiction exhibit hypoactivity in tonic DA transmission and hyperactivity of ML DA neurons (George et al., 1995; Marinelli and White, 2000; Chefer et al., 2003; Alcaro et al., 2007).

From a psychological point of view, losing functional autonomy of the SEEKING/Exploration system is linked to two closely connected phenomena:

(1) A predisposition toward an anhedonic depressive mood characterized by a lack of enthusiasm and a tendency toward distrust and renunciation (Gold et al., 2018; Salone, 2018; Szczypiński and Gola, 2018).
(2) An emotional and behavioral hyper-reactivity to environmental conditions characterized by novelty or artificial reinforcements such as drugs of abuse (Piazza et al., 1989; Pierre and Vezina, 1997). Individuals characterized by this hyper-reactivity have been classified as "novelty seekers" or "sensation seekers" (Bardo et al., 1996).

According to the self-medication hypothesis, such individuals are prone to search for novelty and develop addictive behaviors to provide accessible, rapid, and powerful stimulation that compensates for an endogenous motivational defect (Markou et al., 1998). Unfortunately, this stimulation offers temporary relief but ends up fueling depressive withdrawal, as the potent and circumscribed stimulation of the SEEKING/Exploration system fuels an inhibition of its tonic dopaminergic activity.

PREDISPOSING ENVIRONMENTAL FACTORS

Research conducted on animals and humans has revealed that an individual predisposition to addiction is promoted by stressful environmental conditions (see Ruisoto and Contador, 2019 for a summary). It has also been shown in animals that this predisposition is markedly attenuated if the animals are raised in an enriched environment, characterized by exposure to new stimuli, social interactions, and physical exercise (see Crofton et al., 2015 for a summary of research on the topic). Amongst the various stressors, those related to adverse social conditions or events have received particular attention, as they are probably the most relevant to human psychological development (Pelloux et al., 2019). Social isolation, deprivation from parental care, and forced submission are the elements of social stress that most predispose to the development of addiction.

From a psychobiological perspective, we can define stress as environmental influences that exceed the individual's coping capacity and exert pressure on him to force certain activities and restrict his freedom of action. It is a constraint on the spontaneous dispositions that animate from within, forcing the individual to adapt to the environment, limiting the self's free and spontaneous expression (Winnicott, 1965). The growth and development of a healthy and genuine personality are directly linked to the expression of positive emotional dispositions, such as SEEKING/Exploration, PLAY, LUST/Sexuality, and CARE. The expression of these dispositions can be generally inhibited by living conditions, stressful or traumatic events, or conditions that involve emotional neglect.

Neurochemical evidence shows that traumatic or stressful events activate the glutamatergic circuits at the cortical and limbic levels. Beyond a certain threshold, this activation triggers inflammatory and cytotoxic processes that alter the functionality of the neuronal connectivity (Averill et al., 2017). Repeated, chronic, and uncontrollable stresses also cause a hypofunctionality of the ML DA system. Such hypofunctionality has been linked to a motivational deficit manifested as a reluctance to face and resolve negative situations (learned helplessness) and diminished interest in pleasing situations (anhedonia) (Cabib and Puglisi-Allegra, 1996; Gold et al., 2018; Stanton et al., 2019).

In summary, stressful environmental conditions, especially social ones, may predispose vulnerable individuals to develop an addiction by inhibiting the spontaneous expression of positive emotional dispositions (SEEKING, PLAY, CARE, and LUST). Indeed, those emotions promote and reinforce the influence that the individual exerts on his environment. On the other hand, the pressure that the environment exerts on the individual restricts the range of its actions and favors establishing compulsive habits that act autonomously and independently of the expression of subjective intentionality.

A NEURO-PSYCHO-EVOLUTIONARY INTERPRETATION OF THE PHENOMENA OF ADDICTION

The evolution of terrestrial vertebrates is characterized by an increasing degree of encephalization and by the development of an extensive and densely connected cortical mantle. The process of corticalization begins to be visible in reptiles, which have an allocortical formation known as the medial cortex. This formation is considered the anatomical precursor of the medial temporal lobe of mammals. The medial temporal lobe, which also includes the hippocampus and the parahippocampal gyrus, is the oldest part of the mammalian cortex in evolutionary terms and is involved in the processes of spatial navigation and the formation of abstract representations necessary for spatio-temporal and declarative memory, contextual learning, and some forms of social cognition (Reiter et al., 2017). The evolution of the cerebral cortex has been linked to the development of a form of knowledge called "noetic," based on explicit representations endowed with an object structure and identity whose properties can be abstracted from the context in which they are embedded (Fabbro et al., 2015). Noetic awareness enables an organism to perceive objects and events and the relationships between objects and events and process them cognitively when these objects and events are not present. This information of the noetic type overlays a primary expression of mental activity defined as "anoetic," which is essentially based on pre-representational emotional states and essentially lacks a distinction between the self and the external environment (Solms and Panksepp, 2012). The stage of noetic representation reveals itself as a development of focused attention, which enables the differentiation and categorization of specific features of the environment and the appearance of a form of explicit object awareness and semantic and conceptual memory (Tulving, 1985). In retrospect, this is the form of consciousness Edelman defines as "primary consciousness" and

that is associated with the activity of the reentrant thalamocortical circuits (Edelman, 1992) present in mammals, birds, reptiles, and children from the age of 3 months (Edelman et al., 2005).

As Hobson (2001) argued, the capacities of focused attention that allow noetic cognition to appear to be linked to monoaminergic neurotransmission (serotonin and noradrenaline) and the activity of mesencephalic nuclei such as the locus coeruleus and raphe dorsalis. On the contrary, the type of unfocused exploratory activation seems to be more related to cholinergic neurotransmission promoted by the activity of pontine nuclei such as the pedunculopontine nucleus and the dorsolateral tegmental nucleus. Cholinergic and monoaminergic transmission would therefore preside over two different forms of psycho-behavioral activity. The first, older in neuro-evolutionary terms, is based on a fluid and unfocused exploration of the environment, and therefore lacks explicit references to objects and contexts. On the other hand, the second is linked to the evolution of the cerebral cortex and the possibility of generating objective representations of the surrounding environment, i.e., closed structures with their internal shape and organization recognized as independent of themselves (see **Appendix A**). This type of "mind wandering" is fed by images, representations, and thoughts that have a more open and flexible form and better correspond to the affective states of the self (Alcaro and Panksepp, 2011; Christoff et al., 2016; Alcaro and Carta, 2019).

As previously suggested in other contributes (Alcaro and Panksepp, 2011; Alcaro and Carta, 2019), mind wandering is sustained by the SEEKING drive when such disposition is not constrained by focused, attentive mechanisms which restrict explorations around specific boundaries of perceptual or mental objects. This phenomenon is very clearly observed in the REM sleep phase, which is associated with the ability to dream (Hobson, 2009; Hobson and Friston, 2012) and is characterized by a remarkable activation of the ML DA system (Solms, 2000; Perogamvros and Schwartz, 2012). Functional neuroimaging studies have clearly shown that unfocused mental exploration is associated with resting-state brain activity. Intrinsic and spontaneous activity of this kind appears in some cortical and medial subcortical regions when the organism is not actively interacting with the environment (Northoff et al., 2006; Alcaro and Panksepp, 2011; Raichle, 2015; Alcaro and Carta, 2019). The ability of the mind to detach itself from the immediate requirements of the physical environment to support endogenous activity presides over the evolution of the so-called "reflexive function," or "mentalization," on which all the most advanced processes of communication and social interaction depend. Several empirical facts suggest that the SEEKING/Exploration system influences this type of mental activity. Indeed, the neural substrates of the SEEKING/Exploration system are implicated in all forms of unfocused mental exploration, such as creative-divergent thinking, cognitive flexibility, insights, and associative thinking (Flaherty, 2005; Chermahini and Hommel, 2010; Takeuchi et al., 2010; Zabelina et al., 2016; Boot et al., 2017). Furthermore, dysfunction of the SEEKING emotional system can lead to thinking that is characterized by a loss of motivation and the dominance of depressive rumination (Northoff et al., 2011), while lesions of the same system may lead to the disappearance of dream activity and confusion in mental life (Kaplan-Solms and Solms, 2000).

From the arguments presented above, we can hypothesize that the predisposition to addictive behavior is associated with a disturbed ability of the SEEKING/Exploration system to maintain spontaneous and unfocused activation. Loss of autonomy of SEEKING/Exploration system shows up as an impoverished intrinsic and spontaneous functioning of the mind-brain. In support of this hypothesis, recent studies have shown that patients with addictive disorders exhibit a characteristic alteration in resting-state brain activity and the intrinsic functional connectivity of medial cortical structures (Ma et al., 2011, 2015; Li et al., 2016).

With the functional deficit of the ML DA-SEEKING, a restricted cortico-centric pattern of brain activity, inseparably linked to the representation of objects or the implementation of procedural habits, strictly controls the SEEKING system and the intrinsic dynamism of the mind-brain. Coincidentally, the analysis of the dreams of patients with drug addiction reveals a gradual impoverishment of the content of dream fantasies which lose their complexity and end up focusing almost exclusively on the simple hallucinatory satisfaction of drug cravings (Colace, 2014). In contrast, the practice of meditation (mindfulness), and other forms of focused attention, have been shown to have beneficial effects in treating addictions, especially in reducing craving (Chiesa and Serretti, 2014; Ashe et al., 2015; Tapper, 2018).

ADDICTION AND THE SOCIO-CULTURAL CONTEXT

Neuroscientific research considerably increased our knowledge of the neurobiological substrates of addiction. However, this knowledge has yet to be translated into significant advances in clinical outcomes. As recently underlined by Healing and collaborators, "*one possible reason for the disconnection between addiction neuroscience research and clinical advances (is) the relatively limited extent to which social factors have been integrated into neurobiological addiction research*" (Heilig et al., 2016, p. 592). Indeed, although human and animal studies converge in indicating that social factors play an important role in the development and maintenance of compulsive habits (Pelloux et al., 2019), new bio-psycho-social models of addiction are needed to define efficacious therapeutic strategies.

Social epidemiology on drug abuse has evidenced a strong link between addiction and poor social integration (Berkman and Kawachi, 2000; Berkman et al., 2014). Such evidence has been confirmed by animal models, since single-housed animals are considerably more predisposed to develop and maintain addiction compared to animals raised with conspecifics in an enriched environment (see Pelloux et al., 2019 for a review). Interestingly, social deprivation has been also associated with altered ML DA transmission, as well as with higher impulsive and risk-taking behaviors which usually predispose to develop addiction (Martinez et al., 2010; Li et al., 2017; Walker et al., 2019).

It may then be speculated that socio-relational deprivation (isolation, exclusion, marginalization) may impact the functional organization of the ML DA-SEEKING system, that become less open to social stimuli and more dependent on non-social sources of stimulation. Indeed, as reported by Panksepp and his collaborators, positive socio-emotional systems (PLAY and CARE systems) are evolutive branching of the SEEKING drive oriented toward characteristic kinds of social interactions (Panksepp and Biven, 2012; Tanaka et al., 2018). In accordance with such hypothesis, new therapeutic strategies directed to social integration and relational rehabilitation should be integrated with current pharmacotherapies and de-conditioning techniques to ameliorate clinical outcomes (Heilig et al., 2016).

The recognition of the relevance of socio-relational contexts suggests that the enormous impact of addiction on contemporary societies may be partially related to the lifestyle and cultural ground of advanced capitalist societies. Indeed, although drugs and alcohol had been used since ancient ages (Crocq, 2007), some authors claim that widespread drug abuse has occurred mainly in recent centuries (Westermeyer, 1999; Singer, 2012). Moreover, the problem seems still more pervasive today when considering new behavioral addictions, i.e., pathological gambling, compulsive buying, Internet addiction, etc (Grant et al., 2010).

According to Alexander (2000, 2001, 2012): "*The currently dominant paradigm assumes that addiction is either an individual disease or an individual moral breach. But this individually oriented paradigm has failed. Instead, addiction needs to be understood socially, as a way that large numbers of people adapt to the breakdown of psychologically sustaining culture under the global influence of free-market society.*" Indeed, Alexander claims that "*addiction is endemic in western free-market society [. . .] because free markets inevitably dislocate people from traditional sources of psychological, social, and spiritual support, and because "dislocation," in this broad sense of the term, is the precursor of addiction.*"

Although Alexander's position is not yet supported by strong evidence-based quantitative data, we think that his speculation may encourage the emergence of new research in the socio-affective neuroscience of addiction. Indeed, the lifestyle of capitalist societies may promote compulsive behaviors by forcing individuals to pursuit individualistic and competitive goals and focus on achieving immediate rewards, while depriving them of psycho-environmental contexts adequate to open the SEEKING/Explorative disposition to the socio-relational field.

A notable example of the lack of open social exploration in a highly technologized society is the widespread deprivation of children's spontaneous play, the unstructured and unregulated activity in which children engage when left to express themselves freely, without the strict control of adults (Frost, 2009, 2012; Chudacoff, 2012). Spontaneous play among juveniles is an essential feature of the behavioral development of many different species, including humans, non-human primates, other mammals, and birds (Burghardt, 2005). It is, above all, a source of joy, i.e., an emotional state crucial for psychological well-being and growth.

Many studies have also shown that spontaneous play is at the forefront of the development of essential cognitive, emotional, and social functions and that its expression influences the activity of the frontal and prefrontal cortex, which is responsible for the balance of personality (Panksepp and Biven, 2012). Other studies have directly assessed the effects of play deprivation in juvenile animal models, showing that it disrupts neural circuits regulating aggression and stress responsivity (Kyle et al., 2019).

Unfortunately, today's society tends to limit children's activities to places and contexts (homes, schools, gyms, etc.) that restrict or completely prevent their free expression (Lorenzoni, 2014). To manage the inevitable build-up of frustration resulting from the impediment of this natural, energetic inclination for SEEKING/Exploration and unstructured play, today's society offers quick and reassuring remedies: televisions, video games, social networks, candies, etc. In this way, the "fetish" penetrates modern education as a substitute for the infinite, limitless potential of SEEKING/Exploration inhibited and imprisoned in the world of objects.

Some of the reasons for this deprivation of natural, spontaneous play can also be traced to how contemporary society constructs its urban landscapes as spaces that are less and less suitable for children to express themselves freely. At the same time, such deprivation is probably linked to the now deep-rooted stress and anxiety that pervades the minds of adults when children express their natural vitality in a playful way. Such concerns, unshaped and unexpressed, may be related to a fundamental loss. The loss of the meaning of one's existence cannot arise perhaps precisely because the disposition for SEEKING/Exploration is trapped within the prison of object-related goals and habits.

CONCLUSION

This article describes and interprets the phenomenon of pathological addiction from a neuro-psycho-evolutionary perspective as an expression of vulnerability related to biological and social factors. More specifically, the predisposition to develop addiction is interpreted as a loss of functional autonomy of the SEEKING/Exploration system and a related decline in the spontaneous unfocused mode of mental activity. Consequently, cognitive processes become increasingly fixed and associated with automatic patterns of neuronal activity, which are difficult to extinguish or modify. Although most current treatment methods prefer interventions directed toward the individual using drugs or psychotherapy, the growth of the phenomena of pathological addictions inevitably forces a critical reflection on the socio-cultural conditions in which they develop.

AUTHOR CONTRIBUTIONS

AA had the original idea and coordinated the work. AB revised the manuscript and improved the language style. DC gave his personal contribute with special emphasis to animal research studies. All authors contributed to the article and approved the submitted version.

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APPENDIX A: AN EXCURSION INTO A NEURO-PSYCHOANALYTIC MODEL

Our affective, neuro-ethological view of the SEEKING drive and its involvement in pathological addiction share many points in common with some recent thinking from neuro-psychoanalysis. Indeed, to a degree, the SEEKING disposition can be linked to the instinctive emotional force involved in mental energy ("libido") and its projection toward "external objects" (Kaplan-Solms and Solms, 2000; Alcaro and Panksepp, 2011).

According to the well-known psycho-hydraulic model of drives developed by Freud, psychic energy (libido) is fueled by physical needs and leads naturally to the SEARCH for objects that can satisfy these needs and thus eliminate the conditions of homeostatic imbalance (Freud, 1915; Denton, 2006). This model does not necessarily imply that the individual is aware of the goal object being sought. Nor that this object is unconsciously represented in the mind before it appears in the perceptual field. However, suppose the individual is exploring the environment. In that case, it is possible that reaching a stimulus, or a complex of stimuli, during the act of consumption may influence the activity and limit the field of SEARCH to the object in question. Some years after Freud, Carl G. Jung also hypothesized that there is a form of emotionally motivating energy that is not focused on achieving a predetermined goal. This belief became one of the main reasons for his disagreement with Sigmund Freud. The latter believed that the libido was exclusively oriented toward the satisfaction of biological (especially sexual) drives. The former thought that the libido is an undifferentiated drive that is temporarily bound to specific purposes or objects. By its very nature, it moves freely from object to object and is constantly changing (Jung, 1956).

From the origins of psychoanalysis, Freud (1900) distinguished two forms of mental activity: focused and unfocused, defining them, respectively, as the primary and secondary thinking processes. The secondary process dominates our thinking during the waking state. The primary, ontogenetically archaic form reveals itself in dreaming and several other altered states of consciousness, such as psychedelic and religious experiences, psychosis, prodromes of epileptic crisis, meditation, creative, free-association, and magical thinking, among others (Carhart-Harris and Friston, 2010; Carhart-Harris et al., 2014).

From this novel neuro-psychoanalytic perspective, the phenomenon of addiction appears as the consequence of a robust restriction of the spontaneous expression of the unfocused primary process of thinking exerted by a repetitive and ultra-specific set of memories and procedures.

According to the early psychoanalysts, the restriction of the motivational landscape to a particular set of habits and memories was conceived of as "a compulsion to repeat" (Freud, 1920/1955), whose expression displaces the natural inclination to maintain one's physical and psychological well-being. According to Jung (1959), addiction is governed by the action of complexes of memories and procedural habits (cognitive and motor). Such complexes can operate autonomously, i.e., independently of the ordinary will and intentions, that would normally orient behavior if such complexes were not active.

From this viewpoint, the addict is essentially conditioned, dominated by a set of internalized representations and habits that orient and channel motivational drives in increasingly specific directions. Just as Konrad Lorenz's duck cannot avoid following the object of its imprinting, so the addict cannot avoid continually pursuing the object of addiction, thus losing the very essence of subjective existence, the capacity for self-determination. It follows, therefore, that the crucial question is to understand how such complexes of "dependent memories" are formed and how they act to influence behavior.

Based on Bowlby's (1969/1982) studies, we can identify two primary sources of environmental deprivation that may predispose an individual to develop an addiction. First is the lack of sufficiently strong and stable socio-affective ties, capable of providing a secure base of attachment or a system of belonging. Second is the lack of psycho-environmental conditions that can foster separation, emancipation, and individual autonomy. These two deficits, through seemingly antithetical, are probably complementary aspects of the same process. Attachment studies indicate that exploratory behavior is suppressed in the absence of a sufficiently good, stable, and consistent experience with a caregiver that favors an internalized secure base (Bowlby, 1969/1982). Indeed, the lack of adequate psycho-environmental contexts may be associated with a growing difficulty in tolerating absence, emptiness, and lack as constitutive elements of human life essential for the expression of the capacity to reflect on experience (Bion, 1962; Fonagy and Target, 1997). According to Daniel Stern, it is not what happened in the past but rather how it is remembered and reconstructed in the present (Stern, 1995) that matters in the attachment relationship. Therefore, it looks plausible to imagine that the support and enhancement of a healthy exploratory function may have repercussions on representing a more coherent, stable, and healthy attachment relationship.

To use a mythological metaphor, we can consider the figure of Ulysses as the personification of the relationship between the exploratory drive and the bond of attachment. Ulysses' journey constantly feeds on his firm intention to return to Ithaca to his wife, Penelope. At the same time, his bond with his wife and native land is maintained precisely by his continuous wandering and, therefore, the absence of the person and land he loves. Similarly, psychoanalytic literature from Melanie Klein onward suggests that the relationship with the "loved object" can be said to be complete and in a certain sense real only when one can tolerate and represent its absence, its shortcomings, and its defects. When one cannot accept the experience of being separated, one cannot really be in a relationship because a symbiotic undifferentiated state dominates the panorama of experience.

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The Brain Emotional Systems in Addictions: From Attachment to Dominance/Submission Systems

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Human development has become particularly complex during the evolution. In this complexity, adolescence is an extremely important developmental stage. Adolescence is characterized by biological and social changes that create the prerequisites to psychopathological problems, including both substance and non-substance addictive behaviors. Central to the dynamics of the biological changes during adolescence are the synergy between sexual and neurophysiological development, which activates the motivational/emotional systems of Dominance/Submission. The latter are characterized by the interaction between the sexual hormones, the dopaminergic system and the stress axis (HPA). The maturation of these motivational/emotional systems requires the integration with the phylogenetically more recent Attachment/CARE Systems, which primarily have governed the subject's relationships until puberty. The integration of these systems is particularly complex in the human species, due to the evolution of the process of competition related to sexual selection: from a simple fight between two individuals (of the same genus and species) to a struggle for the acquisition of a position in rank and the competition between groups. The latter is an important evolutionary acquisition and believed to be the variable that has most contributed to enhancing the capacity for cooperation in the human species. The interaction between competition and cooperation, and between competition and attachment, characterizes the entire human relational and emotional structure and the unending work of integration to which the BrainMind is involved. The beginning of the integration of the aforementioned motivational/emotional systems is currently identified in the prepubertal period, during the juvenile stage, with the development of the Adrenarche—the so-called Adrenal Puberty. This latter stage is characterized by a low rate of release of androgens, the hormones released by the adrenal cortex, which activate the same behaviors as those observed in the PLAY system. The Adrenarche and the PLAY system are biological and functional prerequisites of adolescence, a period devoted to learning the difficult task of integrating the phylogenetically ancient Dominance/Submission Systems with the newer Attachment/CARE Systems. These systems accompany very different adaptive goals which can easily give rise to mutual conflict and can in turn make the balance of the BrainMind precarious and vulnerable to mental suffering.

Keywords: addiction, adolescence, affective neuroscience, attachment, dominance/submission systems

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INTRODUCTION

Researches on *human development* (Boughner and Rolian, 2016) have progressively highlighted how the latter has become particularly complex during the evolution, compared to the development of other animal species. In this complexity, *adolescence* is an extremely important developmental stage, because of all changes occurring in the human *BrainMind* (Panksepp, 2011). *Adolescence* in humankind is characterized by multiple aspects—as will be discussed through this article—the most impressive of which is a significant restructuring of the brain (Arain et al., 2013; Walker et al., 2017) within a new hormonal context (Wierenga et al., 2018).

Studies of brain restructuring during *adolescence* have shown the emerging of *the dual systems model* (Pfeifer and Allen, 2012; Gladwin and Figner, 2014; Shulman et al., 2016), in which the limbic system—the seat of emotional functioning and reward—develops before the prefrontal cortex, involved in cognitive and regulatory processes (Padmanabhan et al., 2011; Casey et al., 2016). This model that traced back to *adolescence* the etiology of risk-seeking behaviors, the vulnerability to social frustrations and therefore the development of psychopathology, partially highlights the problem (Crone and Dahl, 2012). Highlighting the poorer regulation of cortical structures on the subcortical ones during *adolescence, the dual systems model* has contributed to paying less attention to the subcortical component. The latter has been relatively little studied as a set of motivational/emotional systems, biologically predetermined and expressing peculiar, endogenous intentionality. *Affective Neuroscience* (Panksepp, 1998) have contributed in the last two decades to reduce this imbalance, significantly bringing attention back to instinctual systems. These systems with peculiar neuronal and hormonal characteristics organize the adaptive behavior of mammals, including the human species, towards the material and relational environment.

What are these instinctual/emotional systems at the basis of mental and relational life? In *Affective Neuroscience*, Panksepp (1998), highlights the presence in mammals of several motivational/emotional systems responsible for regulating the interactions between conspecifics. Those are the SEEKING[1] system that corresponds largely to the mesolimbic dopaminergic (ML DA) system, as will be discussed below; the LUST system that regulates sexuality, the PANIC/GRIEF system that regulates the interaction between caregiver and offspring and works together with the CARE system. In this article, we are going to use Attachment/CARE (Bowlby, 1969) to indicate the complex PANIC/GRIEF and CARE systems of Panksepp. Then there is the PLAY system that regulates the social interactions both in puppies and children and facilitates learning related to competitive interactions. Competitive interactions between sexually mature conspecifics are regulated by the *inter-male aggression*[2] (Panksepp and Zellner, 2004; Kroes et al., 2006), also referred to as the urge for *social dominance* (Panksepp, 1998; Panksepp and Biven, 2012), Dominance system (van der Westhuizen and Solms, 2015) or *agonistic behavior* (Scott and Fredericson, 1951). The urge for *social dominance* is considered a "complex" secondary system made up of three primary emotional systems: "*Contributing factors (to social dominance n.d.r.) include SEEKING and RAGE, as well as FEAR, and surely early experience with the rough-and-tumble PLAY system are involved as well.*" (Panksepp and Biven, 2012, p. 169). Even if the RAGE system can be activated during the inter-male fighting, it is believed that the urge for *social dominance* has to be distinguished from that system (Panksepp and Biven, 2012, p. 169). The Dominance system "neurogeographically" includes the high density of testosterone receptors running from the medial amygdala, through the preoptic, anterior hypothalamic area, and down to the brainstem PAG (periaqueductal gray; Panksepp, 1998; Panksepp and Biven, 2012).

The urge for *social dominance* is in complementary interaction with the primary emotional system of FEAR, which activates submissive behaviors aimed at inhibiting aggression in the rival. It is, therefore, more appropriate to speak of a complex motivational/emotional system of Dominance/Submission (Giacolini and Sabatello, 2019); an exhaustive description of its functioning will be given later. The Dominance/Submission system—found in all vertebrates starting from fishes and reptiles up to mammals—motivates the acquisition of territorial, food and sexual resources (Lorenz, 1963; MacLean, 1990) through which *Sexual selection* takes place (Darwin, 1871).

The SEEKING system, the LUST system, the FEAR system and the RAGE system—present in all vertebrates—are the archaic motivational/emotional systems, while the PANIC/GRIEF system, the CARE system and the PLAY system—present only among mammals and some species of birds—are phylogenetically the most recent ones.

These motivational/emotional systems can be considered from the *Life history theory's* perspective (Del Giudice et al., 2015; Knowles et al., 2019), significant articulations of the appearance of the developmental stage in various species. Research on *adolescence*, within the *Life history theory* and *Affective Neuroscience* point of view, can provide useful indications for the understanding and treatment of psychopathology, which makes its appearance in an elective way in this period of life and therefore also of the *addicted behavior*. It is precisely the emergence of psychopathology on the human development scene that can find an explanatory and treatment model, considering it as an effect of the peculiar features of a*dolescence*—a human-specific evolutionary stage (Bogin, 1994, 1997, 1999; Bogin and Smith, 1996; Robson and Wood, 2008; Hochberg, 2009; Hochberg and Belsky, 2013)—characterized by the restructuring of interactions between the subcortical

[1]The capital letters used for motivational/emotional systems are a convention in Panksepp's works both for labeling neurologically and for a need of a specialized terminology ones.

[2]"*Three distinct aggressive circuit hae been provisionally identified in the mammalia brain: predatory, intermale, and affective attack or RAGE circuits*" (Panksepp, 1998, p. 188).

primary motivational/emotional systems. As we shall see, adolescence constitutes a switch from the phylogenetically more recent motivational/emotional systems of Attachment and CARE (ontogenetically the first ones activated) to the phylogenetically more archaic ones of sexuality (LUST) and Dominance/Submission, which introduce the subject into the dynamics of *Sexual selection* (Darwin, 1871). Until puberty, the interactions between the subject in developmental age and adults are primarily regulated by the motivational/emotional systems of Attachment/CARE, although behaviors of Dominance/Submission are observed among puppies and children (Strayer and Strayer, 1978; Hawley, 1999, 2002; Hawley and Little, 1999; Hawley et al., 2002; Pellegrini and Long, 2002; Pellegrini et al., 2007). With sexual maturation, priority goes not only to the motivational/emotional system of sexuality (LUST) but simultaneously to that of Dominance/Submission. The human *BrainMind* (Panksepp and Biven, 2012) is thus subjected to the need to integrate motivational/emotional systems, each characterized by specific neurophysiological and hormonal characteristics such as to determine intentional and relational objectives that can enter into mutual conflict. Adolescence is a developmental stage in which the work of *integrating* these motivational/emotional systems becomes a priority. This work can expose the subject to the difficulty of integrating these systems, due to the transfer of attachment bonds from caregivers to sexual partners (Cassidy and Shaver, 2016). In adolescence, these attachment bonds no longer derive from the biological predisposition—active at birth—within the temporal windows of *imprinting* (Lorenz, 1937), but they are the result of both *Sexual selection* and the Dominance/Submission system. This new dynamic among primary and secondary emotional systems can create a predisposition to psychopathology, including the most age-specific types of addiction, as will be described in this article.

The urge for *social dominance* is present in both male and female children, as evidenced by the studies on *Adrenarche* (Maninger et al., 2009), the transspecies studies on the PLAY system (Panksepp et al., 1984, 1985) and the researches on *developmental psychology* (Hawley et al., 2002). In males, the Dominance system is characterized by a major *coercive social dominance strategy* while in females by a major *prosocial dominance strategy* (Hawley et al., 2002). With sexual maturity, the Dominance/Submission system is first of all characterized by the production of gonadal testosterone, produced in an extremely greater quantity in males than in females, in which the hormonal system is significantly characterized by estrogens and menstrual dynamics. In adolescence, the Dominance/Submission system acquires centrality in the regulation of social relationships, in line with the theory of *Sexual selection* (Darwin, 1871), exposing individuals to the consequences of the *social rank hierarchy* dynamics (Price et al., 2007), which can be conceptualized as a *continuum* between a richer relational world for dominant subjects and a poorer one for subordinate subjects (Nader and Czoty, 2005; Nader et al., 2012b; also see the interesting article on The Matthew Effect by Sloman and Dunham, 2004). With adolescence, the creation of relational bonds is now largely mediated by the secondary emotional system of Dominance/Submission, such as the conquest of a partner, of friends, of adults consideration, even if each relational bond will be simultaneously regulated by emotions of the Attachment/CARE systems. As we shall see, social stress from both *losses in social encounters* named *Social defeat* and from *social loss, such as the loss of a loved one* both share some same neurohormonal mechanisms (Panksepp et al., 2002, p. 111). *Social defeat* stress, which is activated when the subject is defeated during social interaction and involves the decrease or loss of social bonds, determines the release of CFR (corticotropin-releasing factor) which activates both the FEAR/Submission system and the PANIC/GRIEF systems (Panksepp and Biven, 2012, p. 340). The intra-sexual competition and the *Social defeat* stress exposes the subject to neurophysiological effects that can predispose not only to depression but also to addictions (Zellner et al., 2011). In this article, the interaction between the sexual hormones, the stress axis (HPA) and the dopaminergic system is considered above all in relation to males, both for a lower complexity of the *neurohormonal systems* involved than for females and for a lack of transspecies studies that consider the interactions between intra-sexual competition, *Social defeat* stress and addiction in female individuals (Hawley et al., 2008; Nader et al., 2012a).

ML DA-SEEKING SYSTEM IN MOTIVATED (*ADDICTED*) BEHAVIORS

Investigations on the neurobiological processes involved in the establishment of addictive behaviors and habits indicate a primary role of the mesolimbic dopaminergic (ML DA) system and associated areas and circuits (Wise and Bozarth, 1987; Di Chiara and Imperato, 1988; White, 1996; Alcaro et al., 2007). Indeed, the activation of this system provides the effect of reward and influences the reinforcement-learning processes, conditioning the incentive value attributed to the stimuli and the behaviors in both *classical* and *operant conditioning* (Robinson and Berridge, 2001, 2003, 2008; Salamone and Correa, 2002; Everitt and Robbins, 2005). The ML DA system thus plays a fundamental role in the acquisition of compulsive habits as well as in the continuous reactivation of such habits by conditioned stimuli.

However, from a neuro-ethological perspective which focuses on the instinctive and unconditioned factors that also influence learning (Lorenz, 1965; Panksepp, 1998), the ML DA system is considered to be the neurobiological substratum of the SEEKING system. This system is believed to have an intrinsic psycho-behavioral function that has evolved to motivate organisms to explore and to look for any kind of stimulus necessary for survival and reproduction (Ikemoto and Panksepp, 1999; Alcaro et al., 2007; Alcaro and Panksepp, 2011). Such emotional disposition constitutes the instinctive basis of all motivated behaviors during the appetitive phase of exploration and searches for distal stimuli and it is distinct from the second phase of consumption of a proximal stimulus (Wise and Bozarth, 1987; Berridge and Robinson, 1998; Salamone and Correa, 2012).

Expanding on the perspective of *Affective Neuroscience* (Panksepp, 1998; Alcaro and Panksepp, 2014), we proposed that addiction is generally characterized by a narrowing

and tightening of the SEEKING disposition around certain compulsive memories that result in it being activated exclusively in specific contexts and channeled only through specific sequences of procedural activities. This may be due to some form of control exerted by stored memories in the superior cortical and limbic structures that interact with the activity of the subcortical centers and in particular of the ML DA-SEEKING system (Alcaro et al., 2007). Indeed, neurobiological research on animal dependency models has shown that the formation of compulsive habits is accompanied by a gradual functional reorganization of the brain from the molecular level to the system-circuit level (Nestler, 2002, 2014). At the neurochemical level, for example, a strengthening of glutamatergic synaptic connections has been observed in some nodal centers of *cortico-striatal circuits* (Pennartz et al., 2009), which would give rise to the well-known phenomenon of sensitization through which dependent memory complexes acquire a disproportionate power of activation of the ML DA-SEEKING system (see Steketee and Kalivas, 2011 for a summary on the subject).

In other words, there is a weakening of the ability of the ML DA-SEEKING system to express itself independently of the link with dynamic representations closed within the *superior procephalic circuits* and formed following repeated experiences of conditioning. Such loss of functional autonomy of the ML DA-SEEKING system constitutes, therefore, a common root for all forms of addiction or dependence, despite each having its basis in the action of specific memory complexes (Alcaro et al., 2007; Alcaro and Panksepp, 2011; Alcaro, 2019).

ML DA-SEEKING SYSTEM IN ADOLESCENCE

Although the evidence suggests that the loss of functional autonomy of the mesolimbic dopaminergic system is promoted and enhanced by specific experiences that progressively induce addiction, human and animal studies of dependence models have identified some neurobiological factors that can predispose an individual to develop compulsive behaviors. One of the most prominent of these factors has proved to be an endogenous predisposition to the dysregulation of the functioning of the ML DA-SEEKING system (George et al., 1995; Grace, 2000; Marinelli and White, 2000; Chefer et al., 2003; Alcaro et al., 2007; Alcaro and Panksepp, 2011). Such dysregulation causes the system to be hyper-reactive to particular environmental conditions characterized by the presence of novelty or artificial reinforcements such as substances of abuse (Piazza et al., 1989; Pierre and Vezina, 1997). Individuals characterized by this hyper-reactivity have been classified as "novelty seekers" or "sensation seekers" since they show strong attraction towards novel environments, sensorial stimulation, and high-risk settings (Bardo et al., 1996).

Interestingly, adolescents also show heightened orientation towards rewards in the environment including preferences for novelty, increased interest in risky situations, and other forms of emotional and sensorial stimulation (Wahlstrom et al., 2010). Following these observations, fMRI studies have shown that some neural systems innervated by the ML DA-SEEKING system are significantly more active in adolescents than children or adults when receiving primary rewards (e.g., sweet liquid; Galván and McGlennen, 2013), secondary rewards (e.g., money; Ernst et al., 2005; Galván et al., 2006; Van Leijenhorst et al., 2010), or social rewards (Guyer et al., 2006; Chein et al., 2011), as well as in the presence of appetitive social cues (Somerville et al., 2011). Such spikes in activity are associated with compromised cognitive control (Somerville et al., 2011) and increased self-reported risk-taking (Galván, 2014).

Accordingly, it has been hypothesized that the ML DA-SEEKING system is at a functional ceiling during adolescence (Chambers et al., 2003), as evidenced by overall higher tonic DA levels, peaks in DA cell firing, greater DA innervation, and increased DA receptor densities (see Padmanabhan et al., 2011; Padmanabhan and Luna, 2014). Therefore, the ML DA-SEEKING system is thought to be in a state of "overdrive" during adolescence, which appears to have important functional significance for behavioral outcomes and increases susceptibility to the onset of addiction and many other psychiatric disorders.

However, although the prevailing view is that heightened activity of the ML DA-SEEKING system represents a liability that orients adolescents towards risky behaviors and results in compromised well-being (e.g., Chambers et al., 2003; Casey et al., 2008) It has also been proposed that increases in risk-taking behaviors may also be adaptive for promoting survival and skill acquisition (Spear, 2000; see below).

Indeed, the overdrive of the ML DA-SEEKING system can be linked to the developmental phase of sexual maturation (see below) and to the explosion of hormonal and libidinal energy resulting in the search for contexts and situations in which it can be adequately satisfied (for a *neuro-psychoanalytic* point of view see Solms and Turnbull, 2002). Sexual drive (LUST system) is one of the main biological motivators capable of promoting and facilitating the activation of the SEEKING system (Panksepp and Biven, 2012). Moreover, sexual maturation affected during adolescence leads to a transition from infancy to adulthood, from the familiar environment to a complex and multiform social world (as we will see in detail below). From an *Affective Neuroscience* perspective, such change is also characterized by the transition from an emotional base cantered on the secureness of attachment (CARE disposition, PANIC disposition) and the joy of PLAY towards an emotional base cantered on the lust for sex and the competitive activity towards conspecifics (DOMINANCE, RAGE)[3], although the urge for

[3]Although they are separate developmental phases, there are nevertheless interesting overlaps between the attachment processes and the processes of social competitiveness since some psychobiological indices of secure attachment are also common to individuals who show a propensity for dominance. As a single example, it is sufficient to note that the quantity of D2 receptors, which we can generally associate with the steady functioning of the ML DA-SEEKING system is a good indicator of secure attachment and social dominance. Conversely, lower concentrations of D2 receptors in striatal areas is an indicator of social submission and anxious insecurity that predisposes to the development and maintenance of compulsive behaviors (Morgan et al., 2002).

social dominance is also present among the puppies and children (see above).

In such a context, the tendency to explore and take risks may provide an adaptive function that affords a unique opportunity for adolescents to attain new experiences at a time when they are primed to learn from their environments and leave the safety of their caregivers (Spear, 2011). Therefore, we believe that the development of sexuality and the correlated ML DA-SEEKING, along with the competitive drive within the sexual selection, overdrive constitute the main vectors that lead the adolescent to abandon the safe haven and bonds of parental attachment and to embark on the difficult waters of an open and complex sea made up of uncertain, problematic and dangerous relationships and new unpredictable and uncertain contexts and situations. This journey is the necessary prerequisite for reaching adulthood with the consequent relocation of one's individual identity from the family matrix to that of the shared social world, in which adolescents can find positive opportunities by exploring environments more suited to their genotype than those offered to their family matrix (Scarr and McCartney, 1983). In the next paragraphs, we will see this journey both from a phylogenetic and ontogenetic point of view.

Although adolescence is generally characterized by an ML DA-SEEKING overdrive, individual vulnerability to develop an addiction may be more specifically related to an increased electric responsivity of ML DA neurons to glutamatergic and other excitatory input (Marinelli and White, 2000; Alcaro et al., 2007). Such hyper-reactivity of the SEEKING system may be also related to a deficit in the tonic DA transmission, that is in the levels of DA molecules that extend outside the synaptic space and change slowly because they are relatively independent of nerve impulses (Grace, 2000; Chefer et al., 2003). Indeed, as a result of inhibitory regulatory processes on type D2 autoreceptors, the tonic levels of DA inhibit the readiness for the electrical discharge of DA neurons (Grace, 2000; Schmitz et al., 2003) and then tend to limit the tendency to search for environmental conditions characterized by novelty or artificial reinforcements such as drugs of abuse (Piazza et al., 1989; Pierre and Vezina, 1997). Therefore, the increased risk in adolescence may be related not only to an unspecific DA overload but instead to an enhanced ratio between the electric reactivity of ML DA neurons and the levels of tonic DA and D2 autoreceptors (Alcaro et al., 2007; Alcaro and Panksepp, 2011).

SEXUAL REPRODUCTION (LUST) AND COMPETITION

Sexual maturation determines in all vertebrate species, particularly mammals, the ability to reproduce and activates at the same time a process called *Sexual selection* by Darwin (1871).

Sexual reproduction also involves the drive to mate that is at the same time inextricably connected to the drive to compete with the individuals of the same species and gender (usually males) to gain access to the sexual reward.

This classic theory of motivational/emotional systems connected to the dynamics of *Sexual selection* has been expanded in recent years by studies that show that the urge for *social dominance*—is a strategy for *Sexual selection*, which is in itself a source of reward (Chester, 2017). Attacking a conspecific to impose one's desire and dominance is an expression not only of the *urge for social dominance* (van der Westhuizen and Solms, 2015) but also a source of specific gratification (Chester, 2017).

Inter-male aggression in *Agonistic behavior* (Scott and Fredericson, 1951), highlights the complementary behavioral characteristics in combatants, such as agonistic engagement characterized by manifestations of aggressive threats and pacification, submission, avoidance behaviors in the defeated contender (see below). Unlike predatory aggression, intraspecific contests would be rarely fatal (see for a critic to this classic ethological observation Natarajan and Caramaschi, 2000), except in the human species where the evolution of the brain would have determined a specific use of aggression within the paradigm of *Sexual selection* (Eibl-Eibesfeldt, 1984). The hypothesis that aggression, within the paradigm of *Sexual selection*, may derive from predatory aggression—as we shall see below—seems to be borne out by the positive effect it evokes in the individual (Chester, 2017), *in contrast* to defensive aggression (see note 2) that generates a negative effect (Panksepp, 1998; Panksepp and Biven, 2012). Research by *Affective Neuroscience* also seems to indicate similar conclusions because: "[. . .] *the predatory aggression is the manifestation of the SEEKING urge*." (Panksepp and Biven, 2012, p. 165) and: "[. . .] *the inter-male aggression that leads to dominance hierarchies seems to be an expression of the SEEKING system than of the RAGE system*." (Panksepp and Biven, 2012, p. 168).

The positive effect associated with *inter-male aggression* is evident in the so-called PLAY system (Panksepp, 1998; Burgdorf et al., 2008; Graham and Burghardt, 2010; Panksepp and Biven, 2012), where both males and females playing tendencies are quite comparable (Panksepp, 1998, p. 230–281), even if some researchers highlighted that male infants tend to display more agonistic-like behaviors, while female infants display more social behaviors and behaviors reminiscent of mating (Graham and Burghardt, 2010).

The *inter-male* aggression related to positive affective experience has traditionally been linked to the pleasure of revenge, as retaliation for the violence suffered (Chester and DeWall, 2016). Neuroimaging studies have shown, during vengeful aggressive behavior, both the activation of areas of the *ventral striatum*—part of the ML DA system assigned to the reward—and the reduced activation of the *prefrontal lateral cortex* connected to its regulation (Chester and DeWall, 2016; Chester, 2017; Chester et al., 2019).

The activation of the dopaminergic system connected to aggression, however, is determined not only in aggression by retaliation but also in the absence of an avenging motivation such as proactive aggression or "appetitive aggression" (Carver and Harmon-Jones, 2009; Weierstall and Elbert, 2011; Hecker et al., 2012).

This aspect has been identified as being present in the so-called sensation-seeking personalities in which the pleasure determined by the elevation of the dopaminergic arousal is positively connected to experiencing a strong aggressive activation as an expression of predatory and inter-male aggression (Miller et al., 2012; Chester et al., 2016; Chester, 2017). The significant involvement of the ML DA-SEEKING system in the dynamics of *inter-male* aggression is evidenced by studies that have highlighted characteristics specific to addiction dynamics (Golden and Shaham, 2018). Animals that have experienced dominant aggression on a conspecific tend to prefer places where this experience has occurred and to repeat these behaviors on subordinate conspecifics (Legrand, 2013; Chester, 2017). Chester writes: "*This suggests that aggression is intrinsically reinforcing*" Chester (2017). It is necessary to add and underline an element which is not entirely evident in the studies cited, that this "appetitive aggression": an expression of that particular aggressive motivational-emotional system which—as explained above—developed according to the *Sexual selection* (Lindenfors and Tullberg, 2011) and which is called *inter-male Agonistic behavior* (Scott and Fredericson, 1951), or *Dominance emotional system* (van der Westhuizen and Solms, 2015). To this latter denomination, we prefer the *Dominance/Submission* motivational/emotional system (Giacolini and Sabatello, 2019), because in our opinion it explicitly highlights the complex aspect of this *inter-male* aggressive system, which has the FEAR system as a complementary motivational system (Fish et al., 2005). In any species, the competitive contest does not involve the physical elimination of the contender (see above), as it happens in predatory aggression. This peculiarity was made possible by the function of the FEAR system within the competition, whose manifestations (of the FEAR system) in all species have the power to inhibit aggression in the victorious contender, preventing the elimination of the overwhelmed adversary (see van der Dennen, 2005 for review).

In social species, the FEAR system has given rise to the so-called *Submission* or *Pacification* behaviors, whose signaling is the basis for the formation of rank structures, allowing the coexistence of dominant and submissive individuals. These behaviors have also been called *Yielding subroutines* or *Involuntary Defeat Strategy* (Sloman and Gilbert, 2000; Sloman, 2002) to highlight the dimension of being forced or compelled present in the individual to maintain the rank structure. Such behaviors are considered analogous to those observed in humans manifesting depression (Gilbert, 1992, 2006).

On the other hand, dominant individuals manifest—in an equally compulsive way within the rank structure—*Dominance subroutines* or *Involuntary Dominant Strategy* (Sloman, 2002): the expression of the aggressive component of the motivational/emotional system of *Dominance/Submission* that has the function of reaffirming and verifying the supremacy of dominant individuals over subordinates. *Dominance subroutines* or *Involuntary Dominant Strategy* are considered analogous to the behaviors manifested along the manic spectrum (Sloman, 2002; Malatynska and Knapp, 2005; Johnson and Carver, 2012; Logan and McClung, 2016; Harrison et al., 2018) that are also characterized by the compulsive and unconscious dimension of these emotional states.

It can be assumed that these behaviors function to keep the hierarchies relatively stable and therefore the social structure of conspecific groups, thus favoring their synergy. If *inter-male* aggression—as expressed in *Dominance subroutines*—is a source of reward and potentially of addiction (Golden and Shaham, 2018), the FEAR system can likewise cause the activation of the dopaminergic system, opening the way to compulsive and addictive behaviors expressed as *Yielding subroutines* or *Involuntary Defeat Strategy*. It is now well established that the ML DA-SEEKING is activated not only in the presence of stimuli with a high reward content but also in the presence of adverse stimuli (Ikemoto and Panksepp, 1999; Alcaro et al., 2007). In the latter case, the ML DA-SEEKING appears to drive a search for "safety" (Ikemoto and Panksepp, 1999).

Consequently, the depletion of the dopaminergic system ML DA-SEEKING in the depressive state (Panksepp and Watt, 2011) occurs at the same time as its activation. This contradiction has recently been explained by discovering that the dopaminergic system is not homogeneous, but it is composed of various subsystems. These studies have highlighted how the ML DA system is formed of multiple subtypes of DA neurons with particular axonal projections and inputs, distinct anatomical, molecular and electrophysiological characteristics (Ikemoto, 2007; Lammel et al., 2012, 2014).

It appears that some DA subsystems are activated in the presence of reward stimuli, while others in the presence of stimuli with salience, whether positive or negative, but all subsystems transmit an *alerting signal* (Bromberg-Martin et al., 2010).

The ML DA-SEEKING System thus appears to be a powerful mechanism that can push the individual towards rewarding behaviors, such as aggression for dominance, but can also keep active a depressive emotional dimension connected to a subjective "belief of defeat", which activates automatic protective submission behaviors to maintain a state of "safety".

It should be noted, that the depression considered here is not the one resulting from separation (see the next paragraph) and therefore from the activation of the attachment system or PANIC/GRIEF system and the diminished brain reward/ML DA-SEEKING (Panksepp and Watt, 2011), but rather the effect of the dynamics of the Dominance/Submission motivational/emotional system. However, as will be highlighted later, the neurohormonal dynamic typical of separation will be "secondarily" activated in the defeated subject of the social competition.

Depression, as an emotional manifestation caused by the activation of the FEAR/Submission system (Gilbert, 1992, 2006) and by *Social defeat* (see below), will provide a means to achieve "safety" from the threatening aggression of a dominant and therefore from the source of a negative effect (see about the activation of VTA DA neurons in response to reward or aversive stimuli: Tanimoto et al., 2004; Brischoux et al., 2009; Lammel et al., 2014).

FROM VERTEBRATES TO MAMMALS, TOWARDS *HOMO SAPIENS*

To understand the problem of addiction, a complex model that involves the interaction of the numerous biopsychosocial variables is required (Griffiths and Larkin, 2004; Lewis, 2005; Griffiths, 2008; Ratliff et al., 2016). Similarly, adolescence—as a topic of both research and mental care—involves considering the interaction between multiple factors of varying nature. During this developmental phase of a subject's life, many factors are at work including the development of the soma, the maturation of various body parts, in particular the sexual and cerebral apparatus. Along with this biological development, the *adolescence* stage is characterized by the cultural dimension that is ritualized in multiform ways that lead to entry into adulthood (Kaplan and Garner, 2017; Kunnen et al., 2019).

The mind is the epiphenomenon of the functioning of the cerebral organ, which has evolved over millions of years in its effort to adapt to the environment, first natural and then relational (Alexander, 1990), constituting a complex *BrainMind* system (Cacioppo et al., 2014; Panksepp, 2014).

Adolescence is known to constitute a new phylogenetic developmental stage, added along with *childhood*, during the evolution of the genus *Homo*. This has allowed a better articulation of the stages already present in more evolved mammals, namely *infancy*, *juvenile*, and *sexual maturity*. One of the main causes of these stages of appearance, which have temporally extended the individual growth, is to be found in the massive increase of brain mass that characterizes the human species (Robson and Wood, 2008). The appearance of the *adolescence* growth stage, which extends the stage of puberty to a relatively long period, is assumed to be related to the further increase in the offspring survival rate. Thanks to the help given by young adolescents in raising siblings during *childhood*, the mother was allowed to engage in new pregnancies, contributing to the population growth (Bogin and Smith, 1996). Alongside this aspect connected to the aid in the rearing of offspring, elective for young adolescent females, there is another even more significant one: the learning function allowed by this new developmental stage, namely the learning of relational modalities in the social context, which were becoming more and more complex (Hochberg and Konner, 2020), and of the technological resources that were developing (Robson and Wood, 2008). Among the relational learning peculiar to the human species, a prominent place concerns the intra-gender competition that is *inter-male aggression*, elective in young adolescent males, and typical of *Sexual selection*. However, intra-sexual competition in the human species has been significantly complexed, implying not only the dimension of the conflict between individuals (as among other animal species), but also and above all the dimension concerning competition between groups (Van Vugt et al., 2007). The latter seems to be a peculiarity of the human species, partially shared by other evolved primates such as chimpanzees and orangutans (Wilson and Wrangham, 2003). Competition between groups indicates a complex regulation of the RAGE and FEAR motivational/emotional systems (Lebel, 2017), which has allowed the ability to tolerate proximity between conspecifics of the same sex, partially inhibiting the aggressive and distancing tendency. This has allowed cooperation to conquer the territorial resources, food, and sexual relations of another group of conspecifics. And precisely the ability to cooperate—specific to the human species (Puurtinen and Mappes, 2009) – would have found its origin and enhancement from intra-sexual group competition, as claimed by the *Male Warriors Hypothesis* (Van Vugt et al., 2007; McDonald et al., 2012). According to this theory, cooperation would be the effect of the male individual's discovery that joining in intra-sexual competition determines a greater probability of victory, as well as survival both in obtaining food and in defending themselves from predators. The competition between groups would have selected a particular tendency to be afraid and attack those who do not belong to their group and to have instead positive effects towards members of their group—a propensity identified even among the highly evolved primates (Mahajan et al., 2011). Competition between groups (elective among males) would have contributed to determining the propensity of these males to remain within the group to which they belong at the period of mating, while the females, on the contrary, to migrate towards the husband's group (Knipper et al., 2017). This greater propensity of males to feel part of a belonging group and to start a conflict with conspecifics of the outgroup is significantly correlated with testosterone production (Reimers and Diekhof, 2015; Muñoz-Reyes et al., 2020), which is extremely higher in males than in females. "[. . .] *humans, particularly men, may possess psychological mechanisms enabling them to form coalitions capable of planning, initiating and executing acts of aggression on members of outgroups (with the ultimate goal of acquiring or protecting reproductive resources)*" (McDonald et al., 2012, p. 671). Competition between groups, therefore, highlights the evolution of intra-sexual fighting that requires the individual to be able to combine the motivation for intra-sexual aggression and the fear of the opponent with the ability to create ties of proximity, to build functional alliances for struggling. This ability to compete through the group is an acquisition that seems to have been favored precisely by the onset of a long period of *adolescence*. The *initiation rites* (which took place during the period of adolescence; Alexander and Norbeck, 2011), sanctioned in the so-called primitive populations the transition from the indistinct identity of a *child* to that of an *adult* man. In particular, those related to the acquisition and learning of warrior skills, as well as tolerance and danger management. The *rites of passage* (Abeliovich, 2018) are, therefore, a window on the modeling of the primary and secondary motivational/emotional systems during adolescence, each characterized by a peculiar intentional organization that guides the behavior of single individuals (Montag and Panksepp, 2017). Cooperating to compete is an evolutionary acquisition of the great apes, whereby as in chimpanzees, cooperative behavior can be seen in group hunting, territorial defense, and alliances during male power struggles (Suchak et al., 2016; Massen et al., 2019). In adolescence, cooperating to compete in the new status makes the young adolescent feel inserted in a network of bonds with other

peers and, at the same time, makes him perceive the ability to compete effectively. The emergence of psychopathology in adolescence, including substance use or addictive behaviors, highlights the adolescent's dramatic belief that he is unable to combine the competitive drive with the cooperative drive and to transfer the attachment bonds into a new sexual relationship (Cassidy and Shaver, 2016). Cooperating to compete therefore implies the ability to tolerate the inevitable experience of *Social defeat*, implicit in the structuring of rank within the human group. The latter is an experience that makes the adolescent subject particularly vulnerable to mental pain, as the experience of Attachment-Care systems that had primarily organized his relational and mental life is still present in him.

Paraphrasing the zoologist Richard D. Alexander, the Environment of Evolutionary Adaptation—EEA (Bowlby, 1969) of *Homo sapiens* is no longer the material one but the relational one (Alexander, 1990). Being able to integrate motivational/emotional systems, characterized by purposes, intentionality, and therefore by extremely different *BrainMind* states, is the peculiar work of the adolescent period that makes the young subject vulnerable to psychopathology and addiction.

The *Affective Neuroscience* have (Panksepp, 1998) highlighted how the instinctual-emotional heritage is itself the primary form of consciousness through which human intentionality is expressed (Solms, 2019). Mental functioning cannot be understood, therefore, as a simple learning function, nor consciousness as a simple function of the corticalization of the human species. Based on research with animals (Panksepp, 1998) and humans (Panksepp, 2014; Solms, 2019), *Affective Neuroscience* has highlighted how the instinctual-emotional heritage is itself the primary form of awareness through which human intentionality is expressed.

This approach leads to questions about the phylogenetic heritage that led to the emergence of human psychic functioning and from this perspective the motivational/emotional systems are of particular importance. The latter are phylogenetically *homologous* in mammals and in the human species and they are wired into the subcortical structures between the brainstem and the limbic system, which are currently considered the roots from which the cortical, autonoetic and reflexive consciousness has evolved in a "bottom-up" and "top-down" mutual interaction (Panksepp and Solms, 2012; Solms, 2018).

ATTACHMENT, *INFANCY*, AND MENTAL PAIN

In this article, attention will be paid to the interaction between the "two complexes" motivational/emotional systems crucial for understanding *adolescence* and the dynamics of addictions: the Attachment/CARE systems and the Dominance/Submission systems (Giacolini and Sabatello, 2019).

The well-documented Attachment system (Bowlby, 1969) forms the basis of the child's or offspring's well-being when close to a reference adult or caregiver and involves a mental state that is largely determined by the release of *endogenous opioids* on *mu receptors* when offspring and caregivers are in proximity (Insel and Young, 2001).

The removal of the caregiver causes a depletion of these opioids at the receptor level and the implementation of *dynorphin production on k receptors* (Shippenberg et al., 2007), both of which cause a sense of discomfort and alarm in the offspring (Panksepp, 1998). This malaise occurs not only in infancy but can manifest itself at other times in life following separation from a significantly important individual (Cassidy and Shaver, 2016).

Both Spitz and Wolf (1946) and Bowlby (1969) have been accredited for their important contributions to the study of the separation of children from their caregivers. Spitz and Wolf (1946) has identified analogies between the stages of the prolonged separation process in young children (under 1 year of age) called the *Emotional Deprivation Syndrome*, which can lead to *Anaclitic depression* and the pathogenic effects of chronic stress referred to as *General Adaptation Syndrome* (stress syndrome) by Selye (1936) a few years earlier (Selye, 1936, 1946, 1956; see for current discussion Del Giudice et al., 2018). Here we anticipate the observation that drug withdrawal can be considered a *General Adaptation Syndrome* (Chartoff and Carlezon, 2015).

Descriptions of children's reactions to separation from caregivers are marked by specific behavioral and neurophysiological states summarized in three phases related to the progression of separation. Bowlby (1969) defined the first phase as "Protest," characterized by active recalls to the missing caregiver. If the separation continues and the child does not succeed in obtaining proximity to the sought-after parent, the phases of "Despair" and then of "Detachment" occur. These are identified by a gradual and progressive inhibition of the recall and search of the caregiver (Bowlby, 1969). These descriptions of the separation process identified by Spitz and Bowlby have been supported by the identification of a specific neuronal circuit that regulates the separation process, called the PANIC/GRIEF System (Panksepp, 1998). This neuronal pathway is composed of the *Anterior Cingulate, the Dorsomedial Thalamus, the Periaqueductal Gray*, and some regions of the *cerebellum*. The activity of other areas has been identified only in animals, but being so small, PET in humans hardly highlights them: *the ventral zone of the septum—Dorsal Preoptic Area—Bed Nucleus of Stria Terminalis—BN* (Panksepp, 1998).

The PANIC/GRIEF system is also characterized by specific neurochemistry that has a central point in the *endogenous opioid system*. The separation that gives rise to protest and discomfort is correlated with the depletion of endogenous opioids. If the separation continues, the effect of the continuing state of stress causes the prolonged alteration of the *HPA axis* (*Hypothalamic–Pituitary–Adrenal Axis*) and contributes to a hyperproduction of the *opioid dynorphin* (Bruchas et al., 2010).

This in turn, through the innumerable *kappa receptors* (Shippenberg et al., 2007) found in the ML DA system, inhibits both dopamine production in the *ventral tegmental area VTA* and its release in the *nucleus accumbens* (Watt and Panksepp, 2009).

The subsequent dopamine depletion is expressed as a depotentiation of the ML DA SEEKING system that governs the appetitive behavior (Panksepp, 1998; Watt and Panksepp, 2009; Zellner et al., 2011).

The joint effect of these two depletions characterizes not only the dynamics of separation from a caregiver but also those of depression in adulthood and the abstinence both from substance and non-substance addictive behaviors.

Why this particular interest in the Attachment (PANIC/GRIEF system) and in particular for the dynamics connected to separation? Because it is probably the biggest cause of our mental pain (Panksepp and Biven, 2012). The recognition of the caregiver consolidated during *infancy*, brings with it the stabilization of the need for his/her presence, whose absence will activate the stress and depletion processes mentioned above, responsible for mental pain and analogous to a real *craving* (uncontrollable compulsive desire; Zellner et al., 2011).

From this point of view, the attachment bond can be considered as the prototype of the "first addiction" (Zellner et al., 2011). In this regard, as pointed out by Jaak Panksepp (Yovell et al., 2016), opiates are the first identified antidepressant drugs, bearing in mind all the inevitable problems they entail.

Opiates use is known to reduce and replace the need for social relationships. However, soon the substance that creates this social well-being, heroin for example, inevitably leads to the learning of a reinforcement that activates the appetitive system to seek it out in a paroxysmal way.

Thus attention shifts to the ML DA SEEKING system. Any addictive substance, alcohol, tobacco, cocaine, et cetera, activate the increase of extracellular dopamine concentration in the dopaminergic system sites and especially in the *nucleus accumbens* (Volkow and Li, 2004). Quickly, the ML DA SEEKING system becomes the driving center of addictions, both for substance and non-substance addictive behaviors (like gambling, internet, et cetera) that have the same power to subvert the system (Koob and Volkow, 2016; Uhl et al., 2019).

FROM INFANCY TO JUVENILE AGE

In most mammals, there are only two stages of development: *infancy* and *sexual maturity*. The transition from one to the other is quite sudden and puberty occurs when growth rates are decreasing (Bogin and Smith, 1996). In more social species—such as wolves, lions, elephants, and primates—a third stage has been added after *infancy* (namely after weaning): the *juvenile* stage (Bogin and Smith, 1996), which has postponed the advent of puberty. *Infancy* indicates the period of maximum dependence of the puppy from the *caregiver*, represented electively by breastfeeding. In the human species—as mentioned above—it is replaced by *childhood* around the age of 3. *Childhood* (3–6 years old) is a period in which the immaturity of the dentition and digestive tract requires food prepared by the caregiver, easily digestible, and very energetic to meet the nutritional requirements for the body growth, especially the brain. After *childhood*, the *juvenile* age takes over from around 6–7 years up to about 11–12 years. The *juvenile* stage is characterized by individuals sufficiently autonomous from their caregivers and with motor and cognitive resources such as to be able to provide in part to their sustenance and protection from predators (Bogin and Smith, 1996), even if they still maintain an interaction of dependence with the adult of reference. One of the characteristics of the *juvenile* stage, in some primates and in the human species, is the phenomenon of *Adrenarche* (Maninger et al., 2009). Around the age of 6–8, the maturation of the *hypothalamic-pituitary-adrenal axis* (HPA) is considered the beginning of the pubertal maturation process (Mundy et al., 2015). The maturation of the *adrenal cortex*, *the zona reticularis*, determines the production of androgens such as *dehydroepiandrosterone* (DHEA) and its sulfate DHEA-S along with androstenedione (A4) converted into a certain amount of *testosterone* (Antoniou-Tsigkos et al., 2019). The latter two, with the maturation of the *hypothalamic-pituitary-gonadal axis* (HPG), will be produced in greater quantities by the gonads, characterizing the actual sexual development of puberty. *Adrenarche* is therefore considered to be the beginning of puberty, or as it is defined as "adrenal puberty" (Del Giudice et al., 2009) before the visible signs highlight gonadal puberty. Adrenal androgens are neurosteroids active in brain regions involved in emotional and behavioral regulation (Maninger et al., 2009; Mundy et al., 2015). "Adrenal puberty" determines the appearance of physical signs such as pubic hair, the change in the composition of sweat that produces body odor, but the most significant changes are the behavioral ones shaped by *sexual selection* and related to competition within gender identity (Del Giudice et al., 2009, p. 2). The effects attributed to the *Adrenarche* correspond to those of the PLAY system described by the *Affective Neuroscience* (Panksepp et al., 1984, 1985; Panksepp, 1998). This motivational/emotional system is activated during the *juvenile* stage of mammals and is characterized by an intra-sexual competitive-like interaction, with the characteristic of reversibility (Panksepp and Biven, 2012). In fact, in these interactions regulated by the PLAY system, the competition does not definitively sanction a winner and a loser, as in the competitive interactions that will follow sexual maturation. This reversibility allows the contenders to maintain a mutually friendly interaction and a source of positive effects (Knutson et al., 2002). One of the evolutionary function of the PLAY system seems to be, therefore, to train juvenile subjects to assume behaviors that will be characteristic of adolescence and then of intra-sexual competition in adulthood, even if there is still no clear evidence of a significant continuity from the *rough-and-tumble* Play to mature *Inter-male* aggression in the executive brain mechanisms (Panksepp, 1998, p. 286). The subsequent and massive production of gonadal testosterone in puberty will determine the reduction of the PLAY System manifestations because the androgen hormone promotes aggression, especially between sexual adult male, leading animals and humans to real fights (Panksepp, 1998, p. 286; Panksepp and Biven, 2012, p. 362).

It is thus possible to hypothesize that the PLAY system—functionally connected to the *Adrenarche*—constitutes a developmental stage through which two motivational systems start to be mutually conjugated: the Attachment/CARE system and Dominance/Submission system. *Adrenarche*, through

the production of adrenal hormones with a low androgen content, highlights their strategic function in activating in a reduced way the competitive behavioral system of Dominance/Submission. It can be assumed that this allowed the beginning of integration between these latter emotional systems and the Attachment/CARE motivational/emotional systems, making possible friendly proximity between the offspring while they are struggling.

SOCIAL COMPETITION IN HUMAN DEVELOPMENT

While the motivational/emotional systems of Attachment/CARE have as a priority the maintenance of proximity between individuals (Cassidy and Shaver, 2016), the motivational/emotional systems of Dominance/Submission that regulate intra-sexual competition are predisposed to create distance between individuals to achieve an optimal dislocation of the population concerning environmental resources (Lorenz, 1963).

With puberty, the biological beginning of adolescence, the need to stay close to a caregiver is increasingly replaced by the need to join a peer group. Even before puberty, interaction with peers is fundamental for the proper functioning of mental processes (Pellis and Pellis, 2007; Vicedo, 2010), as considered above. With the beginning of adolescence the urge for *social dominance*, which already had its appearance with the *Adrenarche* (Del Giudice et al., 2009), now acquires particular importance (Weisfeld, 1999; Hawley, 2011), as a tool of sexual selection and to drive the adolescent away from the family environment (Weisfeldt and Woodward, 2004).

During adolescence, gonadal maturation increases the production of testosterone especially in males, with a ratio about ten times higher than in females (Braunstein, 2007), amplifying the *urge for social dominance*, which replaces Attachment as the main organizer of the relational mental life. The maturation of the sexual organs with the increasing production of testosterone, with related gender differences (Holder and Blaustein, 2013), stimulate the dopaminergic system functioning (Wahlstrom et al., 2010) connected to the production levels of the androgen hormone (Jardí et al., 2018). This may be one of the variables that determine greater competitiveness among males along with a stronger drive to seek out risky situations. It is believed to be also one of the causes of schizophrenic syndromes that are more prevalent in adolescent males (Trotman et al., 2013; Bratek et al., 2015), than females, while the latter display an increased incidence of depression (Sundquist et al., 2004; Sinclair et al., 2014).

Brain regions are not affected uniformly by the developmental effects of puberty. In particular, the subcortical areas of the ML DA-SEEKING system mature before the cortical ones (Wahlstrom et al., 2010; see above the *Dual System Theory*), predisposing the subject to both impulsiveness and addiction. In parallel, there is a proliferation of *glucocorticoid receptors* (GR) in the dopaminergic system, especially in *prefrontal cortical areas* (Sinclair et al., 2014). The latter is one of the main causes of vulnerability to social stress in adolescents.

Therefore, adolescents are more inclined to seek stimulation (Steinberg, 2007)—in particular social stimuli—compared to individuals in other stages of life, but at the same time, they are particularly vulnerable to social stress. This concept refers to the subject's vulnerability to easily perceive himself as a loser compared to other conspecifics (Kroes et al., 2006) and therefore inadequate in the context of relationships. This results in negative self-evaluation and evokes a similar emotional state to the one generated by separation related to the Attachment system, because the *Social defeat*, *the loss of social status* and *the social loss*, *the loss of a loved one*, share some of the same neurohormonal mechanisms: *"Both types of social losses share certain key physiological features, such as arousal of the hypothalamic-pituitary-adrenal axis, and activation of non-specific arousals/attentional circuits like ascending norepinephrine and acetylcholine systems."* (Panksepp et al., 2002, p. 111). This connection between *Social defeat* and social loss has been well demonstrated by the *resident-intruder paradigms*, according to which after defeat, if the loser is reunited with other "friendly" animals it recovers from the stress of defeat. On the contrary, if the loser remains isolated it shows signs of weight loss, heart rate disruptions, body temperature regulation, and increased fear (Panksepp et al., 2002) that characterize depression in the human species. This neuro-hormonal dynamic is activated not only as a consequence of competitive interactions in progress but also in the anticipation that they may happen: "*A psychosocial stressor is the anticipation, justified or not, that a challenge to homeostasis looms*." (Sapolsky, 2005, p. 648).

The experience of *Social defeat* can be related to acute and circumscribed social stress or to a lasting state that then becomes chronic stress (Luckett et al., 2012; Gray et al., 2015).

Experiences of continuous *Social defeat*, such as causing chronic stress, have a significant effect on the dopaminergic system, reducing functionality (McLaughlin et al., 2006; Selten and Cantor-Graae, 2007; Selten et al., 2013). In animal models, *Social defeat* stress predisposes the individual to exaggerate subsequent addiction-like behaviors for cocaine, methamphetamine, alcohol, and opioids (Shimamoto, 2018). Those behaviors are related to the intensity, duration, frequency, and stress in defeated animals (Shimamoto, 2018). Exposure to adverse stimuli such as *Social defeat*, as well as positive reinforcement stimuli, increases concentrations of extracellular dopamine in the terminal areas of the ML DA system, nucleus accumbens, striatum, and prefrontal cortex (Tidey and Miczek, 1996; Piazza and Le Moal, 1998; Sapolsky, 2017). In defeated animals, during the social threat, extracellular dopamine levels in the accumbens and prefrontal cortex increase by approximately 160% from baseline (Tidey and Miczek, 1996).

The Dominance system is influenced by two hormones, testosterone and arginine-vasopressin (AVP; or ADH *antidiuretic hormone*). Both are involved in sexual dynamics (Panksepp and Biven, 2012), and the latter also in fostering social ties (van der Westhuizen and Solms, 2015). One of the effects of androgenic hormones is to block the separation alarm (or inhibit the PANIC/GRIEF system) and the social withdrawal in adult males (Enter et al., 2014).

As mentioned above, the Dominance system is complementary to the FEAR/Submission system. The latter is marked by the activation of the stress axis through the release of *corticotrophin-releasing factor* (CFR) and the production of *cortisol*, the neuro-chemical signature that characterizes the experience of *Social defeat* (Panksepp, 1998; Sapolsky, 2004, 2005). *Cortisol* acts by inhibiting the production and functioning of *testosterone* that promote Dominance behaviors and in turn, it reduces the blocking of the social separation alarm and the withdrawal (Enter et al., 2014; see above also Panksepp et al., 2002). At the same time, *cortisol* activates the production of the *opioid dynorphin* (already considered for the effects of separation) that depresses the ML DA system (McLaughlin et al., 2006). It is now well established that the factor that differentiates individuals in the dynamics of Dominance/Submission is the ratio between the basal level of *testosterone* and that of *cortisol* (Terburg et al., 2009; van der Westhuizen and Solms, 2015; Barel et al., 2017). Therefore, consequently, it can be hypothesized that this is one of the causes of the variability in addiction vulnerability during adolescence.

The effects of *cortisol* are, in turn, significantly inhibited by the release of endogenous opioids on *mu receptors*, or artificially by the administration of morphine as widely studied in "playful" interactions between males of various animal species (Panksepp et al., 1985; Panksepp and Biven, 2012). The administration of opioids in animals makes individuals dominant in "playful" competitive situations (Panksepp et al., 1985). This neurochemical dynamic highlights the close analogy and connection between competition stress and separation stress (Giacolini, 2019).

There is therefore a close correlation between the stress of *Social defeat* with the FEAR defensive system (Panksepp, 1998) and with the more phylogenetically recent PANIC/GRIEF emotional system. Both of these primary emotional systems share overlapping neuroanatomy, most notably the PAG (periaqueductal gray), and chemicals such as the neurotransmitters GABA, norepinephrine, serotonin, and dopamine. Furthermore, both are activated by CRF (corticotropin-releasing factor; Panksepp, 1998, p. 268; Panksepp and Biven, 2012, p. 334–340).

The positive correlation observed between secure attachment and social dominance and between insecure attachment and tendency to anxiety and behaviors of Submission and *Social defeat* (Irons and Gilbert, 2005; Hawley et al., 2008) is completely in agreement with the arguments presented above.

How do adolescence, attachment/separation, Dominance/Submission, *Social defeat*, and the dynamics of addictions combine? As described above, chronic stress has a negative effect on the ML DA system, altering its functionality and rhythmicity, and resulting in a significant reduction of D2 receptors. This reduction contributes to creating a predisposition in the individual towards substance or behavioral addictions, so by stimulating the production of dopamine—as mentioned above—the emotional experience (feeling) of well-being is induced. This experience then drives the subject to search for the object that has caused this emotional state to maintain it at an optimal level (Ikemoto and Panksepp, 1999).

In this regard, the study conducted by Morgan et al. (2002) is of particular importance because it is one of the few studies of animal models using primates (*Macaca fascicularis*), rather than rats or hamsters. In this study, adult male macaques subjected to a long period of isolation showed a depletion of D2 receptors in the *basal ganglia*, as observed in subjects with substance addiction or in victims of chronic stress. This depletion of D2 receptors can be closely linked to the vulnerability that subjects display after taking substances of abuse and towards which they subsequently become more easily addicted. The adult male macaques thus treated were in due course divided into groups and after about 3 months they could ingest cocaine. The substance was consumed by all the subjects but was subsequently sought compulsively by those animals belonging to the subordinate rank. The dominants were, on the contrary, resilient to addiction, because they had experienced the substance without developing an addiction. PET scans revealed that the addicted, subordinate animals continued to show depletion of D2 receptors in the region of the *basal ganglia* similar to the one following the period of isolation. The resilient and dominant animals showed instead a recovery to a level similar to the one they had before isolation. According to the authors, this experiment shows that in selected individuals with very similar phenotypic characteristics (basal levels of testosterone and cortisol analogs, et cetera), vulnerability to addiction may be determined by social position or rank that exposes submissive subjects to chronic stress and dominant subjects to the opposite effect (Sapolsky, 2004, 2005). Bearing in mind the questions that arise from extrapolating conclusions about human behavior based on animal models results, Morgan's study is part of a broad line of research on the effects of *Social Defeat*, especially in adolescence, which indicates how it predisposes individuals to a vulnerability towards substance abuse and behavioral addictions (Sullivan et al., 2006; Tharp-Taylor et al., 2009; Topper et al., 2011; Shimamoto, 2018). It is worth mentioning that Björkqvist (2001), notes that the terms "dominant" and "subordinate" are used in animal studies, while the terms "bullies" and "victims" are used in human studies, in which the interaction between peers, students or colleagues are examined. *Social defeat* related to academic, work, and social status frustration has received less attention, although there are some important studies (Selten et al., 2013).

Comparative psychopathology has shown that subordinates are not only constantly in a state of stress, but they are also in a peripheral position concerning the group and more exposed to dangers (Sapolsky, 2004, 2005; Huhman, 2006).

Therefore, *Social defeat* exposes individuals to emotions (feelings) very similar to the experiences of separation. On the opposite, the achievement of a dominant place evokes feelings that can be considered analogous to that of reunification in the dynamic of separation from a caregiver (Kozorovitskiy and Gould, 2004).

CONCLUSION

We have described above how sexual maturation contributes to the enhancement of the ML DA system that, in combination with hormonal changes, creates a powerful drive for a wider exploration of the world and sexual competition in search of an expected reward (Ikemoto, 2007).

But simultaneously, the ML DA system in adolescence also creates an equally powerful drive to avoid distress and to seek "safety" from social pain (namely *Social defeat*; Ikemoto and Panksepp, 1999).

In both cases, adolescence appears to be a period in which the human *BrainMind* is physiologically in a state predisposed to seek greater arousal (Chambers et al., 2003; Crews et al., 2007) or to avoid sources of pain through fixing on easily accessible sources of pleasure that mitigate or nullify the feared sense of threat (García-Oliva and Piqueras, 2016).

In adolescence, the dynamics of the Dominance/Submission system and its interaction with the Attachment/CARE system acquires a particular intensity due to the asymmetry in the maturation of the subcortical areas compared to the cortical ones (see above *the dual systems model*) which makes the subjects more exposed to the neuro-hormonal and psychological dynamics of these emotional systems, exposing teenagers to be particularly vulnerable to mental suffering and addictions.

The Attachment motivation system has long been acquired as an instinctual system that regulates relations between children and caregivers (Cassidy and Shaver, 2016). More difficult is the recognition that interactions and relationships between individuals can be equally regulated by the urge for *social dominance*. If sexuality has always represented the persistence of an instinctual heritage in human mental functioning (Freud, 1905), the competitive interaction—which in every culture influences the dynamics of social relations—is still little studied within the human brain. Adolescence, in this sense, is a phase of development particularly suited to study these instinctual dynamics and the difficult and conflicting work of integrating very different phylogenetically motivational/emotional systems. It is precisely the work of integrating these instinctual systems that creates a state of potential vulnerability to mental pain and consequent addicted problems related to it, together with the dramatic observation of the close functional interaction between the cultural dimension and motivational systems and their regulation (Kunnen, 2012).

In traditional cultures, the difficult passage characteristic of the adolescence stage has been ritualized through social practices that often consisted of removing adolescents from the family context and making them live together. During this transition phase, especially adolescent males were often subjected to tests of courage to prove their worth and their ability to survive by themselves. Furthermore, the rituals of initiation into adulthood often included the use of drugs and other practices that caused altered states of consciousness to lead the individual towards new forms of representation of reality. Such practices have been maintained, albeit in a modified form even in contemporary society. Many of the risk-taking behaviors typical of today's adolescents can be seen as similar initiatory rituals which, however, very often have lost their socio-cultural reference and meaning and which therefore threaten to trap the individual in a spiral of compulsive behaviors with no way out. Moreover, the consequences of risk-taking are likely to be context-dependent. In our modern society, the environments where adolescents take risks (e.g., driving cars) may result in maladaptive instead of adaptive outcomes (Spear, 2008).

Within the *BrainMind* (Panksepp and Biven, 2012), the regulation and the integration between motivational/emotional systems are a central aspect in the construction of both normal and pathological personality functioning (Montag and Panksepp, 2017). However, as contemporary authors pointed out, the heuristic potential connected to the study of motivational/emotional systems has still to be widely explored (Maze, 1993; Boag, 2014), with particular regard to the urge for *social dominance* (Hawley, 2002; Johnson et al., 2012; Panksepp and Biven, 2012).

A limit of this article is that the authors do not address the contrast between the primary process and the secondary and tertiary processes (Panksepp and Biven, 2012) because it is beyond the scope of this article. We intend to address this issue in a future article.

AUTHOR CONTRIBUTIONS

The article was a collaborative, joint effort in which TG took the theoretical lead, AA introduced important neuroscientific contributions, DC played a more supportive and advisory role. All authors contributed to the article and approved the submitted version.

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Drive and Instinct—How They Produce Relatedness and Addiction

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Addictive drugs are responsible for mass killing. Neither persons with addiction nor the general populace seem conscious of the malevolence of governments and drug dealers working together. How could this be? What is the place of psychoanalysis in thinking about deaths from addiction and in responding to patients with addiction? To answer these questions, we revise concepts of SEEKING, drive, instinct, pleasure, and unpleasure as separable. We review the neurobiological mechanism of cathexis. We discuss how addictive drugs take over the will by changing the SEEKING system. We review how opioid tone in the central nervous system regulates human relationships and how this endogenous hormonal system is modified by external opioid administration. We differentiate the pleasure of relatedness from the unpleasure of urgent need including the urgent need for drugs. We show how addictive drug-induced changes in the SEEKING system diminish dopaminergic tone, reducing the motivation to engage in the pursuit of food, water, sex, sleep, and relationships in favor of addictive drugs. With this neuropsychoanalytic understanding of how drugs work, we become more confidently conscious of our ability to respond individually and socially.

Keywords: psychoanalysis, neuropsychoanalysis, addiction, drive, instinct, mass psychology

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INTRODUCTION

Twenty-three percent of Americans die from drug addiction, 17% tobacco, 3% alcohol, 2% opioids, and 1% other drugs (CDC websites)[1,2,3,4] (**Table 1**). The first two are sold with government approval and participation through licensing and taxation. Although illicit drug dealers are responsible for overdose deaths, medical providers also supply opioid and benzodiazepine medications that are also responsible for many overdose deaths.

Most people are not aware of the killing. Worldwide tobacco killed 100 million in the 20th century and is on track to kill 1 billion in the 21st (Koh, 2016). At the very least, one would imagine that psychoanalysis might address how mass killing occurs constantly and appears to be outside the conscious awareness of most humans.

Does psychoanalysis have anything to say about addiction treatment or is it a biological disorder that is outside the purview of a clinical pursuit that depends on interpersonal discussions? Should a psychoanalyst who realizes that their patient has chemical dependency refer the patient out to a drug counselor and an addiction treatment program?

[1]https://www.cdc.gov/nchs/fastats/deaths.htm.
[2]https://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/index.htm#:~:text=Cigarette%20smoking%20is%20responsible%20for,or%201%2C300%20deaths%20every%20day.&text=On%20average%2C%20smokers%20die%2010%20years%20earlier%20than%20nonsmokers.
[3]https://www.cdc.gov/alcohol/features/excessive-alcohol-deaths.html.
[4]https://www.cdc.gov/drugoverdose/data/statedeaths.html#:~:text=In%202018%2C%2067%2C367%20drug%20overdose,driver%20of%20drug%20overdose%20deaths.

TABLE 1 | Deaths in the United States from drugs–2018.

Cause of death		Percentage
Overall	2,839,205	100
Tobacco	480,000	16.9
Alcohol	95,000	3.3
Drug overdose	67,367	2.4
Total addiction deaths	642,367	22.6

The heart of psychoanalysis involves examining the relationship between the treater and the patient. Difficulties observed there can be addressed to solve barriers to relatedness in general. Perhaps, we might start there.

HUMAN RELATIONSHIPS AS A SOLUTION TO ADDICTIVE DISORDERS

Addiction presents a unique challenge in that it is both common in the population and yet remains, despite advances in understanding its underlying genetic, neurobiological, and social risk factors, stubbornly difficult to treat. Does this complicated phenomenon warrant complicated treatment? Maybe not. Alcoholics Anonymous (AA), as described by its members, is "A simple program for complicated people." A 2020 Cochrane Review concludes that interventions aimed at increasing AA engagement and participation (12-Step Facilitation) consistently lead to higher rates of continuous abstinence, indicating that long-term abstinence is not necessarily derived from Twelve-Step Facilitation interventions, but from continued participation in the AA fellowship (Kelly et al., 2020). Although AA has a spiritual tone, many members do not hold the spiritual tenants of the program as essential for recovery (Alcoholics Anonymous, 2018; Kelly et al., 2018). Instead, they see the 12-step program as simultaneously offering involvement in a social fellowship and facilitating a character change necessary to develop and sustain fulfilling human relationships (Alcoholics Anonymous, 2001). There are 12-step programs for drugs, tobacco, gambling, and over-eating, as well as other fellowship-based organizations, such as Self-Management and Recovery Training (SMART) and Women for Sobriety for people with addictions; these programs may prove to have the same benefits demonstrated in AA (Kelly et al., 2020). In other words, AA and related fellowships offer a simple solution, human connection, to the complicated phenomenon of addiction.

What can be said about how the human connection facilitated by 12-step programs, such as AA, serves as an effective treatment for addiction? Neuropsychoanalytic thinking provides insight into addiction and recovery as being related to human connection. Addiction can be seen as an attempt to substitute a drug experience/drug for persons (Johnson, 1999, 2003). Previous publications have created a theoretical hierarchy based on neuropsychoanalytic premises that depression is the biologically determined response to social isolation (Watt and Panksepp, 2009). The concept that addiction exists to ward off depression and conflicts with dependency has been extensively developed by Mosri (2019). Humans are social animals with an innate drive to be attached and related to others (Johnson, 2008). We fall ill when we become disconnected and unrelated. Other attempts at not depending on others are narcissism and psychopathy, fantasies of relationships with an ideal self and other that either follow social norms, narcissism, or make rules that are invented by the person, psychopathy (Johnson, 1993). In the transference focused psychotherapy (Kernberg, 2016) practiced on our addiction medicine service, difficulties with relatedness routinely enter the transference relationship when drug use stops (Johnson, 1992).

Our effort to apply the answers to relatedness and addiction uses the neuropsychoanalytic premise that neuroscience is the basic science of psychoanalysis (Johnson and Mosri, 2016). We take psychoanalysis as a general psychology, as the scientific study of human subjectivity (Koh, 2016).

We will begin with a review of drive as described by Michael Kirsch (Kirsch and Mertens, 2018; Kirsch, 2019). Kirsch explained that all drives depend on hormones that lodge in the lateral hypothalamus to switch the SEEKING system from hunger to thirst to sex to sleep. We will then describe hormonal systems involving endogenous opioids and explain sequential engagement of dopaminergic drive, oxytocin, and opioid stimulation as a foundation of cathexis/relatedness with classical switching in the lateral hypothalamus. These neurobiological systems are disrupted by drugs. With this theoretical understanding, we will understand more fully why AA is so effective, and why psychoanalytic examination of relatedness is often of help in recovery from addiction.

NEUROPSYCHOANALYTIC UNDERSTANDING OF RELATEDNESS AND OF ADDICTION

Drive: Hormones as the Imperative Motor Factor

How can an unconscious motivation induce a conscious emotion or promote a behavior? Kirsch (2019) discussed this concept as one that is relatively accepted within scientific communities but states that the mechanism by which specific motivations may induce specific emotions is not fully understood. He identified Freud's motivational drives as an example of these "unconscious motivations" and asked *how* such motivations might lead to conscious emotions. In Freud's literature on his theory of motivational drives, he identified hunger, thirst, and sex drive as three drives that are similar in that they all have a unique somatic stimulus that acts to promote a specific behavior (Kirsch, 2019). He called these stimuli "imperative motor factors." In 1902, the first hormone was discovered, and in 1905, Freud posited that his imperative motor factors were likely to be "chemical messengers" or hormones (Kirsch, 2019). Kirsch was intrigued by Freud's identification of motivational drives and sought to determine the neurobiological similarities between these so-called "Freudian" drives in order to determine both whether he could identify a

neurobiological avenue by which unconscious motivations can lead to conscious emotions, as well as whether there were other Freudian drives (2019).

Kirsch described three criteria of a Freudian motivational drive—they have an imperative nature, they originate in the lateral hypothalamus, and 5-hydroxytryptamine acts to downregulate the drive and is released once the drive has been satisfied (2019). Using these criteria, Kirsch identified a fourth motivational drive, sleep (2019). He correlated each drive with a unique hormone/imperative motor factor that enabled him to demonstrate that motivational drives are produced independently of one another and target drive-specific areas of the brain (Kirsch, 2019). He correlated hunger with ghrelin, thirst with angiotensin II, sex drive with testosterone/estradiol, and sleep with adenosine. In addition to each hormone targeting brain areas specific to its corresponding drive, Kirsch demonstrated that each hormone targets the lateral hypothalamus and the nucleus accumbens, two main brain areas associated with Panksepp's dopaminergic SEEKING system (2019). Both areas are acted on directly by all four Freudian imperative motor factors—ghrelin, testosterone, angiotensin II, and adenosine. This process requires that peripherally released hormones are able to cross the blood–brain barrier in order to act upon specific brain areas and, in turn, induce the release of neurotransmitters and neuromodulators (Kirsch, 2019). The release of neurotransmitters and neuromodulators is thought to be the way in which peripheral messages can be "converted" into conscious ones (Kirsch, 2019). It is thus theorized that this is the mechanism by which unconscious Freudian motivational drives are able to induce conscious emotions.

Johnson (2008) described the mechanism of cathexis, the psychoanalytic word for persons that means something to one another. Reviewing the animal literature on bonding, Johnson explained that the first dopaminergic SEEKING must be engaged, and then oxytocin and endogenous opioid must be expressed at the same time. If one of these three, dopamine, oxytocin, or endogenous opioid, is blocked, there is no cathexis. 5-Hydroxytryptamine is responsible for processing attachment (Kirsch and Buchholz, 2020).

Reviewing more neurobiology, Johnson (2013) found that "drive reduction" requires sequential engagement of dopaminergic SEEKING followed by gratification. He used Freud's concept of "the will" as drives acting within us. We want to seek and find gratification of drives. It is what all animals want. Finally, drugs take over the will by becoming a goal of the SEEKING system. Drugs are wanted more than natural (food, water, sex, relationships, sleep) goals of the will.

SEEKING, Drive, and Instinct

Panksepp conceptualized the SEEKING system as a dopaminergic pathway that modulates the need both for specific instincts (hunger, thirst, and sex) that originate in the lateral hypothalamus, as well as his other emotional systems, RAGE, FEAR, PANIC, CARE, LUST, and PLAY (Panksepp, 1998). He described the SEEKING system as the "granddaddy" of all his emotional systems in that it is able to regulate those systems (Kirsch, 2019). In an effort to describe the neurobiological underpinnings of Panksepp's idea that the SEEKING system regulates the six emotional systems, Kirsch looked to indirect mechanisms by which the lateral hypothalamus affects brain areas associated with RAGE, FEAR, PANIC, etc. Orexinergic neurons of the lateral hypothalamus modulate appetite and arousal (which relate to the Freudian motivational drives hunger and sleep). Kirsch described that orexinergic neurons have receptors for ghrelin and estrogen, which have an excitatory effect on said neurons, as well as adenosine and angiotensin II, which have an inhibitory effect on said neurons (2019). Interestingly, testosterone receptors were not found to be present on the orexinergic neurons of the lateral hypothalamus, but given that testosterone is enzymatically converted to the estrogen derivative estradiol, a hormone that also influences male sexual behavior, estrogen can be thought of as a substitute for testosterone as the imperative motor factor influencing sex drive (Kirsch, 2019). These orexinergic neurons were found to project out to all of the brain areas associated with Panksepp's emotional systems [i.e., the ventral tegmental area (VTA) and nucleus accumbens, which again are associated with the SEEKING system, the medial amygdala that is associated with RAGE, the central amygdala that is associated with FEAR, and so on] (Kirsch, 2019). This supports Panksepp's assertion that the SEEKING system is the "granddaddy" of the other emotional systems. It makes logistical sense for there to be a system that modulates the importance of particular emotions and instinctual needs, as it is important to be able to prioritize instincts over emotions, as well as one drive over another (Kirsch, 2019). For example, if one wants to sleep, it is important to be able to turn off RAGE, and if one is both hungry and thirsty, it is important to prioritize thirst, given that one can survive 21 days without food and only 3 days without water (Kirsch, 2019).

The six instinctual systems then do not depend on hormones lodging in the lateral hypothalamus. They are turned on directly by orexigenic neurons. We now have three levels of motivational factors:

- Dopaminergic SEEKING; as Panksepp termed it, "The goad without a goal."
- Hormonally sponsored drives that orient SEEKING to a specific goal that includes cathected humans.
- Orexigenic instincts that have either a pleasant feel, CARE, LUST, and PLAY, or an aversive quality, RAGE, FEAR, and PANIC.

The Opioid Hormonal System

The endogenous opioid system is best conceived as a hormonal system as endogenous opioids produced by the brain and adrenal cortex circulate widely in the body, have a multitude of receptor sites, and influence a variety of bodily processes (Johnson et al., 2014). Opioid receptors are prevalent in the gut, as evidenced by the constipation produced by exogenous opioid administration and the cramping, diarrhea, and vomiting characteristic of opioid withdrawal. Endogenous opioids play a role in activating the immune system, whereas exogenous opioid administration has been demonstrated to suppress immune function (Plein and Rittner, 2018). Endogenous opioids interact with other

hormonal systems. The administration of exogenous opioids disrupts function in the hypothalamic–pituitary–adrenal axis and the hypothalamic–pituitary–gonadal axis resulting in decreased production of sex hormones (Khademi et al., 2015). Opioids are also responsible for modifying the intensity of pain.

The regulation of pain by the opioid system has been adapted to modulate social interaction and relatedness (Stein et al., 2007; Panksepp and Watt, 2011). The opioid hormonal system is the engine of relatedness. The hedonic feelings generated by endogenous opioid stimulation serve to motivate humans to continue to engage in social behavior (Panksepp, 1998). Human connection maintains opioid tone in a pleasurable window; too little contact hurts as does too much. Low opioid tone compels us to seek out human contact. Conversely, high opioid tone prompts a desire for distance from others. This is why it feels so nice to interact with a partner or friends after spending some time alone and why after a busy day around colleagues at work or an evening at a crowded party, quietly reading or watching television alone feels blissful (Johnson et al., 2014). We use engineering models to treat our patients and offer an updated version of our inverse U function of pain/pleasure and endogenous opioid tone here:

The Effect of Addictive Drugs on SEEKING, Drive, Instinct, Relatedness, Pleasure, and Unpleasure

We begin with a previously published engineering model of the SEEKING system as influenced by addictive drugs (Johnson and Faraone, 2013; Johnson et al., 2014; Johnson, 2018). Nicotine, amphetamine, and cocaine are the "upper" group. They directly trigger dopamine barrages from the VTA to the nucleus accumbens shell (NAS). Opioid and cannabis directly inhibit the GABAergic inhibitory neuronal system that is a tonic brake on dopamine release to the NAS. Alcohol and benzodiazepines are GABAergic, so ingestion shuts off the appetite for more. For example, one may notice that after a drink or two, one feels one has had enough. Persons who use alcohol for "relief" from PANIC, FEAR, and RAGE signals may override the natural inhibition of "enough" to get rid of the dysphoric feelings, cause the downregulation of the gamma-aminobutyric acid (GABA) system and the upregulation of balancing glutamatergic and noradrenergic drivers, and induce withdrawal when the drug is stopped. The flood of uninhibited dopamine is then responsible for opponent process of the downregulation of the dopamine system combined with new onset of drinking dreams, SEEKING the drug while motor inhibition is activated during rapid eye movement (REM) sleep (Johnson, 2001). N.B.—this formulation is based on **Figure 1**. The authors appreciate that opinions and evidence on alcohol and dopamine are mixed. See, for example, (Thiruchsevam et al., 2017).

The SEEKING system is directly taken over by addictive drugs. An earlier paper explained that Freud's concept of "the will" was simply SEEKING operating inside us (Johnson, 2013). Once SEEKING for addictive drugs is in control of the will, instinctual systems, such as CARE, LUST, PLAY, FEAR, PANIC, and RAGE, turn on sluggishly. While it is impossible to completely avoid sleep, it turns on sluggishly because of downregulated dopamine function, resulting in insomnia.

These instinctual systems underlie relatedness. If one is trying to relate to an individual who SEEKS one or more drugs, one becomes aware of their need to disengage to inhale a cigarette, have a drink, or that the individual returns home only after all the money for cocaine has been spent.

Addictive drugs also cause a surge of serotonin:

Once the SEEKING system is made hyporesponsive to Freudian drives, such as food, water, sex, sleep, and relationships, due to downregulated dopaminergic tone, they are sluggishly active while dopamine-releasing drugs are sought because they will move tone back toward normal. There is an additional explanation from the perspective of central 5-hydroxytryptamine (serotonin) turnover. With the exception of benzodiazepines, all drugs with addictive potential have the capability to induce the release of 5-hydroxytryptamine in the nucleus accumbens (**Table 2**), i.e., a core region of the SEEKING system. An increased level of 5-hydroxytryptamine decreased Freudian drives by decreasing the dopaminergic tone and attachment urges by releasing beta-endorphin (Kirsch and Buchholz, 2020). Hence, drug-addicted individuals complain of insomnia, they lose weight, and they favor drugs over relationships, even with partners and children.

Work on our neuropsychoanalytic addiction service provides further evidence for the opioid hormonal system being the driver of relatedness and for human contact being the treatment for addiction. As shown in **Figure 2**, buprenorphine maintenance moves patients to the right side of the inverse U where emotional contact hurts. Patients maintained on opioids for addiction relate to others autistically. They often exhibit gaze avoidance, report that they have nothing to talk about, and their strongest wish is often to be seen as infrequently as possible. These experiences reflect evidence by Carroll and Weiss (2017) that psychotherapy with patients on buprenorphine maintenance is ineffective; their opioid tone is too high, their drive to relate is squashed, and human contact hurts too much. In fact, we have been able to craft a neuropsychoanalytically informed version of contingency management for buprenorphine-maintained pregnant women where the reward for being off other addictive drugs is to disengage from psychotherapy. This approach both eliminates the need to treat neonatal abstinence syndrome (Tabi et al., 2020) and confirms that human contact hurts buprenorphine-maintained pregnant women.

Patients on opioid maintenance are not aware that they are unrelated. It is only evident to others around them. Patients who are helped off opioids suddenly feel the rush of anxiety associated with low opioid tone. Suddenly feeling alone and vulnerable to emotions that they did not have on opioids acts as a driver toward relapse. They long for the feeling of connectedness that they had on opioids. We call it, "A person in a pill." To counteract the feeling of vulnerability, patients coming off opioids are seen every day on our addiction medicine service while going through withdrawal. Frequent human contact works against relapse by satisfying the drive for relatedness (Johnson et al., 2014).

The current standard of care according to the American Society for Addiction Medicine (ASAM) for treating opioid use disorder (OUD) is medication-assisted treatment (MAT), yet

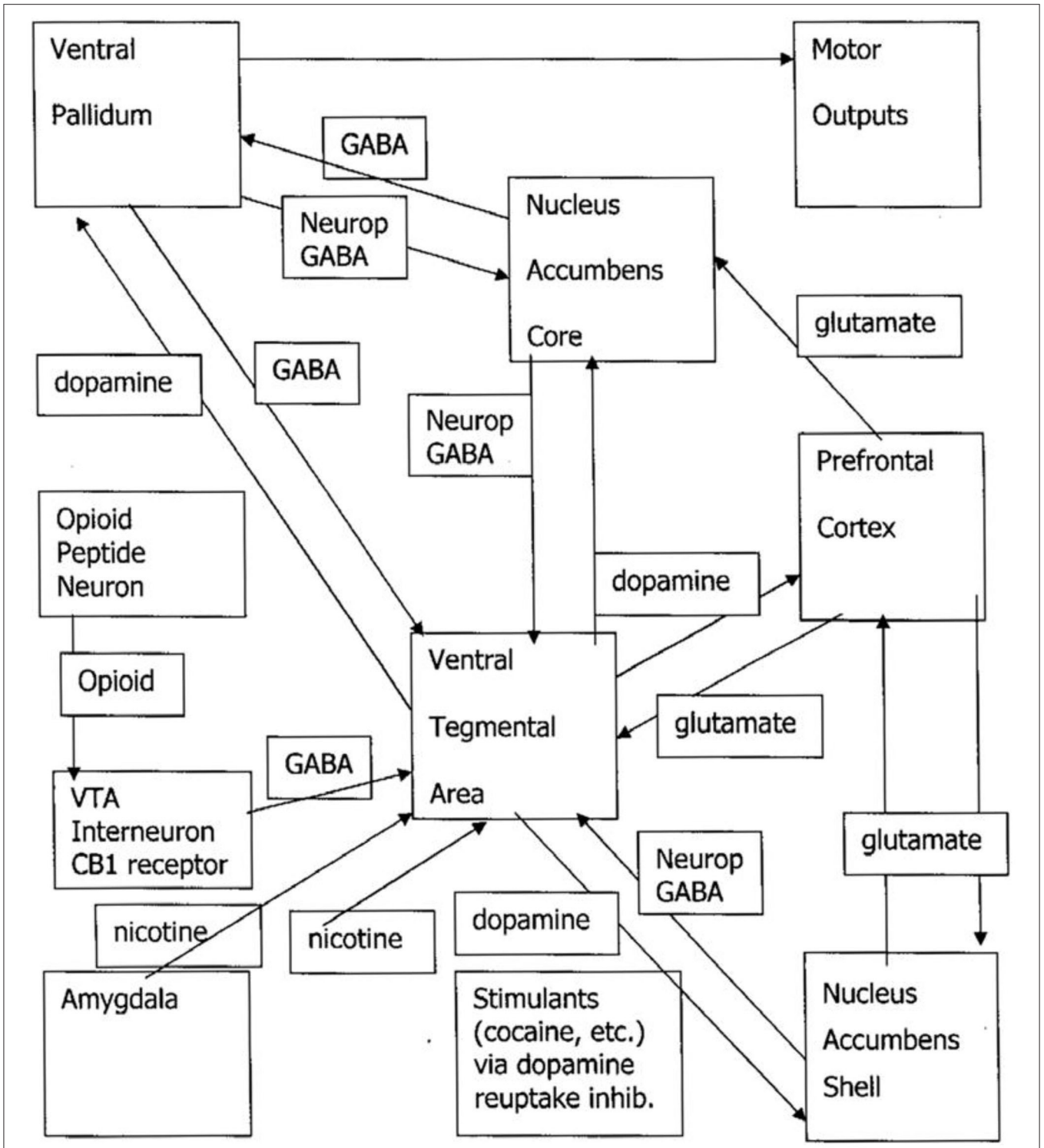

FIGURE 1 | Drug craving/drug dreaming pathways. VTA, ventral tegmental area; GABA, gamma-aminobutyric acid; neurop, neuropeptide; NAS, nucleus accumbens shell. The upper drug pathway is the triangle of the VTA/NAS/prefrontal cortex. The downer drug pathway is represented by the opioid peptide neuron removing the tonic GABAergic brake on VTA release of dopamine to the NAS.

little is known about the potential effects of MAT on drive, instinct, and relatedness. Both buprenorphine and methadone are unquestionably lifesaving medications as evidenced by their effect on reducing mortality by 50% (Coffa and Snyder, 2019). Unrelatedness may explain in part why the current buprenorphine prescribing guidelines were updated to remove

TABLE 2 | Release of serotonin caused by drug use.

Addictive drug	Reported 5-HT release in the nucleus accumbens
Cocaine	Broderick et al., 1993; Parsons and Justice, 1993; Teneud et al., 1996
Alcohol	Yoshimoto et al., 1992
Nicotine	Ma et al., 2005
Amphetamine	Hernandez et al., 1987; Kankaanpää et al., 1998
MDMA	Kankaanpää et al., 1998; Trigo et al., 2007; Baumann et al., 2008
Morphine and heroin	Tao and Auerbach, 1995; Solms and Turnbull, 2002/18; Fadda et al., 2005; Stein et al., 2007; Watt and Panksepp, 2009; Thiruchsevam et al., 2017; Tabi et al., 2020

the requirement that all patients seeking MAT for OUD must participate in mandatory individual and/or group therapy. Making this a requirement causes dropouts from maintenance programs, as counseling was found to have only marginal benefits for buprenorphine-maintained patients, and when combined with the inadequate access to behavioral health providers, access to MAT became drastically limited (Martin et al., 2018). It may be that simply dropping the requirement for psychotherapy recognizes reality without having an explanation for why this is needed.

Our understanding from our patients about what they mean by "high" is simply normal functioning (Johnson, 2018). In other words, "high"-functioning people constantly have the pleasure of bonding and human contact in a propitious human environment. Persons with PANIC, RAGE, and/or FEAR turned on use drugs to get rid of the signal that they need to modify their human environment to feel better.

When meeting a new person, the question is, "What kind of person is this? Should I form a bond?" The answer is not a routine exercise of current judgment. Rather, it is based on previous cathexes. Persons with early histories of benevolent relationships are prone to making more propitious relationships, and persons with a history of abuse are prone to making new relationships based on their early abuse histories (Johnson, 2008).

Brief Neuropsychoanalytic Case

Mr. X is a 34-year-old man with post-traumatic stress disorder, narcissistic personality disorder, alcohol, opioid, cocaine, amphetamine use disorder, alcohol-induced chronic pancreatitis, and opioid-induced hyperalgesia. His cold pressor time, the time he can keep his forearm immersed in a painful ice water bath, has ranged from 14 s when he is using street opioids to 3 min after a 3-month course of low-dose naltrexone to fix the opioid system damage from exogenous hormone (Oaks et al., 2018). Additional psychosocial factors contributing to his overall illness severity include complicated bereavement due to the murder of his wife and young daughter by drug dealers, unemployment despite high educational obtainment, a history of severe physical and emotional abuse during childhood, and ongoing emotional abuse by his immediate family members.

Mr. X has been a patient on our neuropsychoanalytic service for 6 years. His treatment course has included twice weekly individual transference-based psychotherapy and disulfiram for severe alcohol cravings given his high risk of mortality from resumption of alcohol use in the setting of recurrent alcoholic pancreatitis. Later in his course of treatment, at the request of his mother following a period of relapse on heroin and cocaine, Mr. X agreed to 20 mg/day buprenorphine maintenance for a year. During this time, he was objectively disengaged during his individual sessions and actively avoided discussion of anything more than superficial topics. He continued during this time to have significantly impaired interpersonal and occupational functioning. He reported numerous occasions where he had voluntarily left home to sleep unsheltered on the street specifically to avoid interacting with his mother and other family members.

Mr. X reported feeling "mentally sluggish and emotionally numb." He asked to discontinue buprenorphine maintenance. A major concern about remaining on MAT specifically cited was that he was, "Unable to feel a connection to or feel love from my fiancé."

With detox from buprenorphine and low-dose naltrexone, he demonstrated a significantly different behavior in session. He subjectively reported improvements in his cognition, restoration of his ability to experience emotions (both positive and negative), could experience his fiancé's love and affection again, and had returned home to his mother's house. Mr. X demonstrated better engagement in the therapeutic discussion, openly shared his thoughts and feelings related to the pain of his prior life experiences, and was receptive to the treating provider's interpretations of his defense mechanisms and confrontation of cognitive distortions. His affect became brighter and less constricted, and he became employed again. Mr. X did continue to have some interpersonal difficulties at work but was able to tolerate social interactions with his coworkers. He demonstrated a restoration in his relatedness following cessation of his buprenorphine maintenance and continues in treatment. Several months after his detox, Mr. X briefly relapsed on alcohol and street fentanyl following a narcissistic injury, but when offered to re-start MAT, he adamantly refused stating, "On buprenorphine I couldn't feel anything, I didn't care about anything, and I felt like I was losing my intellect. I need to be able to tolerate my feelings without needing drugs. I want to feel love from my fiancé."

DISCUSSION

There has been a long running discussion in psychoanalysis about drive and instinct. Are they the same? Did translation blur some distinction Freud had in mind? Did he use one word at times, and the other at other times, as if he thought them interchangeable? Is the concept of drive outdated for current psychoanalysis? Should we take a relational stance that what we see between psychoanalyst and patient is the bedrock of our science? We have revisited this question with a neuropsychoanalytic approach. What we observe clinically should line up with neuroscience.

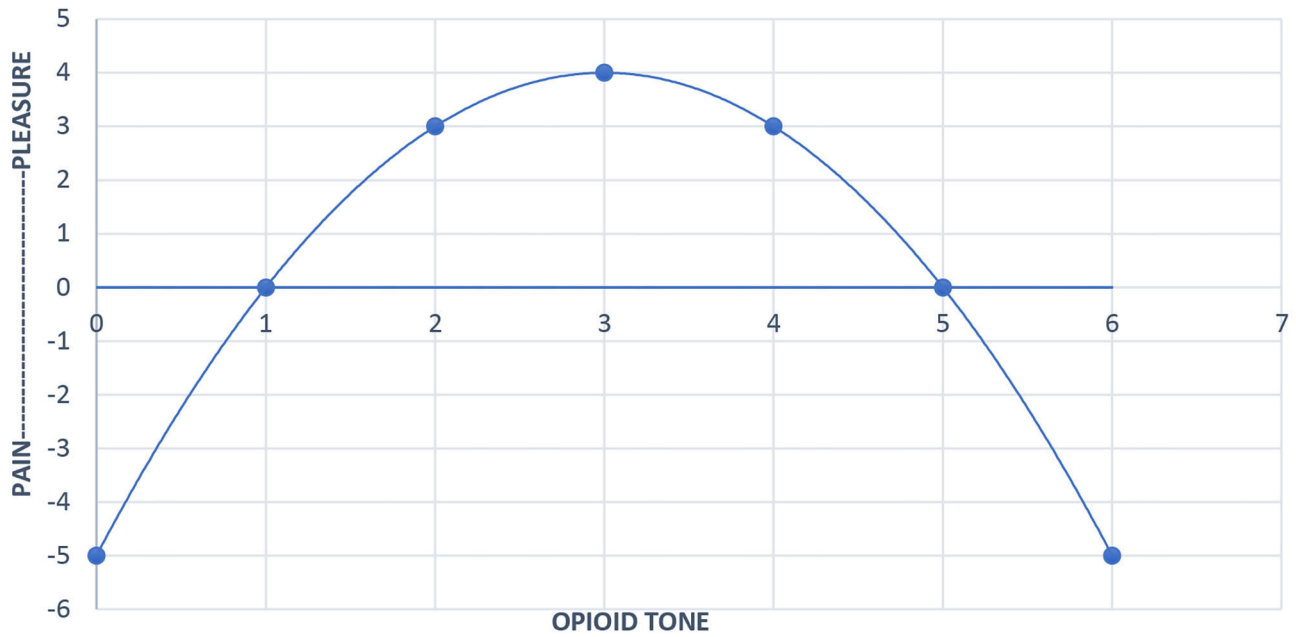

FIGURE 2 | Neurobiological systems engineering model of the relationship of pain, pleasure, and opioid tone. Pleasure (x) = $4 - (x - 3)^2$. x = opioid tone, limit $x = 0 < x < 6$.

Our neuropsychoanalytic addiction medicine service gives us additional information. The brains of our patients have been changed by addictive drugs in ways that are characterized by neuroscience investigations, resulting in aberrant behaviors that we constantly ask patients to describe.

This has resulted in a revision of motivational factors where neuroscience and clinical observation line up in a new way. In summary:

- Dopaminergic SEEKING is a tonic stimulus to exploration; as Panksepp termed it, "The goad without a goal."
- Hormonally sponsored drives orient SEEKING to a specific goal that includes cathected humans.
- Orexigenic instincts have either a pleasant feel, CARE, LUST, and PLAY, or an aversive quality, RAGE, FEAR, and PANIC.
- Addictive drugs take over SEEKING, orienting the victim to constantly, when prompted by withdrawal, endeavoring to obtain a dopamine surge from drug use.
- The "relief" of drug use, the "high," is having the drug remove the aversive experience of PANIC, RAGE, and/or FEAR.

Freud's original conflation about pleasure and unpleasure (Johnson, 2017) is separated into:

- Pleasure is a relaxed, slow, mostly opioidergic experience that has no pressure to repeat. It is modulated interpersonally to optimize human contact.
- Unpleasure is the experience of drives, including for drugs if addicted, not being gratified. One is tortured by the unmet wish for sex, sleep, food, water, or drugs.

High functioning people have all their basic drive needs met. This may be most evident when one is on vacation with a partner and some friends, free to spend time socially, or read a book alone when one wants the pleasure, as indicated in **Figure 2**, of optimal human contact.

SEEKING is fundamentally dopaminergic. It is turned on all the time, even when one is asleep and dreaming. SEEKING is subserved by other systems. Without a switching system, SEEKING is not tuned to any particular goal.

By virtue of the anatomy with the VTA to the NAS median forebrain bundle running through the lateral hypothalamus, drives are turned on by hormones and turned off by a surge of serotonin. Cathexis requires sequential engagement of dopamine and then oxytocin and endogenous opioid. One does not respond to strangers who brush by you on the street. Cathexis requires emotional engagement. Orgasm with a new lover causes a surge of oxytocin and endogenous opioid that promotes cathexis (Johnson, 2008). One may remember lovers much more than acquaintances.

PANIC, RAGE, and FEAR are uncomfortable instincts that promote survival. For teenagers who have had them turned on for their entire lives, the discovery of addictive drugs that turn off these instinctual systems tempts them to be their own psychiatrist and "self-medicate" those instincts away.

The fact that SEEKING has been corrupted by drugs must be made unconscious to allow continued drug use despite the danger that is apparent to treaters. Defenses, such as splitting, omnipotent control, denial, minimization, avoidance, and rationalization, neutralize messages that drug use is

dangerous. Rather than say, "My brain has been taken over by sellers of tobacco," users say, "I like smoking cigarettes. It relaxes me!" The need for a cigarette is a product of dopaminergic craving fueled by nicotine withdrawal. It is unpleasure relieved by another episode of drug use. Interpretations of defenses may undermine the denial system and help actively addicted patients decide to stop using addictive drugs.

Addictive drugs cause dopamine barrages to the nucleus accumbens accompanied by surges of serotonin. This makes it difficult or impossible, depending on which drug it is, for actively addicted patients to make a cathexis with treaters, the engine of psychotherapy. It allows us to understand that for some drugs, the transference relationship can only be used for treatment after use has stopped and the SEEKING system is now available for the patient to relate to the treater.

Pleasure is a relaxed, slow moving hormonal response to events, especially proximity of cathected friends. One wants to be around friends until it feels like enough, signaled unconsciously by opioid tone moving past the midpoint of **Figure 2**. One then wants to be alone until opioid tone moves back past the midpoint where proximity is once again going to produce pleasure. The dysphoria of low opioid tone may be the source of the aphorism of AA, "When you don't feel like a meeting, you should go to a meeting." The proximity of AA members promotes the relaxed good feeling of optimal opioid tone.

With this substantial discussion about how SEEKING, drive, instinct, pleasure, and unpleasure work, and how drugs affect these neurobiological systems, we are now in a position to answer our initial questions about mass killing and the place of psychoanalysis in addiction treatment. PANIC, FEAR, and RAGE are uncomfortable for all of us. Teenagers who grow up in environments where these instinctual systems are turned on all the time use drugs to turn off the signals of distress. While one might hope that children who mature in distressing environments look for better relationships to help them, their cathexis system is tuned to abuse. Drugs and bad relationships go together. Many addicted patients have difficulties with relatedness that may be ameliorated by a treatment where relatedness is the central issue that is studied with the treater. This is in marked contrast with addiction treatments that involve "counseling" or "skills training." We regard our treatment as a sophisticated version of "12 step facilitation." Our psychoanalytic style includes transference focused psychotherapy confrontations, such as, "Most people with good recovery go to Alcoholics Anonymous and you are not going. What is your thinking?"

In order to accommodate the mass killing involved, outside observers also employ defenses. For example, tobacco consumption is described by "packs smoked" rather than "cigarettes inhaled." Smoking "a half pack per day" is a description used by traumatized physicians who experience constant deaths from tobacco. The defense is minimization. The more powerful, disconcerting and danger-announcing alternative would be, "Inhaling 10 cigarettes per day."

Allotting responsibility to the individual "abusing" a drug shifts responsibility for mass killing from the addictive drug industry to their victims. In an unfortunate consilience, since the drug takes over the will, the victims of mind-controlling drugs also take responsibility for using a drug that, in most cases, took over their SEEKING system during childhood. Psychoanalysis can also be used to understand the social phenomenon of tolerating mass killing in that most individuals also use defenses to make the deaths constantly around them the product of the weak will of the victims rather than the malevolence of profit-driven drug selling. Use of these defenses against conscious awareness immobilizes the need for life-saving responses.

On our neuropsychoanalytic addiction medicine service, we have much supervision to address the helplessness we feel while some of our patients continue to use potentially lethal drugs. Our awareness also promotes public health and political activism. We suggest that using psychoanalysis for drug treatment is responsible for more distress in treaters and better outcomes for patients. We appreciate that this assertion is a product of a perspective rather than any empirical evidence.

This exposition is an example of the use of psychoanalysis as a general psychology. It is useful for treatment. We have also used psychoanalysis to make models that explain addictive disease, addictive behavior, and public health issues.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

BJ: wrote a shell/outline of the manuscript. TR, LC, BF, and MK: wrote sections of the manuscript that were then synthesized by BJ. All authors contributed to the article and approved the submitted version.

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HYPOTHESIS AND THEORY
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Affective Neuroscience Contributions to the Treatment of Addiction: The Role of Social Instincts, Pleasure and SEEKING

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Addiction is an illness prevalent in the worldwide population that entails multiple health risks. Because of the nature of addictive disorders, users of drugs seldom look for treatment and when they do, availability can be difficult to access. Permanence in treatment and its outcomes vary from case to case. Most models work from a multidisciplinary approach that tackles several dimensions of addictive disorders. However, the different etiological factors claim for a personalized treatment to enhance opportunities for better results. Problems in relationships with others play an important role in the etiology and the recovery process of addiction. This paper focuses on the social-environmental causes of addiction based on an affective neuroscience approach that attempts to integrate the interplay between social instincts, pleasure, and the SEEKING system in addiction. To advance toward better treatment strategies, it is pertinent to understand the limitations of the current multidisciplinary models. Acknowledging the social nature of the human brain may help to identify the quality of different types of traumatic early life experiences in drug users and how to address them in what may become a neuropsychoanalytic treatment of addiction.

Keywords: affective neuroscience, addiction, treatment, SEEKING system, social instincts, pleasure, neuropsychoanalysis

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INTRODUCTION

Addiction is a complex and prevalent disorder worldwide (1, 2). The extent of the individual and social related consequences of drug use is costly and harmful in various ways. An estimated of 269 million people used drugs during 2017 and 35.6 million suffer from a drug use disorder (1). Prevention and treatment do not seem to cover the scope of this unfathomable problem, despite major efforts to address it. One in eight people receives treatment each year (1). An attempt to explain the failure and/or insufficient results of the existing models of treatment may lead to suggestions to improve the available clinical approaches. Further investigation of the causes and characteristics of addiction seems necessary, as it is one of the major health concerns in many countries. The treatment of addiction is commonly multidisciplinary, e.g., it covers neurobiological, psychiatric, social, and psychological aspects. However, the general outcome of the treatment is modest and short-lasting (3). Recent neurobiological advances have contributed to an improved understanding of the mechanisms of addiction, leading to the development of

different medications to diminish drug use or to achieve abstinence (4). Cognitive-behavioral strategies are effective in controlling craving and promote abstinence. Social support has been recognized as an important aspect of the treatment of addiction (5–7). Most users experienced life backgrounds that challenge social cohesion and lack positive relationships. Such circumstances are stored in different memory systems with an impact on affect regulation, which contributes to a neurochemical hypothesis to explain an enhanced vulnerability to use drugs. The differentiation of pleasure, reward, and SEEKING seems necessary to expand on the modalities of treatment currently available. Acknowledging that a person who suffers from an addictive illness is a special case of a neurological patient may add a frequently forgotten dimension to a self-locking disorder that requires personalized strategies for treatment. The current paper highlights the need for addressing the subjective experience of living with addiction which has not been the main focus of previous studies. Neurobiological aspects, genetic vulnerabilities and early life experiences all contribute to the onset of an addictive disorder influenced by what the person subjectively feels. The correlates of traumatic separation distress and its effect on other social instincts are addressed as important contributors to the vulnerability to addiction. Considering the subjective experience of unmet social needs may add to the current models of treatment.

This paper takes an integrative perspective that considers the various dimensions of addiction. It does not intend to elaborate on every dimension, but to hypothesize their interactions by emphasizing the relevance of early social trauma. The nature of addiction is first explored as a self-locking disorder to highlight the inherent difficulties that addiction poses for its treatment. The influence of social instincts on addiction is later explored by briefly reviewing the four social instincts as proposed in Panksepp's affective neuroscience to hypothesize their role at the onset of addiction as separation-distress trauma. Next, the differentiation between SEEKING, pleasure, and reward is addressed to elaborate on the subjective aspects of addiction. Last, an integration of several dimensions involved with addiction is attempted to discuss potential contributions to the current models of treatment from a social perspective. A neuropsychoanalytic viewpoint is proposed as an integrative approach to analyze individual cases in their several dimensions, such as affect and procedural-emotional memories. A frame of reference that integrates data from different fields offers new insights into addiction and its treatment.

Addiction as a Self-Locking Disorder: Challenges for the Treatment

The main models of treatment for addiction take a multidisciplinary approach that addresses several dimensions of this complex disorder. The treatment may entail detoxification, pharmacological agents (4, 8), and psychotherapy, which may include individual, group, and family approaches (9, 10). However, the most challenging impediment to treat addiction is that users seldom ask for help. People who use drugs frequently report experiencing a pleasurable or helpful effect despite the declining results as tolerance increases. Hence, repeated interventions may be necessary before the person agrees to be treated. It may also take several attempts before the treatment succeeds. It seems unlikely that the current models of treatment ignore any of the different dimensions of addiction. Nonetheless, the question of how to make the different approaches more efficient remains. When all or most aspects of addiction are addressed, alternatives to improve the outcomes of different treatments narrow to looking into more detail at some causes and course of the disease. Addiction can be described as a self-locking illness. A person usually tries drugs, reporting that they were curious to know what it felt like to be intoxicated. If they decide to use drugs subsequently, the risks of developing an addictive disorder increase. Trying different drugs and/or using a group of them regularly may become habitual for many users who do not foresee potential abuse and dependence problems (**Figure 1**). The gradual progression toward addiction impedes many users from noticing that they cannot stop using the drug. At this stage, tolerance, craving, and withdrawal are experienced. Nevertheless, many users still consider that they can control their drug use (10–13). Thinking that they do not have a problem, i.e., denial, accounts for one of the key characteristics of addictive disorders and it explains why users seldom look for help.

It is sometimes considered that users are unaware of the negative consequences of using drugs. This is rarely the case (7, 9, 14). In fact, it has been suggested that in order to use drugs, the person must resort to dissociative defense mechanisms that facilitate that they behave as though their mind could live separate from their body and that using drugs entails no potential harm (10). Users may also rationalize the negative consequences to allow themselves to keep using drugs. As a result of recruiting several defense mechanisms, some users consider the harmful effects of drugs as less important than they are; some may feel that they can control both the use and the damaging effects; others may report that the harmful effects of drugs are irrelevant as they are aware of their inevitable progression toward death regardless of the use of drugs. One common belief amongst users is that if they have knowledge about the drug, then they will use it without consequences, as they can manage the negative outcomes of consumption (15). Denial, dissociation, omnipotent control, and rationalization are some of the defensive mechanisms that diminish the awareness of having a problem. Treatment is then not considered. The disease is essentially inaccessible, namely, self-locking. The use of defenses may entail neurobiological correlates operating in addiction including the modifications of the dopamine mesolimbic pathway and impaired functioning of the prefrontal cortex (PFC), which may contribute to the scarce insight related to the recognition of addiction (7, 8) and to the compulsory use of the drug (13). Behavioral, cognitive, biological, and subjective aspects are coherent in the presentation of addiction.

In sum, the person uses drugs despite their negative consequences because they expect to control them; the latter includes the risk of developing an addictive disorder, namely, no person starts using drugs intending to develop addiction. However, there are important neurobiological implications that contribute to explain the use of the defenses described before.

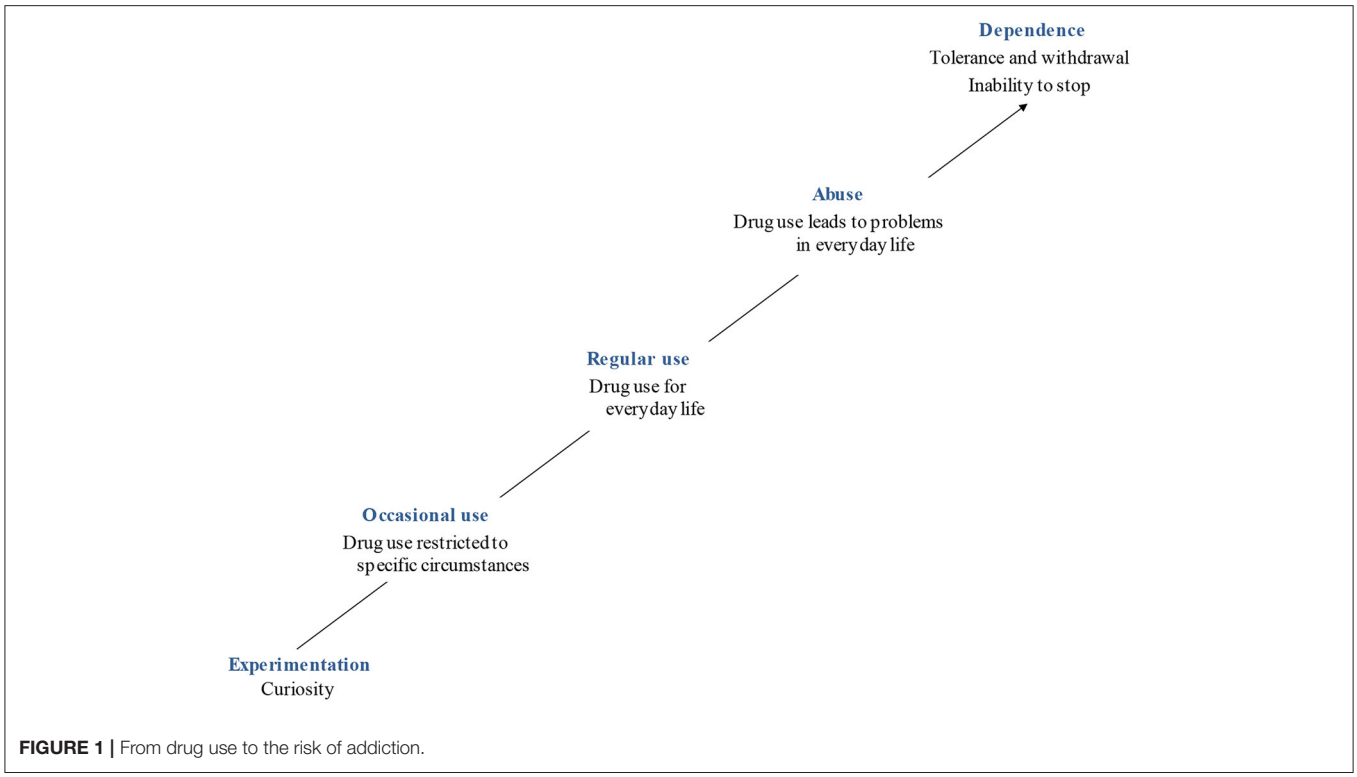

FIGURE 1 | From drug use to the risk of addiction.

When addictive drugs recruit the mesocortical limbic dopamine pathway, they hijack a system involved in motivation, incentive salience (16, 17) and executive functions (3, 8, 12) amongst others. Olds and Milner (18) named it the reward system as they believed they had found the pleasure centers of the brain. Years later, Panksepp (19) challenged Olds and Milner's viewpoint by expanding the study of the circuit to a SEEKING system that involves an urge to explore the world and to predict potential rewards (17). The SEEKING system looks for rewards, but it does not entail the reward. The implications of this system in addiction partially clarify the type of thinking that characterizes addiction, contributing to its self-locking characteristics. Panksepp (19) has argued that an increased activity of the SEEKING system results in distorted thinking. Overarousal of SEEKING relates to superstitious ideas that establish false associations between certain stimuli and the anticipation of a reward. The false association attempts to predict a causal relationship despite the repeated absence of a reward. In brief, the overarousal of the SEEKING system may contribute to the modified "superstitious" thinking that expresses some paradoxes of addiction (20), e.g., using addictive drugs to survive while this behavior leads to harmful effects, sometimes even to death. This type of thinking reduces the chances that users notice their false associations, thus enhancing the risk of addiction while simultaneously decreasing the chances of looking for help. Moreover, Ceceli et al. (8) have recently reviewed the dysfunction of the PFC in addiction. They emphasize the impaired response inhibition and salience attribution (I-RISA) model as proposed by (21) to explain the difficulties in suppressing disadvantageous behaviors related to overvaluing drug reinforcers and undervaluing reinforcers unrelated to drug use. Using addictive drugs results in impaired prefrontal functions such as self-control and insight into illness. The latter components all contribute to the self-locking nature of addiction.

The self-locking characteristic of addiction also leads to distorted goals and beliefs in users who accept treatment. They may agree to be treated expecting to continue drug use while avoiding the harmful consequences, including neurobiological and psychological dependence (10). This belief expresses the need for the addictive substances and reluctance to engage with the treatment, frequently leading to relapse, failure and/or disappointment. Once the dependence stage is active, it becomes increasingly challenging to break the self-locking essence of addiction. Thus, focusing on a deeper understanding of the causes of addiction may be valuable. The genetic, developmental, and social factors are to be considered. An account of the complex social aspects follows.

The Influence of Social Instincts in Addiction

The social aspects related to addiction can be addressed from a cultural viewpoint. The need for acceptance by peers and cultural agreements to use legal and illegal drugs stand out as concurrent causes of addiction (22). However, the primary process instinctual foundations of the human need for others are crucial to the understanding of addiction. Human beings depend on others to survive. When primary relationships are characterized by failure to provide a secure base, other social

instincts may be compromised, which results in an enhanced vulnerability to psychopathology, including addiction (7, 23).

Because of the state of immaturity at the time of birth, mammalian organisms require a primary caregiver while they are young. The need for caregivers is also expressed in situations in which an organism cannot meet their needs on their own, e.g., during illness. The latter implies a social brain that emphasizes the necessity of others to survive. We depend on one another throughout life; infancy is the time in which more care from others is required, particularly from the mother. Separation from the caregiver can cause significant feelings of loneliness and sadness (19, 23) that quickly subside when the reunion with the caregiver takes place. If separation distress persists, it can become a traumatic experience that may influence other types of relationships.

Separation distress has been linked to the endogenous opioid system (EOS) (24–26). Mu opioid receptor (MOR) activity may be persistently low while kappa opioid receptor (KOR) activity may be high, which translates into feelings of PANIC/GRIEF in Panksepian affective neuroscience, as a resource to express the need of a primary caregiver when in situations of helplessness (19, 23). The protracted activation of the PANIC/GRIEF system can translate into an enhanced vulnerability to addiction (20). If one important cause of addiction relates to traumatic separation distress, it is possible to hypothesize that drug users may resort to opioid drugs as an attempt to regulate the feelings derived from protracted PANIC/GRIEF. However, many people use substances that primarily recruit neurochemical pathways not directly related to the endogenous opioid system (EOS). Three main hypotheses are suggested to explain such an inclination (1). Most addictive drugs target the dopamine mesocortical-mesolimbic pathways, which in turn may activate MORs in the nucleus accumbens, then resulting in a temporary relief of PANIC/GRIEF feelings (2). Drugs that do not target the endogenous opioid system directly may be used to relate to people, e.g., in recreational activities such as social gatherings which may increase MOR activity (3). Drugs that target the mesocortical-mesolimbic dopamine pathway may facilitate a subjective feeling of general positive expectation and hope, including that of relatedness with others during intoxication.

The enhanced dopamine activity of the SEEKING system that results from the use of addictive drugs generates feelings of euphoria, while hedonic experiences relate to endogenous opioid activity (17, 23). Addiction becomes a key source of frustration, as no satiety is found when there is a reduced sensitivity to alternative incentives that help to solve problems and to satisfy needs. If problems and needs remain unsolved, no pleasure can be experienced, including that derived from spending quality time with friends and family. A multidisciplinary approach to treat addiction must consider the role of unmet social needs as a relevant contribution to explain the onset of compulsive drug use. As one of the frequent social difficulties present in drug user's lives, enhanced FEAR may impede relating to others as part of renewed traumatic separation distress. Different modalities of traumatic separation distress may explain the need to stimulate the dopamine mesocortical-mesolimbic system related to a depressive cascade that includes EOS dysregulation derived from prolonged separation distress experiences (25).

The Social Nature of the Human Brain[1]

According to (19, 27), the mammalian brain is pre-wired with instincts to survive. When exposed to an unconditioned stimulus, a specific behavioral pattern (an unconditioned response) is ready to solve problems in the world that are signaled by an affective subjective experience. Unpleasant affects drive the organism to act toward resolution of conflict. As instinctual patterns will be insufficient in most circumstances, primary-process emotional responses learn from experience by associating cues in different memory systems; this is the secondary-process level, followed by tertiary cognitions that recruit higher cortical regions to supplement the brain's problem-solving abilities. Mammalian organisms need to relate to others in order to survive. This means that as human beings, we have a social brain with instinctual tendencies to SEEK for relationships. Panksepp's affective neuroscience (19) has proposed the existence of four pro-social affective instincts in the mammalian brain, (1) the LUST system, (2) the CARE system, (3) the PANIC/GRIEF system, and (4) the PLAY system. Hence, there are four formats in which relationships can be established that entail different affective qualities. Instincts enhance our chances of survival. The existence of different types of social relationships implies that they satisfy different needs. A brief description of each pro-social system follows.

An instinct to reproduce links to the feeling of sexual attraction. Panksepp (19, 23) proposed that the LUST system favors the survival of the species through the subjective experience of sexual affects. Regulated by different hormones in males and females, the activation of this circuit favors sexual drive and romantic love at a secondary and tertiary-process level when in combination with other emotions, e.g., CARE. One potential result of sexual interaction is reproduction. Mammalian organisms are born immaturely and require the CARE of adult organisms that will meet the needs of babies. The CARE system protects the survival of others and drives toward looking after those in need. CARE is present in both males and females, albeit it is more active in females because of hormonal mediation. CARE thus promotes social interaction to provide safety and comfort to others in helpless situations that extend beyond babies to ill and old people, for example.

The accompanying pair of CARE is a separation distress system (26) or PANIC/GRIEF system, which is more active in young and immature organisms. Panksepp (19, 23) linked PANIC with the attachment system described by (28, 29) in which the need for CARE makes the young ones feel separation distress when their primary caregiver is away. PANIC/GRIEF contributes to the establishment of the first type of relationship in life; it is subjectively described as the need to be taken care of. The state of immaturity inherent to young mammalian organisms will require the transit through several developmental stages

[1] If the reader is familiar with Panksepp's seven basic emotion systems, particularly of the four pro-social circuits, they may want to skip this section that reviews the key characteristics of the social instincts.

whose success depends on a primary caregiver, frequently but not exclusively, the mother. When the young one and the caregiver experience separation, feelings of PANIC arise in the young one who produces separation-evoked distress vocalizations, crying in humans. These cries or vocalizations are part of a protest phase to call the primary caregiver with the goal of reuniting. If the caregiver and the young one get back together, the PANIC reaction ends. However, if the separation lingers, the protest phase is followed by a despair phase in which the young organism retracts and stops the distress vocalizations or crying. The latter is an attempt to avoid getting attention of dangerous others and to save energy as it becomes unknown whether the primary caregiver will indeed return. In brief, the mechanisms of the PANIC/GRIEF system favor attachment to those who provide CARE. This early relationship between a primary caregiver and a young organism favors survival of the young ones, which explains the subjective feeling of psychic pain (23–26) during separation. The young organism will try to avoid this negative affective experience by staying close to their primary caregiver. Other feelings that present when the PANIC/GRIEF system is active are loneliness and sadness. In sum, the younger the organism, the more they need bonding with others to survive, which is why there is a need for attachment to a primary caregiver.

The last pro-social system proposed by (19, 23) is PLAY. Its activation promotes vigorous physical activity amongst peers that produces laughter. The associated subjective experience is that of joy and having fun while physically interacting with others. Frequent related behaviors may include persecutions and tickling. Panksepp (19) hypothesized that this system may promote the establishment of social hierarchies, social cooperation and exercising of emotional, cognitive, and behavioral patterns as it favors learning social rules linked to cooperation and competition. This pro-social instinct may, in turn, foster friendship and strategies to avoid social rejection. Solms (30, 31) has proposed that it may play a role in empathy by comprehension of the 60/40 rule, 70/30 according to Panksepp (19, 23, 32) in which participants at PLAY should take turns to win and lose for this activity to keep its fun nature. Relations amongst peers may promote group activity for problem solution.

Other basic emotion systems in Panksepp's affective neuroscience (19) include the FEAR and RAGE systems, which prepare the organism to react against stimuli that may endanger survival. FEAR uses flight and/or freezing behaviors while RAGE takes fight as a response to perceived risk. These two systems may contribute to a pro-social approach under certain circumstances, for example, when FEAR and RAGE prompt defending others against different types of danger. Considering how essential social bonds are to survival, the different instances in which they fail may become a crucial aspect, resulting in one reason to use drugs. PANIC/GRIEF, FEAR and RAGE inhibit SEEKING activity (see **Figures 2**, **3**).

Social Trauma: Separation Distress as an Essential Contributor to the Etiology of Addiction

It is well-known that addiction is favored by several types of vulnerabilities, including genetic, psychiatric, social, and contextual difficulties (4, 33). However, to emphasize the obvious, any of the latter requires that the person uses drugs to be at risk of developing an addictive illness. It is here proposed that deficits in social relations have a pervasive influence on neurobiological dysregulation that translates into protracted negative affective experiences. Attaching to a primary caregiver is the most fundamental relationship, as survival depends on it (19, 34, 35). It is an instinct that helps to regulate other types of social instincts and affects, as several developmental theories have asserted [e.g., (36)]. To illustrate one of these instances, Panksepp (19) clarified that PLAY emerges within a supportive and secure base. A proper understanding of pro-social affects entails considering the networks in the brain that are associated with our basic need of relating to others and their specific neurochemistry. Prolonged PANIC/GRIEF activations during infancy because of the separation of the primary caregiver can lead to psychic pain (25) and illness. Problems in this CARE-PANIC relationship may result in a general vulnerability to psychopathology, including addiction (20, 37) and may become an impediment to the satisfaction of other social instincts.

It is here proposed that the context of protracted early separation distress can take two main formats of PANIC/GRIEF activation that may become traumatic. The first relates to extreme abandonment, rejection and/or maltreatment by the primary caregivers. The second refers to ambivalent and confusing relationships with the primary caregivers. For the first type, there is an affective certainty of a constant unpleasant and painful feeling that characterizes the relationship with the primary caregivers predominantly. For the second type, the relation pattern becomes uncertain as the primary caregivers offer an inconsistent type of relationship in which they sometimes reject, abandon, or abuse their children, but in other moments, they may be caring and loving. Both cases may cause depressive symptoms and behaviors (20) that recruit a specific neurochemistry related to PANIC, namely, overactive dynorphin and KORs and low activity in MORs (25, 26). Oxytocin and prolactin are also major players involved with PANIC/GRIEF feelings (19, 23, 27) as they play an inhibitory role that can help to reduce separation distress feelings. They contribute to reinforcing social relations, including that of the primary caregiver and the infant, by enhancing attachment.

Neurochemical systems work in cascades that consequently affect other neuromodulating pathways, resulting in chronic depressive feelings that, in turn, dysregulate the functioning of the seven basic emotion systems (25) (see **Figure 3**). Depression underlies addictive illness (20). It is widely accepted that there is an unpleasant subjective experience that reinforces drug use during the withdrawal stage of addiction [e.g., (3, 38, 39)]. However, a negative affect before developing an addictive illness is less discussed despite the perspicuous formulations of a self-medication hypothesis (40, 41). This perspective challenges the simplistic idea that using drugs is merely for recreational purposes. It may be the case that users report such goal, nonetheless, using drugs entails harming oneself (9, 10, 42). Self-aggressive behaviors can be understood as indicators of depression (for a detailed account of the role of depression in addiction) (20, 37). Based on a psychoanalytic explanation, object loss can reflect a narcissistic type of

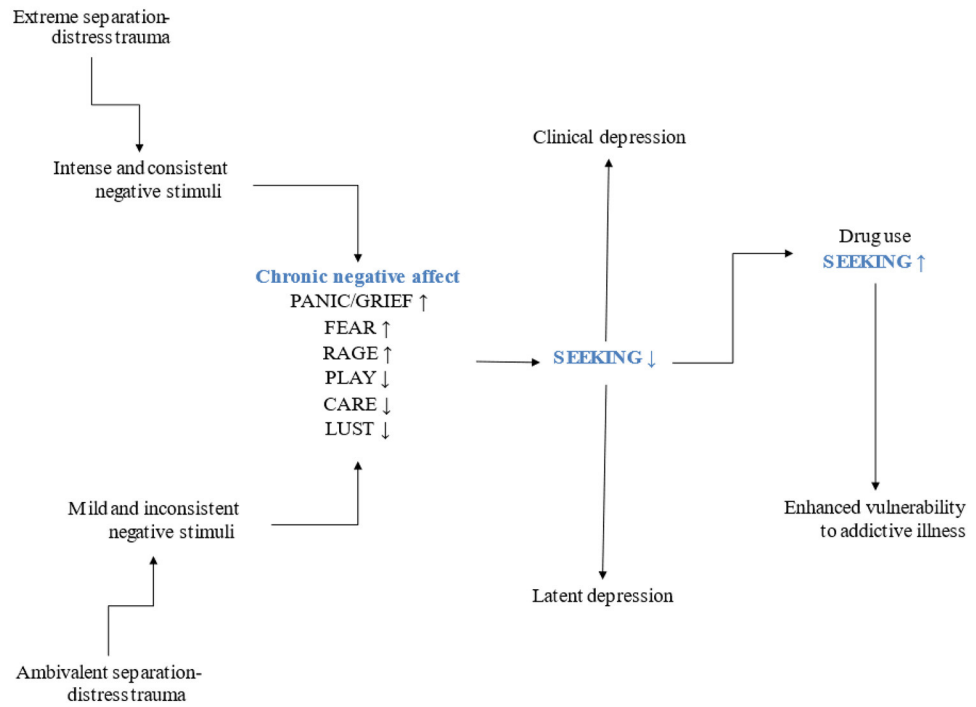

FIGURE 2 | The two types of separation-distress trauma and their impact on affect.

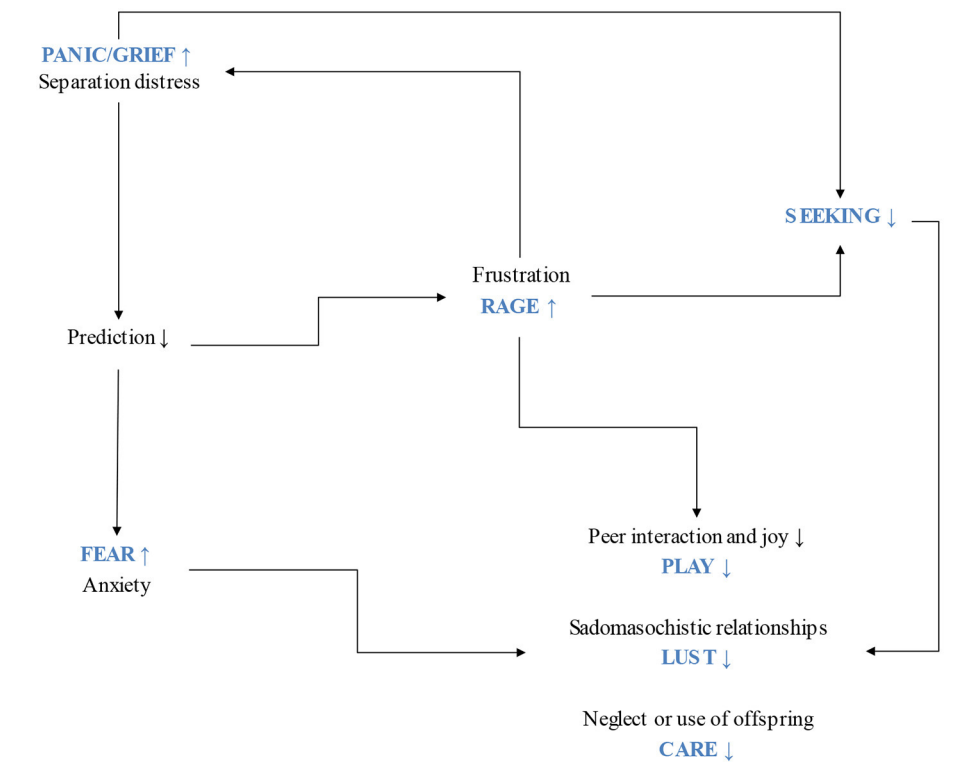

FIGURE 3 | Protracted separation distress affects the basic emotion systems.

relationship that instigates a protest reaction against parting with an object (42–44). This narcissistic relationship may derive from protracted separation distress during childhood. RAGE can result from the object frustration implied in PANIC/GRIEF activations. Aggressive feelings are then expressed against an internalized split representation of the negative affective qualities of the lost object that translate into self-aggression. Using drugs while knowing that they harm the body and the mind should be understood as a self-aggressive behavior motivated by unconscious associative patterns learned from early experience and consolidated in implicit memory structures at a secondary-process level according to Panksepp's nested BrainMind hierarchies (45). Implicit and emotional patterns hardly change after they have been learned, which may lead to a pathological attempt to mourn object loss. The unconditioned love and availability expected from the primary caregivers was not present and the person looks for an explanation in their mistakes or failed endeavors, namely, in failed ego ideal expectations. Psychoanalytically speaking, object control was not achieved, meaning that mild or intense chronic separation distress was present from the start, generating depressive feelings that necessarily relate to neurochemical modifications, featuring the endogenous opioid system (37) (see **Figure 2**).

The hypothesis of depression underlying addiction then relates to object loss. This loss can have an unconscious quality that affects neurobiological circuits chronically, prompting the use of defenses against the negative affects implied (46, 47). The latter explains latent and discrete presentations of depressive symptoms as opposed to clinical depression (20). The extreme context of early abandonment, rejection and/or maltreatment may relate to clinical depression more frequently, while the ambivalent context may generate latent depressions that are easy to miss in the clinical assessment. The extreme context leads to few prediction errors in terms of the certainty of experiencing negative affects when interacting with the primary caregivers. The satisfaction of different needs is not met, resulting in high free energy. On the other hand, the ambivalent and unreliable experience of separation distress trauma leads to frequent prediction errors and hence increased free energy and entropy (48). The affective consequence for both cases is the repetitive feeling of frustration of an instinct to attach, which in turn results in RAGE and in diminished activity of the SEEKING system. The combination of PANIC/GRIEF, RAGE and low SEEKING activation is characteristic of depression (20, 25). The need to modify the subjective and conscious experience of negative affects becomes imperative. The person then becomes more vulnerable to using drugs and, therefore, to addiction.

Solms (30, 49, 50) has proposed that negative affect drives behavior toward meeting unsatisfied needs. The goal is to recover homeostasis, which is signaled by the experience of pleasure. He has hypothesized that successful strategies for problem solving automatize in procedural memory structures. When attempts to meet a certain need are repeatedly unsuccessful, a premature automatization process takes place as the working memory capacity is limited and needs to free space to solve other problems. Solms (51) conceptualizes this illegitimate or premature automatization of a procedural pattern as repression. The repressed leads to repetition, as it cannot be reconsolidated. This regular process is compromised in people who suffer from addiction, either before and/or after the onset of the addictive illness. Solms (51) has suggested that addiction is an attempt to skip the work needed to meet needs, namely, an endeavor to generate positive affects without performing the actions required to solve problems. As much as this hypothesis may be the case for some people who suffer from addiction, actual repression and the intention to skip work should be parsed. The question that should be asked regarding this model is why a person would want to skip the work if it is the only way in which a specific need can be canceled (i.e., by a specific action) (52). The hypothesized answer is that they cannot work toward drive solution because of the problems derived from their failed social interactions. The procedural and emotional memory systems have learned a restricted and unsuccessful repertoire of solutions to social needs that keep repeating without proper analyzing of errors. Volkow has showed that social stressors impede developmental connections between the PFC and limbic regions (12). The appropriate development of key structures involved in affect regulation and inhibition is compromised, contributing to enhanced impulsive behaviors that can easily lead to addictive disease. Negative affects that strongly motivate toward attempts to find relief are not regulated because of the PFC limitations that originate in the separation distress trauma context. This configuration worsens when the person uses addictive drugs as the PFC will lose more of its functions as a result to the repeated exposure to drugs (8). Addiction becomes a conflict between protracted negative affects and a weakened PFC emotion regulation function. To better understand this problem, an elaboration of the ongoing discussion about the reward and the SEEKING system seems necessary in the context of the separation distress trauma.

SEEKING, Pleasure and Rewards: the Frequent Misunderstandings About Addiction

Freud (53) hypothesized that addiction is a compulsive search for pleasure that can be compared to a masturbatory activity. From then until the discovery of the reward system of the brain (18) and to date, addiction has frequently been misunderstood as a hedonic search for pleasurable feelings. People ill with addiction are frequently stigmatized, and it is often considered that they can stop using addictive drugs, but that they refuse to do it. The perspective that addiction is a slow suicide is commonly accompanied by the idea that people who use drugs lie and manipulate those around them. They seem to prefer pleasure against anything else. As much as this description may characterize several people who are ill with addiction, it neglects the many factors that account for the complexity of the disease. The more neurobiological findings related to addiction are available, the more we understand why the syndrome takes these characteristics. People who suffer from addiction need social connectedness and frequently inspire the opposite. Some of the known neurobiological facts that relate to addiction should be used to clarify crucial elements in its understanding, which

may contribute to enhance the positive outcomes of treatment strategies. Behavioral, cognitive, neurobiological, symptomatic, and subjective aspects seem to correlate, explaining the diverse features that characterize addiction.

The reward system that Olds & Milner (18) described associated with the self-stimulation of mesolimbic regions. Rats would press a lever to receive electrical stimulation in those regions and, after having experienced it, they compulsively pressed the lever to gain more of that stimulation. They stopped caring for previously rewarding objects, such as food and the company of sexual partners. Hence, Olds & Milner interpreted that their rats were getting a positive reinforcement, i.e., a reward. The chemical stimulation of the mesolimbic pathway has the same effects that Olds & Milner observed for the electrical stimulation. Addictive drugs initially increase the release of dopamine in the mesolimbic reward pathway, particularly in the nucleus accumbens (NAcc) (3, 54). The person who starts using drugs may repeat this behavior as an attempt to look for pleasure.

When the brain has not been exposed to drugs, the ventral tegmental area (VTA) sends constant tonic firing to the neurons of the PFC. When an extraordinary event takes place, phasic firing increases the release of dopamine activating D1 receptors, i.e., the hypothesized requisite to experience a reward. The initial use of addictive drugs results in phasic firing of dopamine, thus interpreted as a reward. The enhanced repetition of drug use eventually ensues a decreased reactivity of dopamine to regular rewards. Using drugs becomes frustrating. However, the expectation of using an addictive drug does increase dopamine release in dependent users, suggesting reduced D2 modulating receptors in people who suffer from addiction (33). Low expression of D2 receptors in the striatum has been associated with impulsivity and enhanced propensity to use drugs compulsively (7) along with dysfunction of the PFC (8). These data show that the brain is modified in addiction. Volkow has proposed that addiction is an acquired brain disease (55) and many treatments have attempted to tackle its neuroadaptations [see (4) for a brief review], yet the complexity of addiction requires attempts at integrating its many dimensions.

It has been suggested that genetic variables explain half of the risk of developing addiction when using drugs (56) with epigenetics playing an important role when environmental risk factors are associated (57). Some factors involved may play a pivotal role in the vulnerability to addiction because of the potential correlates between behavior, neurobiological features, and phenomenological experience.

Several studies have acknowledged that increased activity of the mesolimbic dopamine pathway does not relate directly to rewards [e.g., (16, 33, 57–61)], but it was probably Panksepp (17, 19, 23) who emphasized the need to understand the psychobiological nature of the dopamine mesolimbic system. He expanded the notion to a SEEKING system that would explain that the dopamine mesocortic-mesolimbic pathway does not signal rewards, but the prediction of a reward as a secondary process learning. This system does not generate sensory pleasure, but a psychomotor eagerness to seek for objects to satisfy basic needs and to avoid distress. The SEEKING system is a primary affective system that promotes exploration of the environment to find resources to survive. Its objects are determined by the input of different regions in the brain that indicate what should be looked for, including memory systems and the lateral hypothalamus. Thus, SEEKING is life. No homeostatic or affective need can be met without engaging with the outside world, which is explored, accompanied by the subjective feeling of curiosity. Panksepp underscored that there are several reward systems in the brain, not one. In particular, the SEEKING system looks for rewards and its positive feeling relates to an expectancy of finding satisfying objects that can link to Berridge's idea of a "wanting" system (16). To clarify, there is no reward while SEEKING. Only when the satisfying object is found can pleasure be available, which is mediated not by dopamine, but mainly by the EOS (17, 19, 23) that relates to a hedonic hotspot in the NAcc, namely, the "liking" system (62). Panksepp (19, 23, 27, 63) identified the periaqueductal gray (PAG) as the most important region of the brain to generate emotional feelings, including pleasure.

The distinction of the pleasure found in rewards and the SEEKING of a reward seems to play a crucial role in the vulnerability to addiction and in its course. Most proposals that describe addiction explain its associated behavior, neurobiological implications, and psychiatric characteristics. Few consider the corresponding subjective experience. Addiction is treated as though there were no subject to live through its different stages and symptoms. Panksepp's SEEKING system claims for an affective indicator that is consciousness in itself (30, 49, 64) along with the rest of the basic emotion systems, including the social instincts. A re-interpretation of addiction is then possible.

A voluntary decision to experiment with drugs is frequently explained by feelings of curiosity and/or recreational purposes. The user knows that the drug will change their state of consciousness, which may decrease the inhibition function of the PFC (8, 13) resulting in the brief experience of e.g., relaxing and having fun depending on the type of drug used (22, 40). This modified state of consciousness may cause feelings of pleasure that most likely will be searched again. Any person may experiment with the effects of legal or illegal drugs without it necessarily becoming a problem. If they do not engage in binging, intoxication, and/or too frequent episodes of drug use, the probability that the person will develop an addictive disorder is relatively low. However, epigenetic factors may play a relevant part in the risk of developing addiction, particularly if there is a background of previous affective struggle derived from the two traumatic contexts described as extreme and ambivalent. When that is the case, a negative affective state is constantly present recruiting neurochemical cascades linked to depression, either clinical or latent that come from a problem with the social instincts and their secondary process affective patterns, later resulting in the experience of protracted PANIC/GRIEF activation characterized by increased KOR activity (25, 26). Dynorphin release can shut down the SEEKING system or decrease its activity (25). Depression then represents an enhanced risk of developing addiction (**Figure 2**).

The negative reinforcement hypothesis (9), also known as the dark side of addiction (38, 39), has been proposed as a powerful

source of motivation to use drugs compulsively. Withdrawal causes a negative affective state characterized by the release of corticotropin-releasing factor (CRF) and dynorphin. The user then SEEKs relief from anxious and painful feelings by using the drug. However, this proposal excludes the existence of a negative reinforcement before the use of drugs. When a person has been exposed to the extreme or ambivalent conditions of trauma, there is a previous difficulty in experiencing rewards related to various factors, including those associated with social instincts and SEEKING. This may cause a self-medication attempt (40, 41) that may result in addiction. The negative affective states derived from the repeated use of drugs add to the previous unpleasurable feelings that motivated using the drug initially. As tolerance, craving and abstinence increase in intensity, the PFC is left with fewer resources to stop using drugs, to acknowledge the problem and hence to look for treatment options (13).

In terms of the social instincts, the person exposed to the extreme or ambivalent separation-distress trauma will experience difficulties in their relationships with others. Johnson (65–68) has extensively worked on an opioid-tone model that hypothesizes a correlation between opioid tone and proximity to others. If a person feels lonely, their opioid tone is low and can be modulated by the company of others. Protracted PANIC/GRIEF activations because of separation-distress trauma translate into psychic pain (25) that could cease with appropriate connectedness to others. However, people who experience protracted separation-distress trauma frequently experience problems with trust, fearing to be repeatedly hurt. Avoiding negative feelings is instinctive; using drugs can briefly ease the pain derived from the different formats of separation distress trauma. Specifically, an attempt to modulate opioid tone by neurochemical manipulation may indicate hopelessness and depression. Trauma causes FEAR and RAGE, which, in combination with PANIC/GRIEF, result in enhanced unpleasurable feelings that have an influence one on the other. A neurochemical cascade characterized by the increased release of CRF (25, 27) and simultaneous decreased MOR activity and increased KOR activity, along with other neurochemical neuromodulators is common in depression (23, 25, 26). This neurochemical configuration matches some of the negative reinforcement features described by (38) related to the dark side of addiction. Further investigation of the neurochemical correlates of separation-distress trauma may enhance the chances of designing targeted prevention strategies against addiction.

According to the separation-distress trauma hypothesis, compulsive users of drugs are not predominantly SEEKING pleasure, but relief from negative affective experiences derived from social difficulties. Some of them may engage in using opioid drugs with the goal of directly changing their feelings of loneliness, separation distress and psychic pain, i.e., to target the protracted activation of the PANIC/GRIEF system. Considering that the decision to use certain types of drugs comes from the subjective modifications of conscious states, it is not possible, in many cases, to suppose that users are aware of the neurochemical background state of their nervous system, or of the molecular properties of their preferred drugs. A fundamental hypothesis is that they select them according to the subjective experience that accompanies intoxication. They can be considered "wild psychiatrists" (20) who run spontaneous empirical testing of different drugs, doses, frequencies, and combinations (37) expecting to feel different; this elaborates on Khantzian's self-medication hypothesis (40, 41). The question then is why some users who suffer from separation distress trauma may prefer drugs that directly or indirectly affect the SEEKING system. No simple answer can be attempted.

One speculative and insufficient answer is that a group of drug users fear the effects of opioid drugs and decide not to try them. However, based on the empirical self-medication hypothesis (40, 41), some may try which relates to the social nature of human beings and its association with the opioid-tone model proposed by Johnson (66). The basic instinct to attach is necessary to survive and is partly modulated by the EOS (23). Opioid drugs cause subjective effects that can be split into two main categories. The first one includes pleasure, analgesia and sedation. The second category entails the modulation of the need for proximity to others (66). High opioid tone contributes to the subjective feeling that the person does not need to relate to others as can be seen in Autism Spectrum Disorder (ASD) (65). This feeling may cause the pleasurable idea of self-sufficiency, which would apparently solve the problem of failed trust derived from early childhood separation-distress trauma. Once the effects of the drug expire, the user is reminded of how dependent they are on the drug and on the people that they get it from. The previous problem with relationships persists and the effects of opioid drugs turn into a grievous illusion of alleviating the pain derived from a PANIC/GRIEF protracted activation. The self-locking nature of addiction attempts to eliminate the basic need of attachment, ensuring the persistence of a negative subjective experience that worsens because of the dark side of addiction (38, 39). The user strives to cease unpleasant feelings by using drugs. The negative affect as an indicator of unmet needs (30, 50) does not cease until specific problems are solved. Unpleasant affects become the conscious reminder of our need to take action to solve problems and meet our needs to survive. People who use drugs neurochemically manipulate the indications of negative affects because they have failed at solving their problems. A child who suffers from the extreme or ambivalent contexts that cause chronic depression can hardly change their environment and social context; they cannot trust others and automatize deficient relationship patterns that entail constant frustration of their attachment needs that result, not in repression as suggested by Solms, but in an enhanced conscious state of negative affect that becomes unbearable. What the chemical manipulation of SEEKING brings is not pleasure or reward, it is hope and positive expectation (23). Protracted feelings of depression entail hopelessness, which is associated with decreased SEEKING dopamine activity. The inability to find a solution to meet the basic need of attachment leads to the hypothesis that using addictive drugs can be understood as an attempt to survive. Without increased activity of the SEEKING system, no search of connectedness will take place.

We are then left with the conundrum of why addiction becomes a self-locking illness that gives scarce opportunity

to help, or otherwise said, why addiction is an illness against life (10). A part of the social support that people ill with addiction need is that clinicians understand this call for help despite the enhanced difficulties that a self-locking illness poses.

The Treatment of Addiction: Revisiting the Self-Locking Nature of Addiction

The current models of treatment for addiction have been thoughtfully designed and cover its many dimensions from a multidisciplinary perspective. Yet, known by many clinicians, addiction still represents an enormous challenge as the outcomes of the different models are frequently not sufficient. The self-locking characteristics of addiction emphasize the need for better prevention programs, but that task has also faced defying difficulties. The treatment of addiction has largely benefited from recent neurobiological findings and from experience. It can be asserted that pertinent steps have been adopted. When a model of treatment seems to be good, but the distinctive characteristics of the disease show that more is necessary, looking into details may result helpful. Hence, this section does not intend to offer novel steps to follow, but to provide qualitative content to complement the different formats of treatment. Addiction is an illness guided by affect. A deeper understanding of the role that social instincts play before and during addiction may contribute to how the treatment is conducted.

When the Treatment Fails

As previously described, the first difficulty is that people ill with addiction consider the need for treatment. Denying the existence of a problem leads to the idea that no help is needed. Drug-dependent people know that they have problems in several dimensions, including their health and their quality of life (9, 14) but they cannot accept it as it entails a change that seems impossible. Furthermore, repeated use of addictive drugs leads to dysfunction of the orbito-frontal cortex via the striato-thalamo-orbitofrontal circuit involved with drive and compulsive behaviors (13) that add to an impairment of self-awareness (69). Too many factors add up to impede the search for treatment; that is the primary concern about the self-locking nature of addiction.

Social support is considered a major contributor to the treatment of addiction (4), and it may play an important role in the format of an intervention. The person ill with addiction is then aware that they are important to a group of people, which many times becomes a key motivator to accept the problem and the treatment. However, the person may be unconvinced and oppose several steps of their treatment, hence they do not commit. Many drug users feel at risk when they are told that they should stop using addictive substances. Their everyday life may predominantly revolve around planning to use drugs, using them and recovering from their effects (9, 70). The idea of abstinence triggers anxiety coupled with craving and withdrawal, and in many cases with the negative affect that existed before addiction. The person may then abandon the treatment and relapse. A new cycle is necessary in these cases, sometimes repeating several times without success. Few users try again until they succeed. The risk in every attempt is that they may stop looking for help and become convinced that they cannot be treated. They may feel locked in their illness while suffering the negative consequences it involves.

The next challenge for those who stay in treatment is to keep the outcome. Volkow (4) has described addiction as a chronic brain disease which entails a constant effort to avoid relapse. PFC inhibition functions are needed to regulate the persistent craving triggered by many internal and external stimuli. Cognitive-behavioral treatments have proved useful in identifying stimuli and to generate more efficient strategies to cope with them. However, a powerful internal stimulus is the factor that motivated the compulsive drug use, i.e., depression (20, 37). Taking drugs may have helped to relieve temporarily the chronic negative affect related to separation-distress traumas, but the protracted need for a reliable caregiver remains unsolved. Hence, the negative affect endures becoming a relevant threat for relapse. Social support is less likely to be accepted in these cases. This is a major concern as people provide the treatment. If the person ill with addiction cannot trust others, they cannot trust the treatment and resist against it (47).

Templates of Social Relationships: the Pathology of Secondary Process Affects

Addiction is a chronic illness that requires long-term treatment. Different modalities address specific aspects of the disease to detox and rehabilitate. Abstinence is one of the primary goals and medications that tackle different symptoms based on neurobiological data are helpful. Withdrawal, craving, anxiety, and sleep disorders are examples of symptoms that can improve with the help of pharmacological agents (4). Nevertheless, the treatment should consider that the person ill with addiction has a subjective experience of the different stages of the disease. Consider the long time it took to acknowledge that neurological patients could benefit from psychotherapy additional to their neurorehabilitation treatment (71). The addicted person is a special case of a neurological patient as their brain has been modified because of the use of drugs and to the damage that they cause. It has taken too long to integrate the neurobiological, behavioral, psychiatric, and subjective aspects of the disease and particularly to treat the feeling experience associated with an acquired brain pathology (55). The problems that people had before using drugs combine with the problems that addiction brings. An instance is the case of anxiety which is present in many drug users. While they initially tried to reduce its intensity, using drugs in fact increases anxiety with the engagement of the brain's stress system that includes the bed nucleus of the stria terminalis, the central medial amygdala, and the posterior shell of the NAcc (3, 33, 38). The many brain modifications that addiction entails determine higher intensity of negative affects.

Addiction begins as an attempt to change a subjective affective state. The modification of the mesolimbic dopamine pathway indicates it is a pathology that involves drives and instincts (17).

TABLE 1 | Comparison between the ideal predominant social instincts and in depression for the different types of relationships.

Type of relationship	Ideal predominant social instinct	In depression
With primary caregiver	Attachment to avoid PANIC/GRIEF	Attachment to avoid PANIC/GRIEF
With peers	PLAY	Attachment to avoid PANIC/GRIEF
Couple	LUST	Attachment to avoid PANIC/GRIEF
With offspring and helpless others	CARE	Attachment to avoid PANIC/GRIEF

There is a loss of will that results in repeating the same self-aggressive behaviors that are associated with internal and external stimuli. Repetition enhances the cycle of addiction, locking the person in social isolation, which increases the vulnerability to addiction. Drug users try to stimulate their SEEKING activity because of the loss of hope (20).

The need for others is instinctive. If a person cannot trust people because of separation-distress trauma, they live in the contradiction of needing others while rejecting them. Psychoanalysis has described this impossible type of relationship as narcissistic (42, 72), anaclitic (43, 44), or allergic (73) just to mention a few proposals. The frustration derived from this paradoxical type of relationship leads to enhanced RAGE that becomes a learned pattern of connecting with others and is stored in procedural and emotional memory systems. Psychoanalytic treatments are based on the understanding of the transference and the countertransference. The narcissistic features of the relationship patterns do not benefit from the classical interpretations of psychoanalytic technique (74). To interpret a symptom, a symbol based on a false connection should be present (46). This is not the case of addiction; thus, a proper psychoanalysis is not indicated. However, a neuropsychoanalytic perspective (67, 75) may become valuable to work with the unconscious patterns of relationship that characterize the transference-countertransference relationship.

A Neuropsychoanalytic Assessment of Affect and the Social Instincts

The person ill with addiction needs to accept social support in order to be treated. Drugs instigate social isolation and people close to the person may become exhausted after many failed attempts to help. The person locks themselves gradually losing interest in the external world. In brief, that is the impact of protracted PANIC/GRIEF on SEEKING (25). To attempt a reunion with others, SEEKING must be active. The hypothesis is that people who use addictive drugs may develop an illness of the most basic of all basic emotion systems, namely SEEKING. All pro-social emotional instincts depend on SEEKING, i.e., PLAY, CARE and LUST, as well as the need to attach and to avoid separation distress (PANIC/GRIEF) (17). From the subjective point of view, stimulating the SEEKING system means feeling hopeful about solving the protracted separation-distress trauma. An analysis of the different dimensions of affect, that includes the subjective nature of affect, behavioral responses, cognitive ideas about feelings and the neurobiological correlates of affects, can be helpful (45). An extended version of that assessment is proposed here.

Considering that depression originates from the experience of loss, an analysis of the person's relationships with others may be useful in identifying the main primary social instinct involved. The predominant primary process affects that should be involved in different types of relationships against the ones present in depression are drafted in **Table 1**. A person whose fundamental relationship with the caregiver has adopted one of the two formats of separation-distress traumas may compromise the rest of the social instincts. Panksepp (19) noted that other types of relationships depend on a secure base. As seen in **Table 1**, when that basic instinct of attachment is not fulfilled, the rest of the social instincts fail as the person SEEKs for the primary caregiver in peers, couple and even in their offspring. Pathological relationships with others can be observed when a predominant instinct is placed in the wrong type of connection. The other social instincts then remain unsatisfied, too. A detailed analysis can help to assess individual cases to identify the quality of the pathology of relationship patterns that belong to procedural emotional memories. These patterns take the form of a repetition compulsion (76) because of the lack of an appropriate repertoire of options to solve social needs. The automatized repeated behavior ensures that no solution is found. As negative affects become chronic, the person becomes more vulnerable to addiction. Analyzing how these features work in each case will provide information to design a personalized treatment.

Several psychoanalytic psychotherapies have emphasized the work with the transference and countertransference to examine patterns of social or object relations [e.g., (74, 77)]. Some of them attempt to use interpretation and some other have modified the technique in various ways. However, no matter the technique, the secondary process associations learned by the procedural and emotional memory systems cannot be forgotten (51). From an evolutionary perspective, it could be hypothesized that traumatic experiences are robust associations that serve the purpose of predicting similar circumstances to avoid future analogous experiences. An interpretation cannot break a relevant association of this type, as they are robust to enhance the chances of survival. The problem is that the pattern generalizes to other stimuli, in this case reacting with the same response regardless of the type of relationship (see **Table 1**). The joy of PLAY, the satisfaction of CARE and the potential establishment of sexual love through LUST are partially deprived, causing a feeling of disappointment and frustration of the different types of relationships.

Treating the pathology of relationship patterns based on an understanding of social instinct deprivation is a challenging task that depends on the general assessment of damage caused by drug use. However, it is here suggested that a technique based on regulating affect with the help of the therapist may provide the person with a conscious experience of what it feels

TABLE 2 | A neuropsychoanalytic assessment of the different dimensions of addiction.

Dimension of addiction	Analysis
Affect	Which subjective state is modified? Which drugs are used to modify affect?
General assessment of brain modifications	Cortical – PFC Subcortical
Cognitive ideas	Report of thoughts
Unconscious patterns of social relations	Repetition compulsion

like to be with the therapist in different situations. Following (74, 78), the satisfied need of feeling safe with the therapist may reduce the basic fault or the feelings of an essential depression (79). These techniques do not use the classical psychoanalytic interpretation but feeling the context or environment of the session and to provide the caregiving function that was missing. A neuropsychoanalytic psychotherapy may help to understand affective procedural patterns thoroughly. As those cannot be modified, new patterns can be experienced in a long-term treatment in which the therapist favors the feeling of reliability and CARE. The latter might guide the person to select new relationships or to change old ones based on the experience of a safe and predictable therapeutic relationship. Although tertiary process resources are always helpful, no cognitive thinking is required for this type of learning. The feeling of protracted separation distress is predicted to linger despite this kind of strategy, which also holds the reality principle that should address that the protracted PANIC/GRIEF activation will probably find no resonance in others who are not the primary caregiver. A process of mourning is proposed to cope with the derived frustration and potential protracted reaction of RAGE that would reinforce the depressive behaviors of self-aggression (20).

In sum, all the regular resources used to treat addiction require that the patient trust the team in charge of the treatment. Without this condition, the expected positive outcome of the treatment may be unlikely. On the neurobiological side, recent findings support the development of new molecules that help with craving, withdrawal, and binging behaviors (4). The more detailed the data, the more targets can be tackled. Reducing the intensity of the negative affect associated with those symptoms can support the work of different formats of psychotherapy. Group therapy directly promotes social support in its various formats. CBT helps to keep abstinence and to create strategies to better cope with triggers of drug use. However, a neuropsychoanalytic technique seems ideal for identifying unconscious associative learning, including that of social secondary process emotions. Models that integrate data related to behaviors, symptoms, subjectivity and neurobiological aspects may guide our current efforts to treat addiction to better outcomes (see **Table 2**).

DISCUSSION

Using drugs entails the risk of developing addiction. The principle behind trying different substances relates to trying to change an affective state. Affective neuroscience distinguishes the activation of three basic emotion systems that generate unpleasant feelings: FEAR, RAGE and PANIC/GRIEF. These, along with decreased activity of the SEEKING, CARE, LUST and PLAY systems, may represent a depressive syndrome that translates into neurochemical cascades (25) that can be manipulated either by medications or by psychotoxic drugs. Treating addiction represents an enhanced challenge when it is acknowledged that the symptoms of the disease are secondary to a previous compromise to experience regular rewards. People with antecedents of protracted PANIC/GRIEF activation are more likely to develop psychopathology; addiction is an enhanced risk in these cases. Recognizing the subjective experience of addiction may add quality to the already suitable models of treatment. Social support is a crucial aspect for the treatment, therefore its complexity should be better understood. The neurochemical stimulation of the SEEKING system relates to the expectation of a reward, suggesting that addiction is an illness in search of hope against chronic unpleasant feelings that may originate in the experience of separation-distress trauma. SEEKING is the prerequisite to establish connectedness with others. Our social instincts help us survive. The treatment of addiction should consider an integrative model of the several dimensions involved in order to improve the outcome. Addiction means learning to live with a chronic disease that represents an increased difficulty against the regular social conflicts of life. One of the most challenging issues related to addiction is its self-locking nature, that prompts two essential concerns. The first is that no treatment is looked for because of PFC impairments and denial. The second is that separation distress trauma may contribute to social isolation; when the use of drugs causes addiction, the self-locking characteristic of addiction contributes to enhanced social isolation. The treatment relies on social connectedness, starting with intervention strategies to accepting the help of doctors, therapists and peers. Trusting others may become one of the major challenges. Understanding the different instinctive social needs emphasizes the need for an integrative approach that considers neurobiological, symptomatic, behavioral, and subjective aspects. Neuropsychoanalysis is a strong candidate to take on the challenge.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

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

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BRIEF RESEARCH REPORT
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Initial Validation and Findings From the Willing/Ready Subscale of the Church Addiction Response Scale

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Addiction has been a global health crisis over recent decades and worsened substantially during COVID-19 lockdowns. We report on the development, validation, and findings from an instrument developed to assess the readiness of churches in the Appalachian Highlands to address addiction. The Church Addiction Response Scale (CARS) is a 41-item, three section measure assessing "What are your views about addiction?" (14 items), "What are your views about interacting with people who are addicted to drugs?" (11 items), and "What do you think the church's role is in addressing addiction?" (16 items). The CARS was found to be unidimensional with strong internal consistency and initial evidence of construct validity was positive. Most respondents reported willingness to assist people living with addiction, but many reported that they felt underprepared, thus were not ready. Areas of preparation were largely those that could be addressed through training, such as understanding the physiology and psychology of addiction, available treatment options, and how to avoid doing harm. Thus, with adequate training, the likelihood of equipping a church-based workforce to provide support for people living with addiction seems attainable.

Keywords: church readiness, religion and health research, addiction, measurement, church mobilization, substance use disorder

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INTRODUCTION

An alarm is being sounded across the nation about the ravages of addiction to substances and increasingly communities of faith are the target of that call (Davis, 2018; Stetzer, 2018; Worthington, 2018). According to the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention [CDC], 2017) the rate of deaths from overdose in the United States (U.S.) was five times higher in 2016 than in 1999 and has increased dramatically during the time of COVID-19 lockdowns. Many states report overdose death rate increases of over 30% compared to 2019, with the annual overdose death rate already exceeding any previous year. In the 12 months ending November 2020, which included the first 6 months of the COVID-19 pandemic, the number of overdose deaths was over 93,000, exceeding the highest previous 12-month period by 20,000

(Centers for Disease Control and Prevention [CDC], 2021). In the counties in which the current study was conducted, the overdose death rate ranged from 30 to 50/100 K, which exceeds the national rate (28.7/100 K; National Opinion Research Center [NORC], n.d.). Tennessee ranks 3rd in the nation for opioid prescribing with a regional rate of 112 per 100 people (Brantley, 2019). Those numbers are decreasing for opioids prescribed for pain, however, opioids prescribed for addiction treatment have risen steadily, are often diverted, and are responsible for over 80% of neonatal abstinence syndrome (NAS), also known as neonatal opioid withdrawal syndrome (NOWS), in infants born in this region (Olsen, 2020). Problematic use of substances is not limited to opioids, or to the United States, however. Just prior to the pandemic, the United Nations Office on Drugs and Crime (United Nations Office on Drugs and Crime [UNODC], 2020) report that over 35 million people worldwide are classified as having drug use disorders, up more than 30% since 2009. This report includes monitoring of opioids, cocaine, cannabis, amphetamine-type stimulants such a methamphetamine, and new psychoactive substances (NPS).

The cost of this epidemic extends beyond multi-billion-dollar economic costs to deeply personal costs to millions of Americans, their families, and communities (U.S. Department of Health and Human Services, n.d.). There is a growing recognition that faith-based organizations can play constructive roles in response to public health issues (Idler et al., 2019). Communities and churches are being challenged to respond constructively to the opioid crisis, but are they responding? The purpose of this research is to describe the readiness of churches in the Appalachian Highlands to address not only the opioid crisis, but problematic use of any substance.

Research has shown that intensive behavioral treatment (close monitoring, accountability) is quite effective in reducing use of many addictive substances (Substance Abuse and Mental Health Services Administration [SAMHSA], 2018). Even with this understanding, the staffing needs are too great to offer the level of needed support through paid personnel. Having a large volunteer workforce, such as equipped churchgoers, can help to meet this need (Stahler et al., 2007; Kerley et al., 2010; Stacer and Roberts, 2018; Glazier, 2020). The faith community can offer behavioral support (building coping skills, changing thought patterns, accountability) and social support to reduce the desire to self-medicate (dealing with past adversity through supportive relationships). Pillion (2017), a State House delegate from nearby Dickenson County, Virginia, stated, "*. . .churches and ministries have a unique role in this important conversation and efforts to assist individuals and families in need. The power in being part of a loving community that helps take away the stigma of addiction cannot be underestimated. People are hungry for a place to feel welcome, supported, and loved*."

Within the metro area in which data were collected, there were just over 500,000 people, of which over 266,000 identified as religious, with the vast majority identifying as Evangelical Christians (The Association of Religion Data Archives [ARDA], 2010). The Pew Research Center (2019) has found that nationwide approximately 54% of individuals identifying as religious are active in church, so if that proportion were applied to this area, over 144,000 would be predicted to attend a church of some kind. Even a small proportion of this could be a beneficial workforce to care for people living with problematic substance use and its sequelae. But are these potential volunteers ready and willing?

Church-based health promoting programs have repeatedly been shown to be successful (e.g., DeHaven et al., 2004; Newlin et al., 2012; Baruth et al., 2013). For example, Epstein et al. (2007, 2009) demonstrated positive outcomes in a randomized controlled trial of substance abuse prevention educational program for school age children, however, they reported the churches' response to participation in the study was disappointing. Such programs can only be helpful to the extent that churches implement them.

Stigma toward substance users is one potential explanation for low church engagement. In the general population, not churches specifically, the tendency to stigmatize differs by substance (Brown, 2015) and is greater toward those who are seen as resistant to changing their drug use behavior or who display low levels of willpower (Witte et al., 2019). Previous research has pointed out that congregational readiness to address addiction is predicted by experience with addictions, attitudes toward learning more about addiction and recovery, perceptions of being able to provide a supportive environment, and perceived willingness and ability to engage with someone living with addiction (Travis et al., 2012). Travis et al. (2012) noted significant readiness deficiencies within churches. Before implementing programs seeking to address the readiness deficiencies noted by Travis et al. (2012) information is needed regarding the specific readiness needs of churches.

A federal planning grant funded a regional effort to mobilize the faith community in the Appalachian Highlands to address addiction. One of the funding requirements was to conduct a needs assessment. A survey, the *Church Addiction Response Scale* (CARS), was developed as part of this needs assessment and it and its initial findings are the focus of the remainder of this article. The CARS is a self-report survey assessing three content domains, (1) *views about addiction*, (2) *views about interacting with people who are addicted to substances*, and (3) *views about the church's role in addressing addiction*. We are reporting on preliminary validation efforts and initial findings for the CARS, focusing on churchgoer *willingness* and *readiness* to support people living with addictions or other problematic substance use.

MATERIALS AND METHODS

Participants

Ethical review and approval was not required for this study as determined by the Institutional Review Board at East Tennessee State University. Written informed consent from the participants was not required to participate in this study in accordance with national legislation and institutional requirements. The 288 respondents (age 18–78 years; mean = 32.75, *SD* = 17.49; 194 female) who indicated they were involved in a church served as the sample for this study. Paper copies of the CARS were collected from participants (n = 16) at area interest meetings

held by a non-profit organization that is seeking to mobilize the faith community to address addiction. An online version was available to undergraduate college students at a local university ($n = 272$).

Measures

The Church Addiction Response Scale

The CARS is a 41-item, three section measure assessing "What are your views about addiction?" (14 items), "What are your views about interacting with people who are addicted to drugs?" (11 items), and "What do you think the church's role is in addressing addiction?" (16 items) (see **Table 1**). All items are rated on a 5-point Likert scale (1 = *strongly agree* to 5 = *strongly disagree)*. Participants were given the following instructions prior to survey completion:

This survey asks questions about your opinions on addiction and substance misuse. For this survey substance misuse is defined as repeated use of drugs or alcohol to feel good, reduce stress, and/or change or avoid reality. Substances include but are not limited to the following: alcohol, illegal substances and/or misuse of prescription drugs including use of prescription drugs in ways other than they were prescribed or use of someone else's prescription medication.

The first section assessed the individual's views of addiction, such as whether they believe it is a medical issue, whether they believe people could stop using drugs if they wanted to, whether treatment is believed to be effective, and other general views of addiction. The remaining two sections assessed aspects of willingness and readiness. The second section assessed the individual, such as whether someone would be willing to help, or whether they would be afraid. The third section assessed the person's perception of the church as ready or willing, such as asking whether church funds should be spent on addressing addiction. The latter two scales were combined into a 27-item *Willing/Ready Subscale* (mean = 110.89, *SD* = 12.79) that is being validated as a measure of church willingness/readiness to address addiction.

Statistical Analysis Plan

Exploratory factor analysis (EFA) was conducted to determine whether factors were present. Items that were negatively related to the full measure were reverse scored so that lower item and total scores would indicate more willingness/readiness. In order to assess initial convergent validity with measures of both willingness and readiness to address addiction, the total of all items (except the item with which it was being correlated) was correlated with each of two items, one indicating willingness and one indicating readiness. The item that said, "I want to help someone who is trying to overcome addiction any way I can," was used as a proxy for willingness. The item that said, "Our church is already doing things to help people who are addicted to drugs" was used as a proxy for church readiness. Descriptive statistics were calculated for total score on the *Willing/Ready Subscale*. Finally, independent *t*-tests were run on all items comparing means for the group.

RESULTS

Initial Church Addiction Response Scale Validation

Exploratory factor analysis indicated that a one-factor solution was most parsimonious. Ten items that were negatively related to the full scale during EFA were reverse scored so that on all items and the total score, lower scores indicated greater willingness or readiness. Alternatively, high scores could be interpreted as hesitancy to enter this work. Internal consistency of the measure was high ($\alpha = 0.88$) and was not significantly changed with removal of any item. To investigate convergent validity with measures of both willingness and readiness to address addiction, the total of all items except the item with which it was being correlated was correlated with each proxy item. The item that said, "I want to help someone who is trying to overcome addiction any way I can," indicating willingness, was strongly positively correlated with the total of the remaining items ($r = 0.50$, $p < 0.001$). The item that said, "Our church is already doing things to help people who are addicted to drugs," indicating readiness, was also strongly positively correlated with the total of the remaining items ($r = 0.42$, $p < 0.001$). An item from the first section of the CARS was used as an additional indicator of convergent validity. The total on the *Willing/Ready Subscale* was strongly positively correlated ($r = 0.53$, $p < 0.001$) with the item that stated, "Money spent helping people who are trying to overcome addiction is money well spent. Taken together, there is initial support for the *Willing/Ready Subscale* from the CARS to be used to predict willingness and readiness of churchgoers to address addiction.

Initial Church Addiction Response Scale Willing/Ready Subscale Findings

Overall, most (>88%) respondents reported they would help someone living with addiction anyway they can, and 71.6% reported they thought the people in their church would be willing to learn to help. Other positive findings were that a vast majority (88%) thought that money spent on helping people with addiction is money well spent, and 90.5% would be willing to administer Narcan if trained. Additionally, almost everyone (97.1%) understood that past experiences can contribute to addiction. However, more than a quarter (27.2%) felt their church does not know what to do and over 30% felt that they might do something wrong.

Some areas indicating a need for training were identified with this survey as well. There was variation in what respondents believe about addiction, with some believing it is a medical issue that should only be handled medically (68.1%), some believing substitution medications should never be used (37.1%), and a small percentage believing treatment is ineffective (17.6%). Item means and standard deviations are included in **Table 1**. Also, 51.8% thought that people just need to "muster up enough willpower to stop" using substances, and 43.6% believe people can stop using substances if they really want to. Although willing to help for the most part, people did express concern about people living with addiction getting things dirty (25.5%), making

TABLE 1 | Church Addiction Response Scale (1 = strongly agree to 5 = strongly disagree) overall means with group differences between online vs. in-person administration noted.

Item	Mean	SD
Section 1. Views of addiction		
God CAN take away someone's addiction.	1.93**	1.22
If someone repents and prays honestly, God WILL ALWAYS take away their addiction.	3.19	1.40
Addiction is genetic/physical, so treatment can't really help.	4.17	1.05
Someone who is addicted to substances could stop if they really wanted to.	3.14**	1.35
Past experiences can drive someone to misuse substances.	1.34	0.59
I would be embarrassed to tell someone that I or a loved one was struggling with addiction.	2.82	1.40
Addiction is a medical issue so it should be treated medically.	2.26*	1.13
Addiction treatment isn't very effective.	3.62**	1.04
People who are addicted to substances should stop using them completely and not take substitutes.	2.97	1.28
People should be allowed to die of overdoses.	4.38***	1.11
People who are addicted to substances are valuable.	1.36***	0.80
People need to muster up enough willpower not to use substances.	2.80***	1.26
Money spent helping people who are trying to overcome addiction is money well spent.	1.70	0.88
Addiction should be handled by professionals.	1.67**	0.88
Section 2. Views of interacting with people addicted to drugs		
I want to model to my loved ones that it is good to help someone who is addicted to substances.	1.45	0.71
I might do something wrong or make things worse if I try to help someone who is addicted to substances.	3.22	1.12
I'm afraid I might be injured or catch a disease if I try to help people who are addicted to substances.	4.06	1.11
It's too hard emotionally to help people who are addicted to substances.	3.38	1.17
It's too expensive to try to help people who are addicted to substances.	3.74***	1.16
I want to help someone who is trying to overcome addiction any way I can.	1.69***	0.80
I don't want to be an enabler so I shouldn't help people who are addicted to substances.	3.88*	1.13
God judges people who are addicted to substances, so I shouldn't be soft on them.	4.59	0.83
God loves people who are addicted to substances, so I should too.	1.19	0.64
If someone had overdosed, I would be willing to administer naloxone (Narcan) to try to save them if I was trained.	1.32	0.71
If someone I knew was addicted to substances, I would stay away from them.	3.97***	1.07
All people are struggling with something, so I should be able to empathize with people who are addicted to substances.	1.55***	0.79
Section 3. Church role in addressing addiction		
People in our church are willing to learn how to help people who are addicted to substances.	1.99	1.03
The church doesn't know how to deal with addiction and might do something wrong or make things worse.	3.39	1.16
Our church is too poor to be able to do anything worthwhile to help people who are addicted to substances.	4.27	0.99
The church should be a place for someone who is addicted to substances to seek help.	1.32	0.67
People who are addicted to substances might damage the church (break things, steal things, get things dirty).	3.57	1.16
If people who are addicted to substances come into our church or religious services, it will make people nervous.	3.25	1.18
Since it's the sick who need a physician, we should help people who are addicted to substances.	1.73**	0.91
Church funds should not be wasted on helping people who are addicted to substances.	4.42	0.79
If a church helps people who are addicted to substances, they will become dependent and keep wanting things.	3.69*	1.02
Churches should welcome people who are addicted to substances as they would anyone else.	1.21	0.56
Our church is already doing things to help people who are addicted to substances.	2.35*	1.13
I would fear for my family's safety if people who are addicted to substances came to church.	4.21	1.07
If we allow people who are addicted to substances to be a part of our church, we will be perceived as being soft on sin.	4.48	0.90
If people who are addicted to substances go to a church, they may get more people in the church addicted.	4.45	0.97
Our church is too busy with other activities to minister to people who are addicted to substances.	4.42	0.92

Italicized items were included in the Willing/Ready Subscale. Bold items were used as proxy for convergent validity investigation. Asterisks indicate questions on which groups differed significantly. All differences indicated that the paper group was more knowledgeable and more ready/willing ($p < 0.05$, **$p < 0.01$, ***$p < 0.001$).*

people nervous (36.0%), fearing for their family's safety (11.2%), worrying that additional church members will become addicted (6.1%), and being concerned that they might be personally injured (15.9%).

Although there were large differences in group size (16 in-person, 272 online), we investigated group differences between the in-person group who attended interest meetings about church mobilization to address addiction and the online,

younger, primarily college student group, controlling for unequal variances when necessary. Significant differences were found for several items (*p*s ranged from <0.001 to 0.013), and where differences were found, the in-person responses were universally more favorable toward helping people living with addiction (e.g., addicted people are valuable, I want to help, it's [not] too expensive to help, people should [not] be allowed to die of overdoses; see **Table 1**). The online group was more likely to view addiction as a medical issue [$t(286) = 2.50$, $p = 0.013$] but was more likely than the paper group to believe that treatment was ineffective [$t(286) = 2.75$, $p = 0.005$].

DISCUSSION

Initial validation of the *Willing/Ready Subscale* of the *Church Addiction Response Scale* is quite promising. Further validation through establishing convergent and discriminant validity and test-retest reliability are warranted, but in this initial validation, tested psychometric properties (e.g., internal consistency, validity) were found to be well-supported and respondents identified barriers to readiness that can be practically overcome.

It would be difficult to overcome barriers related to values, for example, if respondents had said they were not willing to help or did not find people living with addiction worthy of help. However, most of the barriers to readiness revealed by this instrument can be overcome through training regarding the science of addiction including likely origins of addiction and treatment options, as well as interaction with people who are addicted to substances. Both instilling an understanding about origins of addiction such as having a history of adverse childhood experiences (ACEs) (Felitti et al., 1998) and interacting with people who live with addictions both have been shown to reduce stigma at least sometimes (Corrigan and Nieweglowski, 2019; Sattler et al., 2021).

In the Appalachian Highlands, churches are plentiful, and a large proportion of the population attends church. Within these church walls is a potentially large volunteer workforce who could be mobilized to assist in addressing the problem of problematic substance use. According to this study, there seems to be strong support for churches being an appropriate place for addressing substance use. For the most part, respondents seemed to value the use of church funds and time to address addiction. Areas of mixed response primarily fell in four categories: (1) being unsure about the origins of and physiological aspects of addiction, (2) personal discomfort about danger, damage, and nervousness about interacting with people who differ (i.e., stigma), (3) lack of knowledge about how addiction should be treated, and (4) differing degrees of understanding about how the tenets of the Christian faith support care for people living with problematic substance use. It was apparent that those who were already involved in such work or who attended gatherings to investigate this work were more ready and willing than the general (and younger) churchgoing population.

Areas of training that could address some of the areas of expressed need include: (1) physical processes related to development of, continuation of, and treatment of addiction, (2) psychological processes related to development of, continuation of, and treatment of addiction, (3) pharmacological and non-pharmacological treatment options for addiction, (4) risk factors predictive of developing problematic substance use, such as poverty and ACEs, (5) how tenets of the Christian faith relate to understanding and caring for individuals who are addicted to substances, (6) what challenges are faced by people who live with addiction, and (7) ways to assist with those challenges. In addition, the needs assessment noted the greatest workforce shortages/gaps in helping with substance use problems included emotional/social support for people living with addiction and lack of transportation and housing. Providing training in the identified areas of need could move churchgoers from being willing and/or ready to help with these problems of substance use to active engagement with people with problematic substance use, thus facilitating healing.

Providing assistance to churchgoers as churches develop programs that meet some of the expressed practical needs of community members living with addiction (e.g., transportation, housing, job readiness) will give churchgoers opportunities to enhance treatment and recovery access. Equipping churches will deepen the commitment of churchgoers to invest time and resources into addressing addiction and may help to reduce the stigma toward individuals with problematic substance use histories.

One exemplar of a successful approach to expanding the volunteer workforce to address substance use concerns has been pilot tested by a non-profit organization called Uplift Appalachia, the developers of this instrument (Clements and Clements, 2020). Their approach included equipping a number of churchgoers within the targeted communities who became intrinsically motivated to physically, emotionally, and spiritually support people who were addicted to substances. Uplift Appalachia helped members of the volunteer workforce and people living with problematic substance use to gain a better understanding of scientifically supported mechanisms of addiction and addiction treatment, and then provided programs to enhance support while meeting practical needs. Uplift Appalachia determined the biggest practical need of individuals living with addiction was transportation to access treatment. The shortage of treatment options in rural areas places barriers on patients who must travel farther to access medication assisted treatment (MAT) and, in some cases, have to rely on friends or family for transportation (Rosenblum et al., 2011; Pullen and Oser, 2014; Sigmon, 2014). Given the mountainous terrain, travel is often time-consuming and costly. Many who live with substance use issues have lost driving privileges and/or cannot afford a vehicle or fuel. Although some services are provided online because of COVID-19, limited access to technology, limited skill using that technology, and limited broadband access can prevent access. Volunteers trained by Uplift Appalachia are able to better support people living with addiction and help the people living with addiction better understand their illness. Pilot data from a small church-based volunteer rideshare program confirmed that riders maintained sobriety and employment during the

period in which they were receiving free transportation. The riders also expressed feelings of connection after receiving regular rides from volunteer drivers. Drivers reported feeling helpful and feeling less stigma toward recovering substance users. A more sophisticated study to investigate effects of this model is warranted as the original study did not have a control group comparison. The enhanced understanding about addiction and its origins, the development of relationships, and the meeting of practical needs through transportation are hypothesized to reduce the demand for substances among individuals who are addicted to them. Additionally, as churches become motivated to be a workforce, they may be mobilized more quickly if they are provided implementable programs such as this. We believe implementation of a church-based transportation program can help to improve access to treatment and recovery for people who live with addiction while building supportive relationships, thus meeting two documented needs (access and support).

In conclusion, this instrument seems to be a helpful tool for gauging readiness and willingness of the faith community to support individuals with problematic substance use. To date, most of the barriers to action identified revolve around a need for further training about addiction, rather than a perception that the work is unimportant, or that the people are not valued. Pilot testing of a church-based rideshare program has shown that churchgoers can be trained and engaged in efforts to care for people living with addiction. Having prepared programming may facilitate engagement in this work.

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 East Tennessee State University Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

AC was PI of the funded project during which church readiness data were collected, outlined the article, conducting statistical analyses, and wrote much of the methods and results. NC contributed to choosing the direction of the article, and collaborated on validation efforts, conducted analyses, and contributed to the literature collection and writing. DW was instrumental in assessing clarity for a healthcare audience, edited wording, suggested needed literature, edited both body and references, and participated in brainstorming meetings throughout. BM was involved in the initial needs assessment discussion, has conducted parallel qualitative research in this same region, contributed to the literature collection and writing, and checked the accuracy of religious and cultural descriptions, both locally and generally. All authors were part of a research group who are focused on church mobilization to address addiction.

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Using Trauma Informed Principles in Health Communication: Improving Faith/Science/Clinical Collaboration to Address Addiction

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Problematic substance use is a pressing global health problem, and dissemination and implementation of accurate health information regarding prevention, treatment, and recovery are vital. In many nations, especially the US, many people are involved in religious groups or faith communities, and this offers a potential route to positively affect health through health information dissemination in communities that may have limited health resources. Health information related to addiction will be used as the backdrop issue for this discussion, but many health arenas could be substituted. This article evaluates the utility of commonly used health communication theories for communicating health information about addiction in religious settings and identifies their shortcomings. A lack of trusting, equally contributing, bidirectional collaboration among representatives of the clinical/scientific community and religious/faith communities in the development and dissemination of health information is identified as a potential impediment to effectiveness. The Substance Abuse and Mental Health Services Administration's (SAMHSA) tenets of trauma-informed practice, although developed for one-on-one use with those who have experienced trauma or adversity, are presented as a much more broadly applicable framework to improve communication between groups such as organizations or communities. As an example, we focus on health communication within, with, and through religious groups and particularly within churches.

Keywords: health communication, faith-based health programming, trauma-informed approach, health information dissemination, faith and science, addiction, substance use and misuse

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INTRODUCTION

In cities and towns throughout the United States, people gather together in religious services. In fact, there are approximately 384,000 congregations of various denominations throughout the United States (Brauer, 2017). In Christian denominations alone, there are roughly 167 million people who may gather together in any given week (Pew Research Center, 2019). Within

congregations, people attend for various purposes, some for worship, others to socialize, some for information sharing about their own lives as well as community, national, and global issues, and some because of a desire to enhance flourishing for themselves and others.

Since churchgoers are familiar with information sharing within their congregations, have a natural connection to their communities, and profess commitments to bodily health and flourishing, then disseminating health information to and through churches is sometimes seen as a valuable approach for reaching communities (Brewer and Williams, 2019; Idler et al., 2019). Such dissemination efforts have been on display during the COVID-19 pandemic through a variety of initiatives such as church-based vaccine clinics (Federal Emergency Management Association [FEMA], 2021) and efforts to persuade faith leaders to promote health information about COVID-19 (Abdul-Mutakabbir et al., 2021). There are many areas predating the pandemic in which the clinical/scientific community has sought to disseminate information through churches, such as in the arena of addiction prevention, treatment, and recovery (The Partnership Center, n.d.; Tennessee Department of Mental Health and Substance Abuse Services, 2021). Yet, these initiatives have met with limited success. The present models for health communication may be limited in their efficacy in these communities given their unidirectional approach *from* the clinical/scientific community *to* the faith community. Through an examination of the literature on health information dissemination in churches (Blevins et al., 2019) and the implicit communication theories which guide these practices, we propose an approach that may improve collaboration between the clinical/scientific community and the faith community, focusing on addiction while recognizing applications extend to many health conditions of interest.

Such collaboration would build off existing commitments and practices within faith communities. In the National Congregation Survey conducted in 2019, 33.2% of congregations reported having health-related programming within their churches (Chaves et al., 2020). Within these health programs there are variations in efficacy and structure. Two common and contrasting structures of health programs are faith-based and faith-placed approaches (DeHaven et al., 2004; Joseph et al., 2017; Baptiste-Roberts et al., 2021). Faith-based programs are health programs specifically designed with the faith communities' values and beliefs in mind (DeHaven et al., 2004; Stewart, 2016; Johnston et al., 2018). Many faith-based programs have been developed to address various health concerns, such as described by Schwingel and Gálvez (2016) who implemented a behavioral life-style change program in a Latino church community that was taught by *promotoras*, church lay health advisors, who added bible readings and teachings relevant to the program. In contrast, faith-placed programs are health programs developed by outside sources and implemented "as is" (Stewart, 2016), for example, health screening implemented in churches (Lynch et al., 2020) or educational materials developed and implemented by health professionals in churches (Miller and Mars, 2020).

Faith-placed approaches, those without input from or modification to fit the faith community, continue to be used by health organizations to disseminate health information to and through churches, but are sometimes poorly received (Cochrane et al., 2014; Blevins et al., 2019; Tshiswaka et al., 2021). It is easy to see why such approaches are attractive to health organizations. They seem to offer widespread dissemination of carefully crafted and controlled health information by groups trusted in the local community. While some faith-placed strategies are effective, such as stroke education programs conducted within a church (Tshiswaka et al., 2021), health communication that is not informed by, or differs with, the church's faith beliefs may be less effective (Blevins et al., 2019). Faith-placed strategies face certain limitations that faith-based programs, developed in collaboration with the communities they are intended to serve, do not. For example, faith-placed information, such as pamphlets, developed by health professionals may or may not be understood by the churchgoers, sometimes due to educational levels (Williams et al., 2019). Alternately, churchgoers may understand the material, but disagree on religious grounds or even be offended by the information at times as happened when the human papilloma virus (HPV) vaccine was first introduced (Touyz and Touyz, 2013). Lastly, churchgoers may not trust the source of the information due to previous experiences with an outside organization or general mistrust of the medical community (Jaiswal and Halkitis, 2019). In short, faith-placed approaches may be limited in their efficacy due to the limited emphasis placed on facilitating trust, ensuring congruence between materials and the churchgoers' faith beliefs, and creating a process to ensure the members of the faith community understand the materials. There are topics on which it may be difficult or even impossible to align the views of particular faith communities and certain practices within the health sciences, from Jehovah's Witnesses opposition to receiving blood transfusions (Crowe and DeSimone, 2019) to several Christian denominations opposing physician-assisted suicide (JW.org, 2021). These topics tend to amplify the chasm between science and faith and make communication challenging. However, these differences do not need to be seen as barriers to communication but opportunities to find common ground (Idler et al., 2019). When discussing potentially controversial topics, such as sex, the tenets of the faith community's beliefs will impact how they receive information. For example, a faith community may feel that abstinence must be emphasized as a part of sex-education. For that reason, information about the HPV vaccine, HIV, STIs, and sex-education would need to non-judgmentally acknowledge that faith communities' beliefs about abstinence as part of the framework in which the information is presented. Faith-based interventions should begin with identifying and recognizing the importance of these beliefs and the influence they may have on churchgoers in health decision-making. Without such acknowledgment of the faith community's beliefs, health communication on these controversial topics will likely be compromised.

When discussing addiction treatment, clinical views often stand in some tension with those of many faith communities. For example, recent messaging around addiction seems designed to reject some efforts to make moral sense of substance use issues. The widely promoted phrasing, "Addiction is a chronic relapsing brain disease, NOT a moral failing" (paraphrased from multiple

sources such as Leshner, 1997; Substance Abuse and Mental Health Services Administration [SAMHSA], 2018; MacKillop, 2020), sets up a dichotomy between solely physical views of addiction and perspectives that attempt to make room for moral agency and responsibility. While this phrase likely stems from well-intentioned and often-needed efforts to reduce stigma, such efforts do not need to assume that medical and moral/theological accounts of addiction are in conflict. These efforts to reduce stigma may find better success by aligning messages and enhancing collaboration. Many people of faith would say that both disease and moral agency must be considered in most issues related to health, including addiction (Rise and Halkjelsvik, 2019). Finding areas of alignment and collaboration begins with listening well and working to build trust in both directions.

Unfortunately, trust can be difficult to come by. The clinical community may believe that the church is not a reliable site for information dissemination or material distribution. They may see churchgoers as closeminded, uneducated, or uninformed. For example, in a qualitative study of 34 teams of faith community leaders and health community leaders, some community leaders noted that faith-based organizations "lack credibility" in disseminating health information (Kegler et al., 2010, p. 673). Some scientists believe that religious beliefs are not based in verifiable facts and therefore are less valuable than scientific information (Ecklund et al., 2011, 2016), perhaps leading to a less collaborative approach to dissemination of information in church settings. And while at times this skepticism may be warranted, its prominence in the medical community can prevent the recognition of possibilities for constructive collaboration. In 2019, a special issue section of the *American Journal of Public Health* (AJPH) explored faith/public health partnerships as a way to disseminate health information (Idler et al., 2019). By examining specific case studies and interventions, the articles and commentaries built a case for why faith communities should be taken seriously as potentially constructive collaborators. However, while the AJPH special issue sought to highlight the value that faith communities can play as vehicles for public health efforts, there was little attention to the bidirectional nature of full-fledged partnerships. Further focus on the give and take natural to trusting, robust collaborations is needed, and within that focus questions of the nature of health communication arise.

Recognizing the potential contributions religious communities might make in addressing public health crises and the need for bidirectional partnerships as part of such efforts, this article examines the health communication theories that often are at play within such collaborations. After analyzing why these approaches may have limited success in faith settings, we will propose a new approach to health communication that should enhance collaboration between clinical/scientific and faith communities, with an eye toward application to concerns surrounding addiction.

Health Communication Theories

Utilization of effective health communication strategies has been touted as essential to the health outcomes of a community (Schillinger et al., 2020) including those related to addiction, yet theorists differ as to what is the best health communication strategy. We have chosen to present an overview of the two most commonly cited health communication theories, the Health Belief model (Rosenstock et al., 1988) and the Transtheoretical Model (Prochaska and Velicer, 1997). Then we will introduce a third model, Kleinman's Theory of Explanatory Models (1978), which addresses some of the shortcomings of the others. Each of the theories will be explored specifically in relation to promoting health communication within churches. Finally, we will propose that a trauma-informed perspective offers a better perspective to guide health communication in partnership with faith communities.

The Health Belief Model

The Health Belief Model was developed in the early days of the United States Public Health Service in the 1950s to address ongoing issues with individual compliance to health interventions (Rosenstock et al., 1988). The model consists of four key constructs: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. These constructs are believed to influence an individual to engage in a behavior to prevent a health disease or condition (Rosenstock et al., 1988). In short, an individual must feel that they are susceptible to a disease or condition, that the disease or condition could be severe, that there are benefits to preventing the disease or condition, and that the benefits of health behavior change outweigh the barriers (Rosenstock et al., 1988). The theory posits that a *trigger* or cue to action, either internal (e.g., chest pains, shortness of breath) or external (e.g., advice of a family member or doctor), can motivate a new behavior due to the fact that a trigger will either increase or decrease perceived susceptibility, perceived severity, perceived benefits, or perceived barriers (Rosenstock et al., 1988). It is important to note that modifying factors such as demographics (e.g., age, education), sociopsychological factors (e.g., social class, personality), and structural factors (e.g., disease knowledge) also exert influence on health decision making.

When applying this theory, the clinical community seeks to initiate an external trigger to change behavior. This could be through sharing information about risky substance use or by identifying and addressing factors that may be barriers to change such as lack of knowledge about addiction treatment options (Rosenstock et al., 1988; Healthy People 2030 et al., 2021). According to Rosenstock et al. (1988), identification of the barrier should lead to education about the desired behavior and eventual behavior change. The strength of this model comes from its ability to focus on factors that may be preventing health behavior change (Rosenstock et al., 1988). However, critics argue that application of the model in practice is challenging due to the number of barriers that may influence the health behavior and choosing which is most significant to address (Jones et al., 2015). The Health Belief Model assumes stable health beliefs and tends to be provider focused. This deemphasis of the patients' perspectives limits the understanding of their intention to perform a health behavior, which often involve motivators unrelated to health (Schwarzer, 2001).

Health organizations have drawn from the Health Belief Model in their efforts to disseminate health information in

churches. They typically do so by choosing a health behavior and providing church-based education on that behavior (e.g., Martinez et al., 2016; White, 2018). This has often been in the form of *faith-placed* programming, which has the problems listed above, particularly the potential for distrust of the health messengers and possible incongruence between health materials and churchgoers' faith beliefs. In these approaches, the attention to barriers described in the Health Belief Model generally narrows to a focus on education through one-way communication from the clinical community to the faith community. The cited deemphasis on the patient, or in this case, on the faith community, perspective, not only reduces the tailoring of the message to the audience, but misses a chance for collaborative trust building.

The Transtheoretical Model

Another well-known theory, the Transtheoretical Model (Prochaska and Velicer, 1997), attempts to remedy many of the stated criticisms of the Health Belief Model in ways that have important implications for engagements with faith communities. Rather than focusing on group-level dissemination of prepared health material, The Transtheoretical Model focuses more on individual-level change. It posits that individuals go through six stages (Precontemplation, Contemplation, Preparation, Action, Maintenance, and Termination) when choosing whether to change a health behavior (Prochaska and Velicer, 1997). Through discussion, a person is challenged by a trusted coach to move to the next stage through presentation of health material, under the assumption that the person will gradually be convinced to move toward behavior change in a stage-like fashion. This theory has yielded some success at achieving change in culturally diverse samples (Callaghan et al., 2005); however, critics state that the attempt to utilize stages does not consider the complexity of humans and human behavior (Adams and White, 2005; Brug et al., 2005).

Some of the success of the Transtheoretical Model is likely due to the dialogue and established trust between provider and patient and the autonomy of the patient to move at their own pace. However, though the patient has some autonomy over how quickly to move through the stages, the target of that movement is determined by the healthcare provider (e.g., smoking cessation is the goal, everyone should be vaccinated), thus is often provider driven and one-sided in content as was seen in the Health Belief Model. The stages of the Transtheoretical Model could be applied to work with an organization such as a church rather than with an individual; however, it still suffers from the criticism of one-way communication from the clinical/scientific community to the faith community.

Churches, which are often at the center of community life, present numerous opportunities for disseminating health information, thus it is important to find the best method for that dissemination. Both of these theories have been utilized frequently in public health interventions but suffer from limitations. They flow unidirectionally, limiting interaction between interventionists and the community itself. Buy-in from the community is essential in order to have an effective health intervention (Idler et al., 2019), thus an approach with more bidirectional input is indicated.

Kleinman's Theory of Explanatory Models

Anthropologist and psychiatrist Kleinman (1978) sought to overcome unidirectional models of doctor patient interaction through the concept of the Theory of Explanatory Models. While this theory is focused on doctor-patient interactions, it could be used as a framework to inform communication between two communities (clinical/scientific and faith) rather than two individuals, and we will review it as such. Kleinman argued that both physicians and patients are influenced by culturally informed explanatory models which guide their understanding and treatment of illnesses. Kleinman recognized that patients' explanatory models were influenced by personal, cultural, and social meaning ascribed to illness and recommended asking eight questions to elicit the patient's explanatory model: 1. What do you call the problem? 2. What do you think has caused the problem? 3. Why do you think it started when it did? 4. What do you think the sickness does? How does it work? 5. How severe is the sickness? Will it have a long or a short course? 6. What kind of treatment do you think the patient should receive? 7. What are the chief problems the sickness has caused? 8. What do you fear most about the sickness? (McSweeney et al., 1997). Comparing the physicians' and patients' explanatory models was thought to illuminate discrepancies that existed and could then be discussed or "negotiated" with patients (Kleinman, 1978, p. 257). Understanding the differences between the patient and practitioner explanatory models provided a mechanism for conversations that, according to Kleinman, could attempt to "educate the patient" if the patient's model was different than the physician's (p. 257).

Since its inception, Kleinman's theory has been expanded to look at both health and illness (McSweeney et al., 1997). The importance of negotiating with patients is emphasized rather than simply recommending educating patients about differences in health care providers' and patients' explanatory models (McSweeney et al., 1997; Kleinman and Benson, 2006). This negotiation should result in the patient feeling heard, thus valued, and should allow intervention to be better tailored to the specific situation. That value and tailoring should increase buy-in. Kleinman and Benson (2006) noted that explanatory models provide clinicians with the opportunity to walk alongside patients rather than elevating clinical/scientific understanding as superior. In a study by Daack-Hirsch and Gamboa (2010), Kleinman's theory was used to describe the alignment of beliefs about cleft lip/cleft palate between healthcare workers and working people in the Philippines. Piven et al. (2008) studied the explanatory models about depression held by certified nursing assistants' in nursing homes and compared their models to mood screening and diagnostic criteria for depression. In both of these studies, exploring explanatory models provided structure within which to consider how differences in illness beliefs may influence health communication between care providers and patients. Explanatory models are not static explanations within an entire culture, necessarily, rather they are changing and fluid because they include not

TABLE 1 | SAMHSA's six key principles of a trauma-informed approach applied to health communication.

Key principle	SAMHSA description focused on trauma*	Broad application for church/healthcare communication
Safety	Seek to ensure physical, emotional, and relational safety as defined by the person	Views can be expressed by all parties without fear of judgment. Collaborators are seen as allies.
Trustworthiness and transparency	Operations are conducted and decisions are made with transparency with the goal of building and maintaining trust	Clinical/scientific community and faith community members openly discuss views and seek to build trust through understanding each other's perspectives. Domain specific knowledge is acknowledged.
Peer support	People with lived experience with adversity contribute to planning and provide mutual support	People with lived experience within the faith community and those with lived experience in the clinical/scientific community contribute to planning and provide mutual support
Collaboration and mutuality	Power differences are leveled and individuals work collaboratively	Members of the clinical/scientific community and faith community should work to place themselves and the other group on a level playing field. Acknowledge differing views, but do not let them become barriers. Find commonalities.
Empowerment, voice, and choice	Strengths should be capitalized on, individuals should be heard and helped to use their voices, and should be given choices, and those choices should be honored.	Members of the clinical/scientific community and the faith community should be heard and strengths of each point of view should be capitalized on. As health communication endeavors are developed, churches should have a voice in what is said and a choice in what to adopt.
Cultural, historical, and gender issues	It should be understood that a person's culture, their own history, their culture's history, and issues related to gender influence many things about them. This should not be written off or downplayed, but used as a way to better understand the person.	The clinical/scientific community should seek to understand the culture, history, and particular people and perspectives of the faith community, and the faith community should seek to understand the culture, history, and particular people and perspectives of the clinical/scientific community.

**Adapted from Substance Abuse, and Mental Health Services Administration [SAMHSA], 2014, (10–11).*

only social and cultural beliefs, but also individuals' and communities' understanding of past experiences, knowledge, and their interplay (McSweeney et al., 1997). Kleinman and Benson (2006) noted explanatory models should be more like ethnography, truly emphasizing relationships and engagement with people to have the opportunity to hear their explanatory model and then moving forward together.

Kleinman's theory does provide a communication theory that could facilitate dialogue between the clinical community and the faith community. By recognizing that churches have their own explanatory models with beliefs, norms, and values that may be very different from those of the clinical community, the need for collaboration when health information is disseminated within churches is paramount. In fact, each diverse religion, each religious group, each church, each member of each church, each branch of the clinical/scientific community, and each member of the clinical/scientific community will also have their own personal explanatory models. Such differences press the need for careful, charitable, and sustained dialogue.

Attention to articulating explanatory models and negotiating between those that differ gets us closer to the collaboration we believe is vital for accurate health information dissemination to and through faith communities, but in some cases, it still falls short. First, Kleinman's theory tends to be focused on communication with an individual rather than a group, and we are proposing to equip large and diverse groups with valid health information, requiring an expanded focus beyond one on one communication. Second, although the patient's beliefs are taken into consideration, it is unclear whether Kleinman provides for the possibility that the message itself could be altered by the perspective of the hearer, or just that the route of communicating the message would be altered. Often the healthcare provider still controls the goal of the message and simply seeks to understand how to deliver what is believed to be scientifically sound in a way that motivates the hearer to follow their guidance. In most instances we found, health *messaging* was modified by understanding the explanatory model of the faith community (Blevins et al., 2019), but the ultimate goal of that messaging usually was driven by the healthcare community. This is superior to messaging without consideration of the hearer's explanatory model, but in the case of communication between the clinical/scientific community and the faith community, our hope is that collaboration will occur such that not only the delivery of the information is altered, but that perspectives of the faith community are incorporated into the message itself, as appropriate, within a genuine collaboration.

Trauma-Informed Perspective for Communication

We would like to propose a different approach to communication within churches involving the repurposing of what has come to be known as trauma-informed care, trauma-informed practice, or trauma-informed principles (Substance Abuse, and Mental Health Services Administration [SAMHSA], 2014). Trauma-informed principles were initially developed to guide one-on-one interactions between healthcare or social service providers and individuals who have experienced trauma, abuse, or adversity. This paradigm has not previously been applied to general health communication or to organization-level communication to our knowledge. We contend that trauma-informed principles, which we outline below, can and should be used much more broadly than originally intended. This breadth can include one-on-one use with anyone regardless of trauma history as well as more macro-level, organization to organization or community to community communication as we recommend here. We believe that trauma-informed principles

address the shortcomings of prior health communication theories and may facilitate truly collaborative health messaging in faith communities. A trauma-informed perspective, like the Theory of Explanatory Models and the Transtheoretical Model, has been used as a way to facilitate communication between individuals and has also been used to create a culture within one organization to facilitate such interpersonal communication. We believe its tenets (e.g., empathy, open-mindedness, seeking to understand another's perspective, not forcing one's own agenda) can also be used at a more macro level to facilitate communication and collaboration between organizations and communities. It does so in a way that addresses several of the issues we noted above with the other three models.

We feel that it is important to introduce the origin of this theoretical framework, admitting the term trauma, though central to the theory's origin, can be distracting and sometimes off putting. We ask the reader to refrain from focusing too closely on the term "trauma," as we propose our broader view of this theory. A trauma-informed perspective is equated with viewing people, all people, through a lens of empathy, lack of judgment, and open-mindedly seeking their input into what they need (Substance Abuse, and Mental Health Services Administration [SAMHSA], 2014). The theory was initially developed in response to findings from the Adverse Childhood Experiences Study (ACEs) (Felitti et al., 1998; Substance Abuse, and Mental Health Services Administration [SAMHSA], 2014), emphasizing the importance of understanding that many people have experienced traumatic events, and that those experiences shape and explain poor behavior choices and ongoing health issues. Substance Abuse, and Mental Health Services Administration [SAMHSA], 2014 recommended what was then coined a *trauma-informed approach* as a type of universal precaution that included three E's (i.e., Events can be traumatic, someone's Experience of the event is most important, long-term Effects can be caused by the experience), four R's (i.e., *Realize* widespread trauma, *Recognize* signs and symptoms indicating past trauma, *Respond* appropriately, *Resist* re-traumatization), and six principles. Those six principles of a trauma-informed approach will be presented as a framework for enhanced health communication within churches and are described in **Table 1**.

While trauma-informed principles originated from research on interacting with individuals with trauma histories, we believe those tenets are applicable to communication much more generally and at the organization level. We propose that both fields involved in church-based health communication (e.g., church, clinical/scientific community) practicing the tenants of a trauma-informed perspective is the best way to enhance communication of, perceived value of, and dissemination of heath information in and through the church. Those tenets include empathizing with the other's perspective, finding and utilizing strengths, and being collaborative and non-judgmental. Idler et al. (2019), in their introduction to an *American Journal of Public Health* special issue section regarding faith/public health collaboration, posited some best practices for communication between public health agencies and faith communities that nicely parallel trauma-informed practice. They included taking a ground-up, strengths identifying, listening approach with a goal of empowering stakeholders; respecting each organization's domain expertise in collaborations; seeing faith leaders as allies (we expand this to recommend all individuals in one field see those in the other field as allies); recognizing ideological differences but not allowing them to become barriers to finding common goals; and maintaining long-term collaborations that can be activated when crises arise. Beyond these areas of overlap and resonance with Idler et al. (2019), trauma-informed principles would push even further to call for genuine empathetic dialogue and negotiation between clinical and faith communities.

Substance Abuse, and Mental Health Services Administration [SAMHSA] (2014) six principles appear to cover fairly isolated domains at first glance, however, when combined, can foster open, non-judgmental communication. How might this look in preparing health communication materials and programs for dissemination to and through the faith community? Individuals who are seeking to disseminate such materials should work with members of the faith community, seeking to understand their beliefs regarding the health behavior of interest in an open-minded, non-judgmental way. Trusted individuals who understand both the science and the tenets of the faith should be in such conversations, serving as liaisons between the groups. Facilitators may be needed to coach groups on the trauma-informed perspective to encourage open-mindedness, address power differentials, and offer reframing and rephrasing to prevent misunderstandings.

Ideally, members of the faith community and the clinical/scientific community will feel safe and heard, trust will be built between them, and messages and messaging can be developed through collaboration. The greatest hurdles we anticipate will be that some in the clinical/scientific community will be hesitant to open-mindedly explore the validity of faith perspectives that may stand in tension with commonly held public health perspectives, or they may struggle to understand that many faith communities both value health *and* prioritize other goods as well, rather than solely prioritizing the health and comfort of themselves or others. We do not propose that the clinical/scientific community must embrace or even believe all of the tenets of the faith community. Likewise, we do not expect the faith community to embrace all of the tenets of the clinical/scientific community. What we hope is that members of the faith community can be equipped with scientifically accurate knowledge and that scientifically accurate knowledge can be explored using the faith community's frameworks of belief.

DISCUSSION

The kind of open-minded collaboration between the faith and clinical/scientific community we are suggesting must always be negotiated considering the particularities of these communities in each local environment. When this is done, health promoting

messages and messaging can be created in ways that (1) align with the tenets of the faith, (2) are understandable to the faith community, and (3) that the faith community values. Such efforts will require commitment from individuals who are well versed in both clinical/scientific information *and* the tenets of the faith community through which materials are to be disseminated. To most effectively facilitate two-way communication, those bridge-builders with knowledge of clinical/scientific information and faith tenets and others involved in the health communication process need to be familiar with trauma-informed principles. This faith community alignment and buy-in should vastly improve health information dissemination.

Although our proposed ideas about enhancing health communication within churches is broadly applicable to many health conditions from COVID-19 vaccination to diabetes education, a trauma-informed approach to health communication related to addiction may be the impetus needed to begin to mobilize the faith community to partner with the clinical/scientific community to address the current large-scale addiction problem. So far, the efforts by either group alone to reduce deaths from addiction or lower the number of babies with neonatal abstinence syndrome have fallen short, but true collaboration in a respectful, equal partnership may start a movement that could turn the tide and change the world.

AUTHOR CONTRIBUTIONS

AC was central to formulating the direction of this article and the need for it, wrote most of the section on trauma-informed practice, and edited in light of her work in faith community mobilization to address addiction. NC was involved in initial framing of this article and wrote several drafts with much input from AC. DW was involved in initial framing of this article and contributed to and edited several early drafts with NC. BH gathered information on health communication theories and summarized them, read, and edited the health communication theory section. BM edited drafts of the original article, contributed several sources, and reframed content. He was instrumental in connecting theories and served as a theology expert. All authors contributed to the article and approved the submitted version.

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METHODS
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Developing a mHealth Routine Outcome Monitoring and Feedback App ("SMART Track") to Support Self-Management of Addictive Behaviours

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Background: Routine outcome monitoring (ROM) has been implemented across a range of addiction treatment services, settings and organisations. Mutual support groups are a notable exception. Innovative solutions are needed. SMART Track is a purpose built smartphone app designed to capture ROM data and provide tailored feedback to adults attending Australian SMART Recovery groups for addictive behaviour(s).

Objective: Details regarding the formative stage of app development is essential, but often neglected. Improved consideration of the end-user is vital for curtailing app attrition and enhancing engagement. This paper provides a pragmatic example of how principles embedded in published frameworks can be operationalised to address these priorities during the design and development of the SMART Track app.

Methods: Three published frameworks for creating digital health technologies ("Person-Based Approach," "BIT" Model and IDEAS framework) were integrated and applied across two stages of research to inform the development, design and content of SMART Track. These frameworks were chosen to ensure that SMART Track was informed by the needs and preferences of the end-user ("Person-Based"); best practise recommendations for mHealth development ("BIT" Model) and a collaborative, iterative development process between the multi-disciplinary research team, app developers and end-users (IDEAS framework).

Results: Stage one of the research process generated in-depth knowledge to inform app development, including a comprehensive set of aims (clinical, research/organisation,

and usage); clear articulation of the target behaviour (self-monitoring of recovery related behaviours and experiences); relevant theory (self-determination and social control); appropriate behavioural strategies (e.g., behaviour change taxonomy and process motivators) and key factors that may influence engagement (e.g., transparency, relevance and trust). These findings were synthesised into guiding principles that were applied during stage two in an iterative approach to app design, content and development.

Conclusions: This paper contributes new knowledge on important person-centred and theoretical considerations that underpin a novel ROM and feedback app for people with addictive behaviour(s). Although person-centred design and best-practise recommendations were employed, further research is needed to determine whether this leads to improved usage outcomes.

Clinical Trial Registration: Pilot Trial: http://anzctr.org.au/Trial/Registration/TrialReview.aspx?id=377336.

Keywords: addiction, SMART recovery, routine outcome monitoring, mHealth, person-based approach, behavioral intervention technology

INTRODUCTION

Routine Outcome Monitoring (ROM), or the systematic, repeated assessment of client progress throughout treatment (1), is an integral component of evidence-based healthcare for a range of chronic conditions (2), including addictive behaviours (3, 4). Traditionally, ROM has been performed using clinician-rated instruments (1). Over recent years, the importance of capturing the client perspective has been acknowledged (5). ROM data is important for treatment planning and quality assurance (6–9) and allows organisations to understand, evaluate and improve service delivery (9, 10). From a research perspective, ROM data provides insight into which clients receive the most benefit from services and how variations in care may impact engagement and outcomes (9).

Meta-analytic and/or systematic reviews largely report ROM has positive clinical benefits (1, 11, 12). Feedback from ROM assessments (rather than the assessment process in and of itself) may be central to these benefits (13), although further evidence is needed (14). Positive outcomes are more likely when feedback is immediate, personalised, delivered in an engaging and collaborative way and reflects change over time (13, 15). The vast majority of existing ROM approaches provide clinician feedback only (16, 17). This is unfortunate as direct client feedback may enhance the positive impact of ROM on treatment outcomes (1). Improving client involvement in the feedback process is an important clinical and research priority (18).

Various approaches to ROM have been implemented across a range of mental health (19) and addiction (20, 21) treatment services, settings and organisations. Mutual support groups are a notable exception. "Mutual support" refers to the reciprocal provision of social, emotional and informational support by group members undergoing recovery from addiction (22). Although accumulating evidence points to the importance and benefit of participating in mutual support (23–25) a major limitation in developing a strong evidence base has been the lack of systematic outcome data evaluating routine service provision. Although 12-step models are traditionally the most well-known and accessed model of mutual support (26), other approaches (e.g., SMART Recovery) are gaining momentum. SMART was originally developed as an alternative to 12-step approaches, with the major distinction being that it employs principles and strategies from cognitive behavioural therapy (CBT) and motivational interviewing [MI (27)]. Furthermore, unlike other clinically endorsed (3, 6) models of mutual support for addictive behaviours (e.g., 12-step approaches), SMART Recovery groups utilise a trained facilitator to oversee the conduct of the group. This provides a unique opportunity for encouraging ROM and feedback as a standard component of the groups.

Integration of ROM and feedback into clinical services is not without challenges (28, 29). Factors that can undermine engagement with ROM and feedback include the "time burden" associated with completing, scoring, interpreting or discussing outcome assessments (28, 30). Scepticism regarding the perceived relevance of the outcome(s) assessed and/or feedback generated has also been noted (31, 32). Within addiction services, client engagement, retention and follow-up are well-documented challenges (33), therefore the introduction of ROM instruments must be brief and the turn-around of feedback rapid (13). Few of the validated tools developed to assess treatment outcome within drug and alcohol settings [e.g., Addiction Severity Index (34)], have been investigated within the context of ROM and feedback (13). The utility of these instruments for continuous monitoring and feedback is therefore unknown. Furthermore, the principles of person centred care and recovery oriented service provision (35) would suggest that ROM should be holistic and multi-dimensional (36). Given the importance of brevity, this further complicates the process of instrument selection.

The idea of using technology to track progress within healthcare settings is not new but current approaches are limited (37), and further research (38) and innovation (39, 40) is needed. Unlike other Health Information Technology approaches (e.g.,

web-based platforms), mobile health applications (mHealth apps) have the potential to offer a quick, easy, interactive and engaging platform for tracking and accessing information about health and health-related behaviours (41). As smartphone ownership and usage is commonplace (42) smartphone apps have the added benefit of engaging individuals in real-time, in everyday situations and offering moment-to-moment, tailored content and support as needed (43). Immediacy of feedback and personalisation have been identified as factors that may increase responsiveness and ongoing motivation to utilise ROM systems (44). Accordingly, the functional capabilities of a smartphone app makes it the ideal platform to administer ROM and feedback, not only for putting the client at the centre of the ROM and feedback process, but as an engaging and streamlined mechanism for providing timely and personalised feedback across time.

Recent systematic reviews of digital recovery support services (45), digital measurement feedback systems (37, 38) and addiction-related mHealth apps [e.g., (46–49)] point to the promise of utilising technology for the purposes of ROM and feedback. However, a key limitation is the ever-increasing gap between availability of mHealth apps and scientific validation (47, 50–52). It is not surprising then that an international workshop of experts in digital health identified improved evaluation of digital health technologies as a key priority for future development efforts (53). Central to this is an improved focus on theory-informed content and design (53).

Improved attention to user engagement is also warranted, as mHealth apps are characterised by high levels of attrition. According to recent figures, 66% of app users drop out after the first use and 80% drop out within the first month (54). Inadequate consideration of the needs and preferences of the end user throughout the development process has been implicated (53, 55, 56). Fortunately, there are now several frameworks (55, 57, 58) available to ensure that app development is grounded in a sound understanding of the end user; incorporates theoretically-informed and evidence based content; and employs best practise methods for app development.

Objectives and Importance

Details regarding the formative stage of mHealth development are essential (59, 60), but often neglected in published reports (53, 61). Improved consideration of the end user throughout development is vital for curtailing attrition and enhancing engagement (55, 56). Ensuring that appropriate theory is used to guide development is recommended for both mHealth apps (51, 53) and ROM and feedback systems (18, 37). This paper describes how published guidelines were used in the current study to ensure that these priorities were addressed throughout the development of a ROM and feedback mHealth app ("SMART Track") for people attending Australian SMART Recovery groups (online and/or face to face). The preliminary evaluation of this app using a pilot study with nested qualitative evaluation and economic analysis is reported separately (62, 63).

MATERIALS AND METHODS

This paper addresses development items from the CONSORT E-Health (60) and mERA (59) checklists. This study has been approved by the University of Wollongong and Illawarra Shoalhaven Local Health District (ISLHD) Health and Medical Human Research Ethics Committee (2018/099; HREC/18/WGONG/34).

Summary of Frameworks Utilised

The development of the SMART Track app was informed by three published frameworks that offer guidance on the creation of digital health technologies. Although each model can be used in isolation, we chose to combine these approaches to ensure that app development was informed by a more comprehensive set of guidelines that included foci related to the end-user [i.e., "person"; "Person-Based" (55)], best practise recommendations for mHealth development ["BIT" Model (57)] and a collaborative, iterative development process between the research team, app developers and participants [IDEAS framework (58)].

Firstly, from a person based perspective, app design, development, and content was informed by an in-depth understanding of SMART Recovery participants and the associated context/environment in which SMART Track will be used (55). Central to this approach was the conduct of preparatory qualitative work and the development of "guiding principles" which ensured that key decisions (e.g., including or rejecting app features and/or content) remained faithful to the understanding of the person, their context and the design objectives (55). Secondly, the BIT-Model represents a mechanism for improving the success with which researchers and developers are able to translate the clinical aim(s) of an intervention into an "implementable" technological solution (57). It was therefore utilised in the current study to ensure that central theoretical and technological considerations were adequately addressed. Finally, the IDEAS framework is designed to enhance the quality, relevance and likely efficacy of digital health interventions (58). It arose from a multi-disciplinary collaboration between researchers, designers and engineers and capitalises upon the strengths from each discipline by integrating behavioural theory, human-centred design and rigorous evaluation (58). Guidance pertaining to the formative stages of app development ("Integrate" and "DEsign") were employed. It is beyond the scope of the current paper to discuss these frameworks in detail. Rather, we focus on how they were used to inform the design, content and development of SMART Track.

Integrating the Person-Centred, BIT-Model and IDEAS Framework

Our approach to integrating the three frameworks in the current study is described detail in **Figure 1**, and summarised below.

Stage One: In-depth Understanding

The initial stage of development focused on generating an in-depth understanding of people (i.e., SMART Recovery participants and SMART Recovery group facilitators), theory and

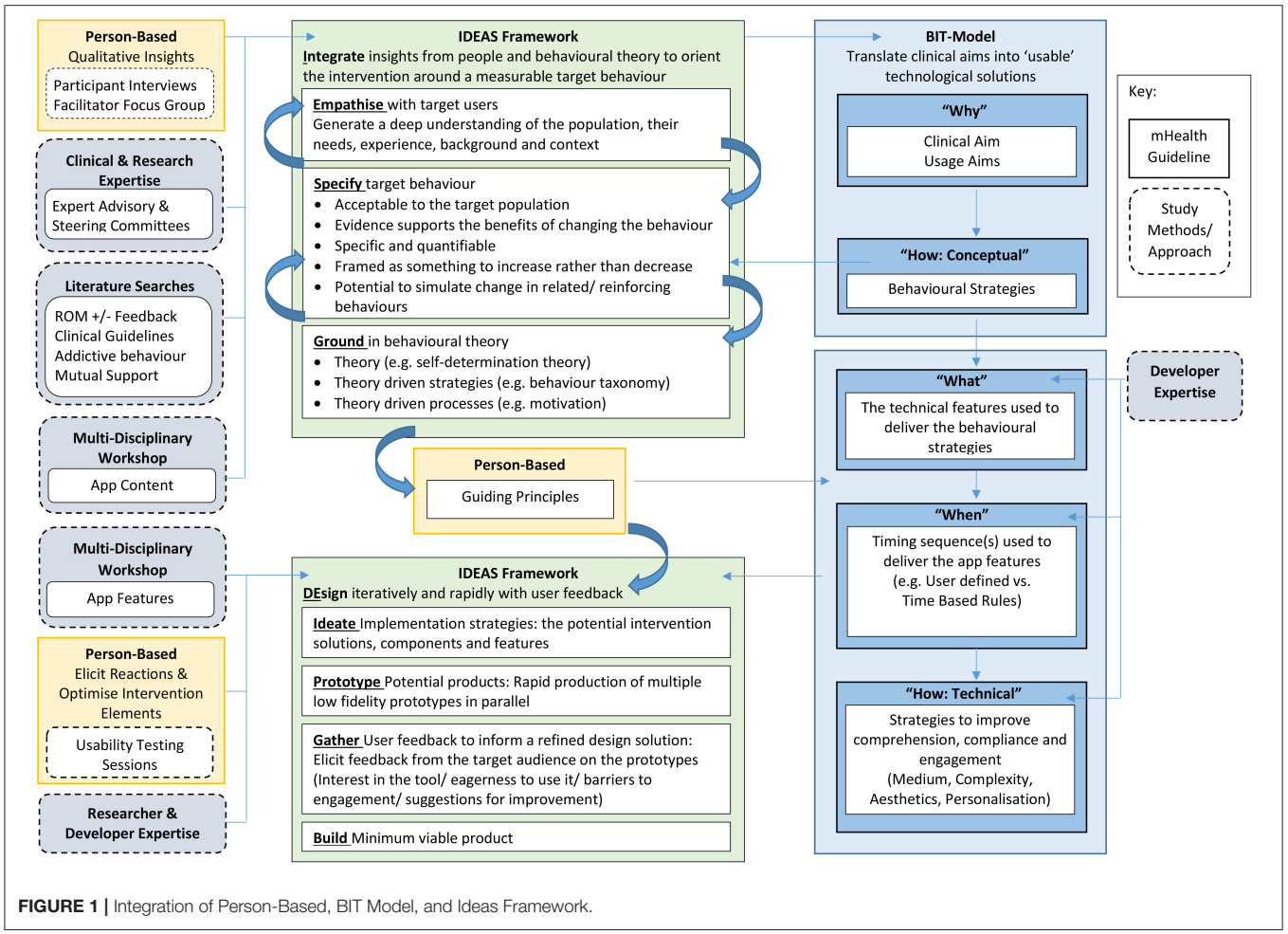


FIGURE 1 | Integration of Person-Based, BIT Model, and Ideas Framework.

behavioural strategies to guide app development. Stage one of development was informed by the guidance offered by the "Why" and "How (Conceptual)" stages of the "BIT Model" (64) and the "Integrate" phase of the IDEAS framework (58). These insights were synthesised into a set of guiding principles [person-based (55)] to inform app development, content, and design.

Procedure

The initial stage of development was an iterative process informed by: (a) qualitative feedback from SMART Recovery participants and SMART Recovery group facilitators; (b) clinical and research expertise from the expert advisory and steering committees; (c) a multi-disciplinary workshop facilitated by the customer experience agency contracted for app development and design (GHO, Sydney); and (d) key findings from the literature.

Qualitative Insights

Qualitative insights were derived via a series of 1:1 semi-structured telephone interviews with a sample of SMART Recovery participants (N = 20) and a semi-structured telephone focus group conducted with a sample of SMART Recovery group facilitators (N = 8). To allow rapid turn-around of feedback, at the end of each interview the qualitative researcher generated a brief summary of interview content (focusing on recommendations for app content, and barriers and facilitators to app use). A detailed account of the qualitative evaluation has been reported separately (65).

Clinical and Research Expertise

The expert advisory committee (n = 12) comprised researchers, clinicians, staff affiliated with SMART Recovery and/or Universities across the states of New South Wales, Queensland, and Victoria in Australia. The expert advisory committee initially met via tele/video conference fortnightly, and then monthly as the study progressed. The steering committee (n = 8) comprised members of the research team (chief investigator, principal investigator at SMART Recovery and trial-coordinator) and representatives from key health, non-government and Aboriginal Community Controlled organisations. Steering committee meetings were scheduled at least twice per year via tele/videoconference. Members of the expert advisory and steering committees also provided additional feedback via email and/or phone between meetings as needed.

Multi-Disciplinary Workshop

The multi-disciplinary workshop was facilitated by customer experience agency GHO at their Sydney office and attended by members of the development team (Executive Strategy Director, Senior UX/UI Designer, Front End Developer, Executive Creative Director, Project Manager) and expert advisory committee (researchers, clinicians and/or SMART Recovery group facilitators). Group discussion explored the objectives of the project (for the ROM and feedback tool, research team, funding body and SMART Recovery); proposed intervention features; factors that could influence engagement; and examples of how technology can be used to increase appeal/engagement with self-monitoring.

Key Findings From the Literature

The trial-coordinator in collaboration with members of the expert advisory committee regularly reviewed the published literature throughout the project to keep abreast of key findings pertaining to ROM and feedback (development, evaluation, engagement, tools, strategies, and/or content). Literature searches were pragmatic and ongoing as a systematic review of the literature was beyond the resources of the current project.

Stage Two: App Development

Stage two focused on applying the learnings from stage one (described below under results) to the design, content and development of the SMART Track app.

Procedure

Development [DEsign phase (58)] proceeded according to an iterative process informed by the outcomes from stage one; the digital user experience (UX) and creative expertise of GHO; and feedback from the research team, SMART Recovery participants and SMART Recovery group facilitators. Accordingly, the features ("what"), timing ("when"), delivery, design, and content ("how": technical) of SMART Track evolved over time in-line with feedback received.

Multi-Disciplinary Workshop

A second multi-disciplinary workshop was held to refine the proposed content and features of the ROM and feedback (based on the learnings from stage one). This workshop was again facilitated by GHO and attended by members of the development team (Senior UX/UI Designer, Front End Developer, Executive Creative Director, Project Manager) and expert advisory committee (researchers, clinicians, and/or SMART Recovery facilitators).

Prototyping and Feedback

App development was broken into three "sprints," each focusing on the design and functionality of a discrete section of the app. For each sprint, GHO used the software platforms "Sketch" to create high fidelity designs and "InVision" to present prototypes for feedback. Prototypes were presented to the research team in the first instance (via the video conferencing software "Zoom") and amended following collaborative input from GHO and the research team.

Amended prototypes were then reviewed during nine individual usability testing sessions (three sessions per "sprint"). Participants comprised a convenience sample of SMART Recovery participants ($n = 5$), SMART Recovery group facilitators ($n = 3$), and the research team ($n = 1$). Sessions were facilitated by the Senior UX/UI Designer at GHO in collaboration with the GHO Project Manager and/or Research trial-coordinator. Within each session the participant was asked to use the prototype (via Smart phone or Web), and notes were taken about how the participant interacted with the prototype (e.g., facial expressions/body language conveying confusion and/or excitement) and any comments made. Participants were given time for spontaneous use and were also prompted with various scenarios (e.g., imagine that you wanted to add a personal motivation for change—where would you go?). The prototype was then amended in line with the verbal and non-verbal feedback collected and re-presented to the research team for final discussion, feedback, amendments and sign-off.

Information Synthesis

Following the methods outlined above, stage one findings were derived from the qualitative interviews with SMART Recovery participants and the focus group with SMART Recovery group facilitators; the clinical, research and development expertise of the research team and our collaborators; and a thorough understanding of relevant literature. Information was synthesised using the following methods. Content summaries generated by the qualitative researcher were reviewed by the trial-coordinator. Information pertaining to usability and acceptability was extracted. This information was summarised alongside knowledge derived from the literature and used to facilitate team discussion pertaining to app content and features. This in turn was used to generate content for each of the key considerations detailed within the Person-Centred, BIT-Model and IDEAS Framework, which was further reviewed and discussed until consensus was reached. Stage two findings were derived from applying stage one findings to the design, development and content of the SMART Track app.

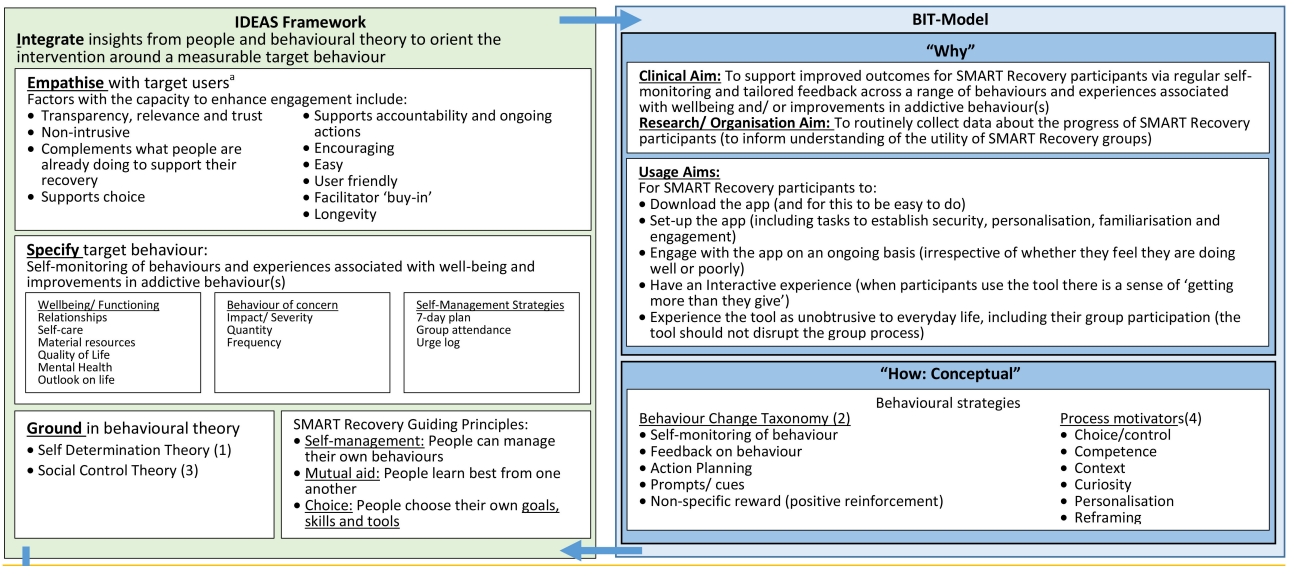
RESULTS

Stage One: In-depth Understanding

The "in-depth understanding" used to inform the development of SMART Track is described in detail in **Figure 2** and summarised below according to the relevant components of each framework. Stage one culminated with the development of a set of "guiding principles" ("person based" (55) See **Figure 2**].

BIT Model: "Why"

From a funding perspective, the project remit was to develop a ROM and feedback (i.e., self-monitoring) app. From a clinical perspective, the aim was to develop a tool that participants would experience as useful in supporting their recovery (clinical aim). If it was experienced as useful, it seemed likely that participants would be more willing to use the tool beyond the initial download (usage aims), which was important as regular participant engagement with ROM and



Person-Based

Guiding Principles

Briefly describe relevant aspects of the people who will use the app and the context	• Adults with experience of one or more addictive behaviour(s) – primarily alcohol, but may also be substance and/ or behavioural (e.g. gambling; food etc) • Attending a free, group based programme (SMART Recovery) designed to provide support (emotional/ informational/ social) an improve self-management skills • Participants strongly value this social connection, the collaborative process of helping and learning, and the process of developing skills, awareness and confidence to actively make effective changes in their life. • Participants are accustomed (and value) to the anonymity/ confidentiality that SMART recovery offers. • Attendance at SMART Recovery may be voluntary or mandated (i.e. range of extrinsic/ intrinsic motivators for attendance). • They may or may not be attending other services for addiction and/ or mental health (they may feel that their needs are met by their group). • They may have limited education and familiarity with technology (computer, apps and/ or email). • There is no 'typical' participant – considerable variation exists in ○ The type of addictive behaviour and the duration of difficulties ○ Individual recovery goal(s) (e.g. abstinence across all substances/ behaviours vs. abstinence across only the behaviour of concern vs. controlled use vs. focus on general lifestyle improvements); ○ Location (city vs. regional vs. rural) ○ How confident/ able they feel about making and/ or maintaining changes to their addictive behaviour(s). ○ Cognitive function, time, money and resources are also likely to vary according to where the individual is at in their recovery. • There is a high proportion of mental health related concerns amongst attendees (including depression, anxiety and/ or trauma experiences). • Common factors that can influence engagement in self-management include stress, impulsivity, boredom low motivation and/ or confidence

Person-Based

Key behavioural issues, needs and/ or challenges that must be addressed	Research/ Organisation Perspective: Routine outcome monitoring and feedback is common across addiction treatment and support services. However, there is currently no routine system in place for SMART Recovery participants to objectively track their progress and receive feedback. Administration via Smartphone will overcome many of the known barriers to routine progress monitoring (e.g. time associated with administration, scoring and interpretation). Person Perspective: If SMART Recovery participants are to engage in objective self-monitoring, the SmartPhone app must support what people are already doing to work on their experience of addictive behaviour(s). It needs to be something that respects participant autonomy, promotes competence and facilitates positive emotional experience and a sense of relatedness. It needs to be simple, engaging, unobtrusive and confidential.	
Design objectives and solutions	Objective	Solution
	To overcome peoples concern, fear and/ or scepticism about using technology to track their progress and receive feedback (confidentiality/ motives behind the development/ use of the tool)	• Neutral app name/ branding • Optional pin code for security • Clear information about rationale and key privacy concerns (verbal and written) • Involve facilitators in the beta testing – so they are experientially aware of what the participants will be asked to do and can provide information and/ or reassurance
	To support people to start self-monitoring key behaviours and experiences of relevance to improving wellbeing and/ or supporting change in addictive behaviours	• A smart-phone application that is easy to download, set up and use • The person is able to make some decisions about the app (to increase sense of autonomy/ personalisation/ control) • Question content is chosen to reflect a range of experiences and behaviours of importance to addiction recovery • Questions are clear and concise; rating scales and response options make sense • Feedback is clear, concise, tailored, meaningful, encouraging, immediate and can be reflected on over time
	To encourage people to continue self-monitoring key behaviours and experiences of relevance to improving wellbeing and supporting change in addictive behaviours	• A smart-phone application that fits within what people are already doing to support their addiction recovery • Can be integrated into meetings, but can be used outside of meetings as needed • Participants can set and track their progress towards personally meaningful goals (continued use reinforces helpful/ important behaviours) • App content allows participants to identify and reflect on helpful and less helpful behaviours and/ or decisions • Support participant autonomy, competence and positive emotional experience by providing feedback that is tailored, encouraging and facilitates self-reflection and self-management behaviours (graphs, self-reflection questions, recommended self-management resources) • Engaging (visually and content/ features), easy to use and navigate, unobtrusive (sense of getting more back than they put in) • Prompts/ notifications from the app and/ or facilitators to encourage participants to answer questions and review feedback

[a]A detailed description of the associated considerations for design, content and functionality is presented in supplementary Table 1

FIGURE 2 | Stage one findings used to inform app development, as a function of theoretical model.

feedback represents an important opportunity for improving understanding of participant outcomes within SMART Recovery (research/organisation aim).

IDEAS Framework: "Empathise"

Key factors with the capacity to influence participant engagement (thereby perceived utility) of the app are outlined in **Figure 2** (see also **Supplementary Table 1**). Participant feedback and research findings highlighted that trust in the app is of paramount importance. From this it was concluded that the rationale for data collection (and how data will be used, stored, and protected) must be made clear and the relevance to the individual highlighted. The development work also highlighted the importance of ensuring that the app is experienced as unobtrusive and that it both complements and reinforces what people are already doing to support their recovery (e.g., group attendance, working towards meaningful goals, self-management skills). Furthermore, it must be "easy" (to download, set up, navigate and use), user-friendly (e.g., non-stigmatising language, language that is simple, concrete, confident and helpful) and encouraging (e.g., "celebrate successes"). As SMART Recovery group facilitators are central to the conduct of groups, it became apparent that participant engagement may be compromised if the app is perceived by facilitators as unhelpful or disruptive. To support the longevity of the app, team discussions and expert input highlighted the importance of developing the app with future platforms in mind.

IDEAS Framework: "Specify"

The behaviour of interest targeted by the ROM and feedback app is regular self-assessment of progress. To enhance the perceived relevance and utility of the app to SMART Recovery participants our preparatory work demonstrated that the target content for self-assessment must be experienced by participants to be meaningful. Accordingly a range of behaviours and experiences were included to reflect the diversity of SMART Recovery participants. ROM questions were drawn from validated self-report instruments [e.g., Substance Use Recovery Evaluator (66); K-10 (67, 68); Screener for Substance and Behavioural Addictions (69)]; and as needed, wording was modified in line with participant feedback. Further details are available in the published protocol (63).

IDEAS Framework: "Ground"

To optimise the likelihood that participants would be willing to engage in regular self-assessment, this project drew from the program principles of SMART Recovery Australia (SRAU) (70) and insights from Self Determination Theory (71) and Social Control Theory (72). Specifically, we sought to ensure that the app complemented what participants were already doing to support their recovery. Accordingly, guided by the program principles of SRAU, SMART Track was developed so that it could be used alongside SMART Recovery group participation as a way of enhancing competence and confidence ("self-management"); facilitating meaningful discussion with peers ("mutual aid") and supporting individual recovery goals ("choice"). Consistent with these principles, Self-Determination Theory highlights the importance of utilising competence, positive emotional experience and autonomy to motivate desired behaviour(s) (71). Finally, drawing from Social Control Theory, as connexion with others motivates "desirable" behaviour [e.g., via modelling and accountability (72)] we also sought to include features that would support connexion with and learning from others (e.g., lived experience storeys and prompts for participants to discuss their feedback at their SMART Recovery group).

BIT Model: "How (Conceptual)"

The preparatory work also identified "self-monitoring" and "feedback" (64) as key strategies for facilitating participant engagement in self-assessment. Additional strategies drawn from the Behaviour Change Taxonomy [e.g., action planning, prompts/cues and positive reinforcement (73)] and process motivators [e.g., strategies to facilitate choice, competence and personalization (58)] were also identified as potential ways of enhancing engagement with the process of self-monitoring.

Stage Two: App Development

BIT Model: "What"

The features included in SMART Track ["What": BIT Elements (57)] are presented in **Figure 3** according to the underlying behavioural strategies and process motivators ["How": Conceptual (57)]. The relationship between these features and learnings from stage one are summarised below.

Features to Support Individual Recovery Journey

To enhance compatibility between SMART Track and what participants already do to support their recovery, several SMART Recovery tools are featured. Firstly, a "7-day plan" allows participants to specify details of an action plan and record their progress towards personally meaningful goals. Secondly, an interactive "urge log" allows participants to rate the strength of an urge as it is experienced, receive coping strategies and motivational messages to assist with urge management and to record associated triggers, outcome(s) and any (un)helpful management strategies. Additional SMART Recovery programme content and self-management tools are also available through a "resources" section. Participant expertise in self-management is acknowledged by including "hints, tips and motivations" derived directly from qualitative interviews with SMART Recovery participants and "motivational stories" of self-management and/or recovery.

Features to Respect Participant Autonomy

Respect for participant autonomy is made via several features that promote choice and control. For example, to allow people to monitor personally meaningful outcomes the app includes both multidimensional outcome assessment, and the option of tracking progress towards personally meaningful goals. There is also some flexibility in the timing and frequency of push notifications. Furthermore, the wording of push notifications (e.g., "log now," "log later") is such that ultimately it is up to the individual whether or when they choose to engage in the various self-monitoring tasks.

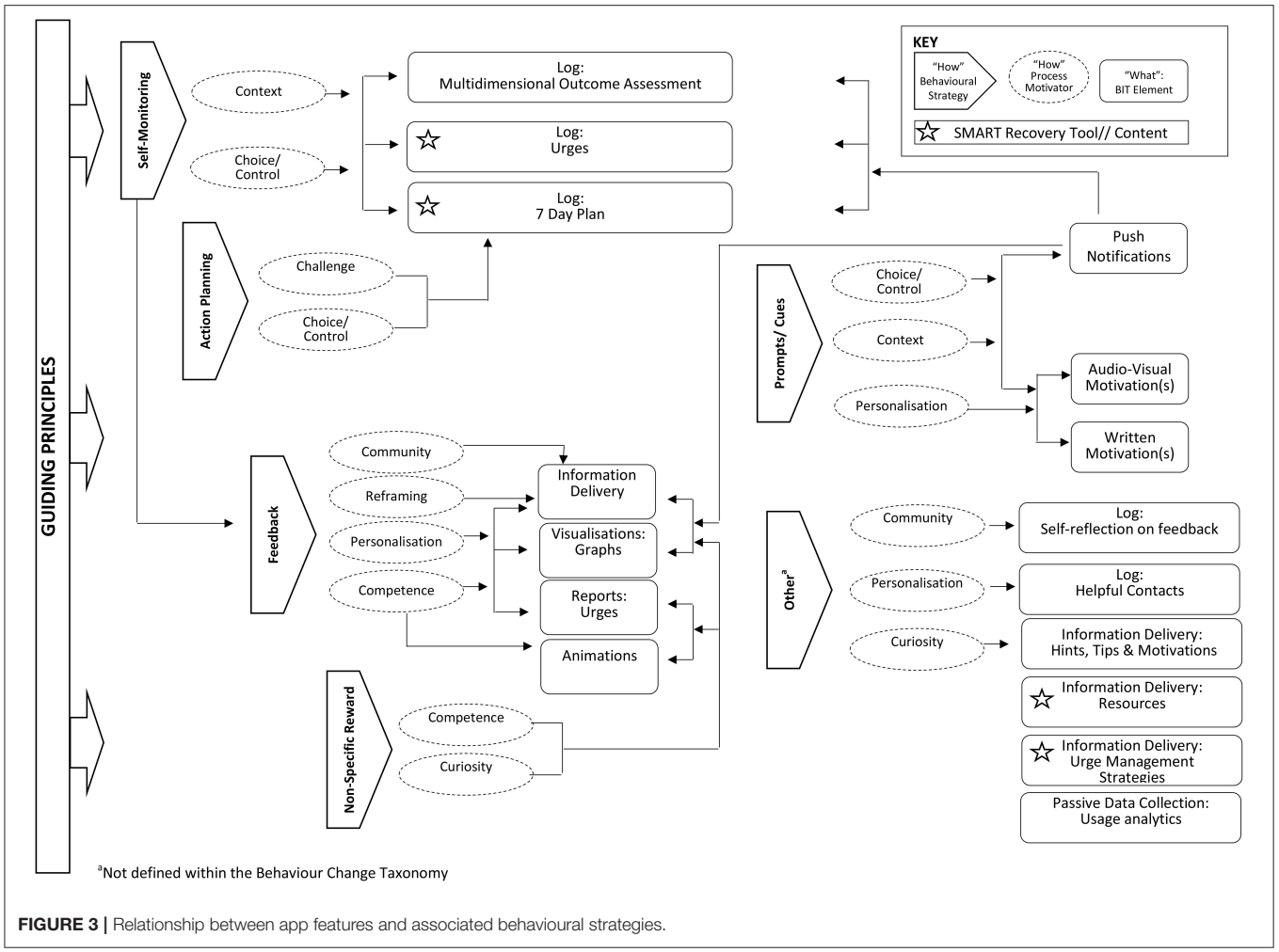


FIGURE 3 | Relationship between app features and associated behavioural strategies.

Features to Facilitate Positive Emotional Experience and Relatedness

When participants achieve personally meaningful goals, animations (celebratory confetti) are used to celebrate success. Progress on the various outcome assessments is highlighted and reinforced (graphs across time) and the wording of written feedback is such that all efforts are encouraged. Although a social networking feature was beyond the scope of the current app (due to funding and other pragmatic constraints), participants are encouraged to consider discussing their feedback with trusted others (e.g., SMART Recovery group). They can also use the app to log "helpful contacts" and are prompted to consider accessing support when progress is challenging and/or urges are experienced.

BIT Model: "When"

To balance client autonomy with routine collection of outcome data, the app includes a mix of user-defined workflows and time-based rules (64). For example, participants are prompted to link the completion of the ROM items and their 7-day plan to attendance at a SMART Recovery group; tick off their completed tasks as they are achieved and log their urges following each self-reported experience (i.e., user-defined). ROM items not completed at the end of each 1-week cycle (proposed ROM frequency) will count as "missing data" and the next week of progress monitoring will commence (i.e., time-based rules).

"How": Technical Characteristics

Consistent with the guiding principles that were developed, and informed by the creative and technical expertise of GHO, decisions regarding medium, complexity, aesthetics and personalisation were made to optimise the likelihood that the app would be experienced as simple, engaging, unobtrusive and confidential.

Medium

Text was the primary medium employed to communicate information within the app. Given the diverse experience of SMART Recovery participants, several strategies were employed to maximise accessibility. Firstly, where possible, written information was supplemented by visual prompts (e.g., when orienting people to the app) or content (e.g., when providing feedback). Efforts were made to convey content using simple, brief sentences and a conversational tone. Where detailed

information was required (e.g., privacy policy), key elements were summarised in the app, with more detailed content accessible via a link.

Complexity

To provide context and assist with completion, ROM items are prefaced by a brief description of item content and the rationale behind collecting this information. To simplify use, ROM items are completed using radio buttons, multi-select buttons, drop down menus and sliding scales. Free text response options are used sparingly, and restricted to capturing idiosyncratic outcomes (e.g., 7-day plan) and reflections (e.g., used to capture personal reflections on feedback received).

Aesthetics

The colour scheme and style of SMART Track was guided by the need to ensure that it complemented SMART Recovery branding, whilst not being instantly recognisable as to respect an individual's privacy. Otherwise, aesthetics were selected by GHO with a view to optimise ease of use (e.g., layout, interaction cues, text style, and size) and participant engagement (e.g., colour scheme, graphics).

Personalisation

To optimise ease of use, personal relevance and participant engagement a range of features were included to support personalisation. Participant responses to the ROM items directly inform tailored visual (graphs over time) and written feedback. Participants can elect to add one or more personal motivations for change (visual, video and/or written). This information can be amended as many times as needed and is displayed prominently within the app. A "contacts" section allows participants to enter the details of key support people. The "urge log" allows participants to enter the helpful strategies and/or motivations they would like to see when they next experience an urge.

SMART Track: An Overview of the Resultant Mhealth ROM and Feedback App

In summary, SMART Track consists of core ROM and feedback functionality and several additional features to enhance engagement (Resources; Customisable support(s) and personal motivation(s); Interactive urge log; and Pop up motivations and self-management strategies; **Figure 4**). Further details are available in the published protocol (63), and briefly summarised below. SMART Track provides multi-dimensional ROM assessment and feedback (ROM items are detailed in **Supplementary Table 2** as a function of target domain and assessment frequency). Feedback consists of tailored visual and written feedback across eight domains (7-day plan, behaviour of concern, effect of substance use, self-care, relationships, outlook on life, resources and mental health; **Figure 5**). The "Resources" screen delivers ten pieces of content. This is distributed across seven self-management resources (including SMART Recovery resources) and three motivational storeys [extracted with permission from the "Lives of Substance" website (74)]. Participants have the option of tailoring app content by uploading key contact number(s)/support services and/or personal motivation(s) for change (photo, audio, video, and/or written) into the "Me" section of the app. In addition to tracking the number, frequency and strength of urges, when the participant experiences an urge, the interactive urge log prompts participants to manage their urges, log triggers, and reflect on how to maintain/improve effective urge self-management. Participants also receive a "pop" up message when they open the app for the first time each day. SMART Track is freely available for Android (75) and Apple (75) devices.

DISCUSSION

This paper illustrates how three published frameworks were integrated and applied to the design and development (55, 57, 58) of an app designed to routinely monitor outcomes and provide feedback to participants attending SMART Recovery groups. It adds to the growing body of technology based solutions for ROM and feedback (37, 38, 45). By detailing the formative stage of SMART Track, this paper provides a pragmatic example of how principles embedded in these models can be operationalised to address key priorities in mHealth app development. This paper adds to the growing body of literature that has harnessed technology to overcome traditional barriers to ROM [e.g., scoring and providing tailored feedback (76)].

Strengths

Our user-centred and theory informed approach to the design and development of SMART Track addresses key limitations (51, 53) within the mHealth literature. Evidence from mHealth apps designed to support self-management of other chronic conditions suggest that future research efforts should focus on "a simple and user-friendly-designed mHealth system, data confidentiality, lay language use for structured and automated feedback or advice, positive motivation and improving engagement" (77). When developing tools to assess patient outcomes, early, meaningful and ongoing consultation with key stakeholders is central to maximising acceptability and person engagement (78). End-users want to be actively involved and consulted throughout the development process (79). These principles were at the forefront of the current body of work.

Challenges and Opportunities

The use of cloud functions for collecting and storing data means that SMART Track needs a reliable internet connexion to function. This is a common limitation within the digital health technology literature (37). Reliance on internet connectivity not only impacts the user experience, but may also inadvertently disadvantage certain user-groups (45). Improving offline functionality represents an important challenge for future development and evaluation efforts. Although considerable efforts were made to support a personalised experience (e.g., tailored written and visual feedback derived from participant responses; user led goal setting; choice over when/whether to receive goal-setting notifications; option to add personal motivations to support urge management) funding and time constraints meant that we were unable to action all participant priorities. For example, common requests included the option of

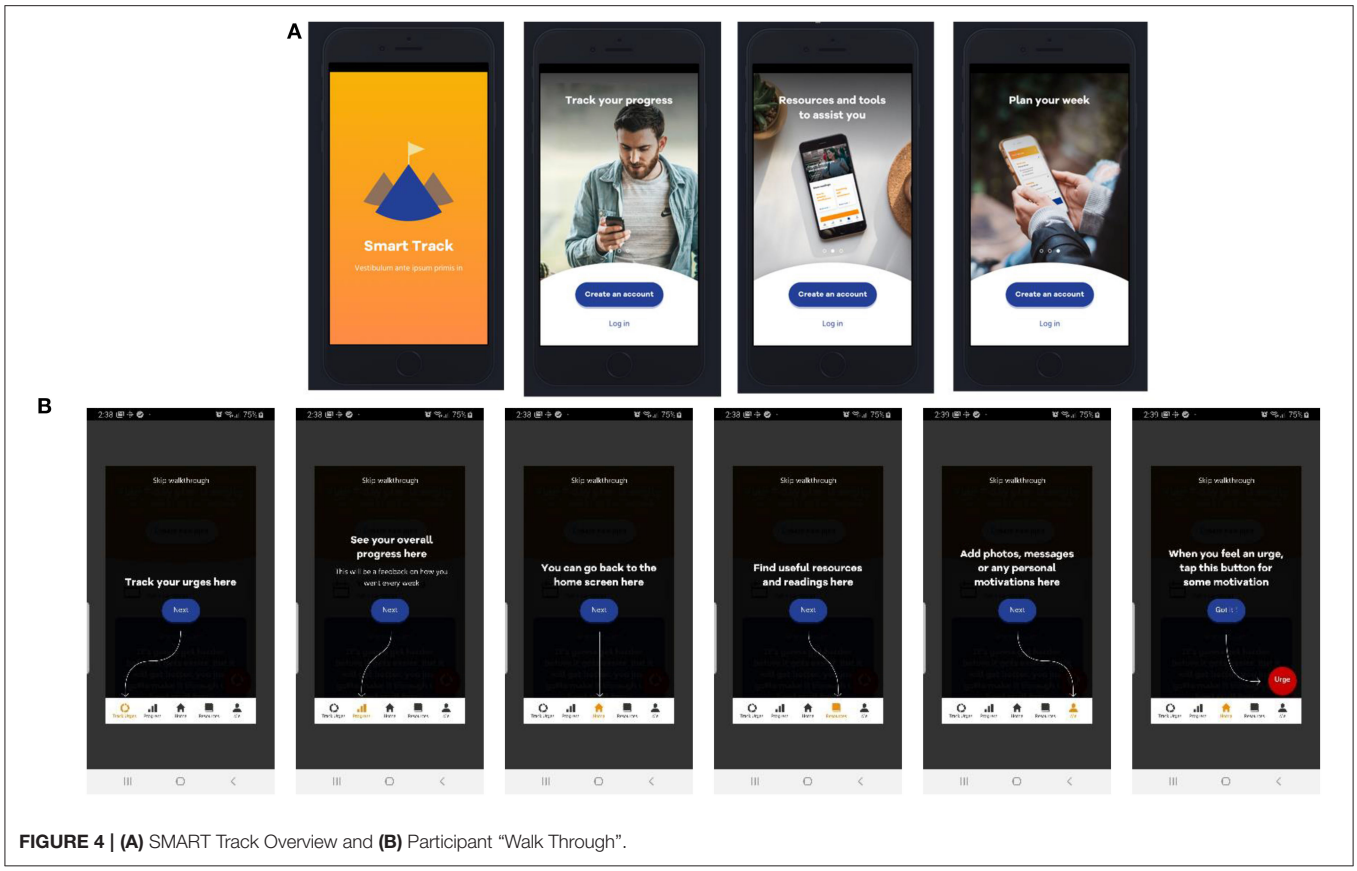


FIGURE 4 | (A) SMART Track Overview and **(B)** Participant "Walk Through".

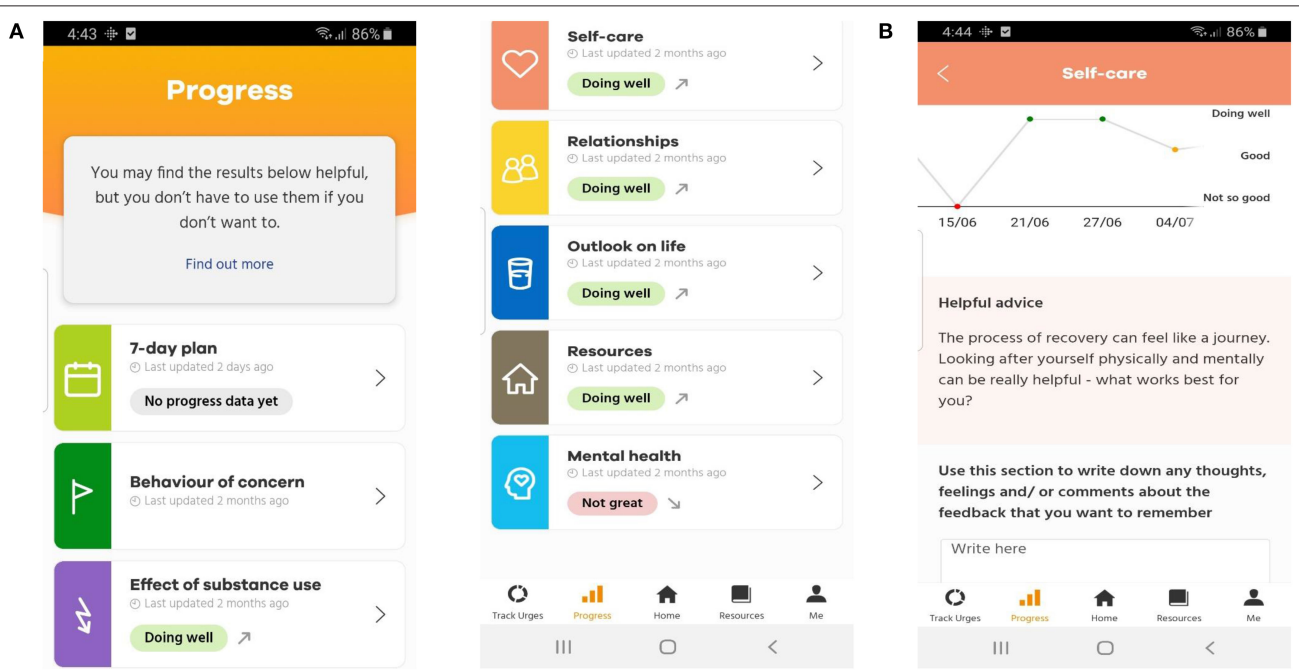


FIGURE 5 | (A) Overall progress screen and **(B)** Progress screen for the individual domain of "self-care".

being able to share feedback with trusted others (e.g., via shared log-in or direct export options); the option of participating in a discussion board feature (e.g., to share resources and support) and the capacity to complete self-management activities and worksheets within the app. Future research would benefit from continued efforts to improve the user experience and identify the demographic, clinical and contextual factors that may influence engagement with and utility of SMART Track. For example, by using routinely captured data analytics, and/or geospatial data SMART Track could be used to identify participant characteristics, contextual factors and/or app features associated with engagement, attrition and clinical outcomes (39, 40). Such information could have potential clinical benefits, for example providing early warning signs to participants at risk of poor outcomes, thereby allowing them to seek additional support and potentially circumvent a relapse [e.g., see (80)]. Finally, although our integration of three published frameworks ensured that the development and evaluation of SMART Track was informed by the needs and preferences of the end-user (55); best practise recommendations for mHealth development (57) and a collaborative, iterative development process (58), the process was complicated by overlap between these models. The development of new, comprehensive guidelines applicable to the development and evaluation of mHealth apps offer an important solution moving forward [e.g., The Accelerated Creation-to-Sustainment model (81)].

CONCLUSIONS

Although the principles derived from models used in the development of SMART Track facilitated the process of app design and development, future research is needed to determine whether this leads to improved outcomes such as uptake, engagement and sustained use. One of the most critical indicators of this app's success will be the frequency that users complete the routine outcome assessments embedded in the app. Review of the extent that various features of the app are utilised will provide insights into which elements of the various models appear to facilitate user engagement. A pilot study has been conducted (62, 63) and provides preliminary evidence for the feasibility, acceptability and utility of SMART Track for ROM and feedback in SMART Recovery groups.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the authors don't have permission to share the data. Requests to access the datasets should be directed to alisonbe@uow.edu.au.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Wollongong and Illawarra Shoalhaven Local Health District (ISLHD) Health and Medical Human Research Ethics Committee (2018/099; HREC/18/WGONG/34). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AKB: conceptualisation, methodology, formal analysis, investigation, data curation, writing—original draft, writing—review and editing, project administration, and funding acquisition. PK: conceptualisation, methodology, resources, writing—review and editing, supervision, and funding acquisition. FD, ALB, LH, and AS: conceptualisation, methodology, writing—review and editing, supervision, and funding acquisition. VM: conceptualisation, methodology, writing—review and editing, and supervision. JN and JK: conceptualisation, methodology, writing—review and editing, and funding acquisition. RG: methodology, formal analysis, investigation, and writing—review and editing. AA and RM: conceptualisation, methodology, resources, writing—review and editing, and funding acquisition. RC and MM: methodology, software, resources, data curation, and writing—review and editing. Authorship follows ICMJE recommendations (82). All author offered critical revisions to the manuscript for important intellectual content, have approved the final version of this manuscript, agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved, and made substantial contributions to study conception, design, methods, and/or the content and features of the ROM and feedback system under investigation.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.677637/full#supplementary-material

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Conflict of Interest: RM is Executive Director of SMART Recovery Australia. AA is employed by SMART Recovery as the National Program Manager and Trainer. PK, FD, ALB, AS, LH, VM, AKB, JK, and AA volunteer as members of the SMART Recovery Australia Research Advisory Committee. RC is the Exec. Creative Director and MM is the BBA Technical Lead at GHO, the company contracted to design and develop the app. The potential and/or perceived conflict of interest is negligible. The role of study investigators on the research advisory committee and/or as an employee of SMART Recovery is freely available on the SMART Recovery Australia website (and study participants can be directed to this information as required). The role of GHO is the design and development of SMART Track is clearly detailed in app store description(s). Furthermore, the team responsible for informing study design and overseeing the conduct of the study and data analysis also consists of researchers, clinicians, and statisticians independent from SMART Recovery. An independent qualitative researcher was recruited to collect and analyse the qualitative data.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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"Test Your Spirituality in One Minute or Less" Structural Validity of the Multidimensional Inventory for Religious/Spiritual Well-Being Short Version (MI-RSWB 12)

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Background: The Multidimensional Inventory for Religious/Spiritual Well-Being (MI-RSWB 48) was developed in order to address a religious/spiritual dimension as being an important part of psychological well-being. In the meantime, the instrument has been successfully applied in numerous studies. Subsequently, a short version, the MI-RSWB 12 was constructed, especially for the use in clinical assessment. Here it is intended to contribute to the further development of the MI-RSWB 12 by investigating its structural validity through structural equation modeling.

Materials and Methods: A total sample of 1,097 German-speaking adults (744 females; 67.8%; Age range: 18–69 years) from the normal population filled in the MI-RSWB 12 via an online-survey. In line with theoretical assumptions 5 different factor structure models for the MI-RSWB 12 were tested: (1) a single-factor model, (2) a model with four correlated RSWB dimensions, (3) a single higher-order model with four lower order factors, (4) a two higher-order model with four lower order factors, (5) a bifactor model, which includes four specific RSWB dimensions.

Results: The single-factor model provided the poorest model fit, with no indices falling within the acceptable range. The four-factor, two higher-order factors and the bifactor models showed overall acceptable fit indices. With regard to the Akaike information criterion (AIC), the four-factor model demonstrated superiority compared to both the two higher-order factor model and the bifactor model, which in turn showed did not differ from each other.

Conclusion: Four different MI-RSWB 12 sub-scales should be calculated in future studies, while a general factor and two higher order factors are statistically valid as well. Further applications of the MI-RSWB 12, especially in the clinical patient groups, are encouraged.

Keywords: psychological well-being, scale validation, spirituality structural equation modeling, test development, spirituality

INTRODUCTION

In the past two decades in particular, there has been a remarkable increase in interest coming from psychology, medicine as well as the whole field of neurosciences in topics such as religiosity and spirituality as being related to various parameters of mental health, psychological well-being, and coping with illness (cf. Rosmarin et al., 2020). This comes rather surprisingly, as originally the whole field of natural sciences viewed religion rather critically. Accordingly, Sigmund Freud rated religion as a kind of obsessive-compulsive neurosis (Freud, 1907) as well as an illusion, which will dissolve in the future (Freud, 1927). But not only Freud, as the founder of psychoanalysis, also one of the earliest representatives of behavioral theories, Ivan Pavlov, could find little positive in religion, as he judged religion as a kind reassurance for "nervenschwache Menschen" [neurasthenic people] (cf. Windholz, 1986). In contrast, Jung (1962/1937), the founder of Analytical Psychology, took a completely contrary position and saw religion and spirituality as an integral part of the human psyche (cf. Palmer, 2003; see also Kernberg, 2000 or Black, 2006 for an overview of contemporary psychoanalytic views on religion and spirituality). In correspondence to the positive Jungian view of religion there has been a benevolent appraisal of religion and spirituality throughout the second half of the 20th century, especially in the tradition of humanistic psychology. Correspondingly, one of the key figures of the humanistic approach, Abraham Maslow placed the need for transcendence (or the transpersonal realm in Maslow's words) at the top of his pyramid of needs (1964).

One of the main concerns for the field of psychology of religion has always been to precisely define its own research subject (Pargament, 1999). Both areas of religiosity and spirituality partly overlap in content as they concern the transcendent area of perception, whereby religiosity can be perceived more as a belief system tied to institutions and traditions. In the case of spirituality, the connection to the transcendent realm of perception refers more to the personal relationship of the human individual to God or a higher power of any kind, regardless of a particular belief system (Unterrainer et al., 2014). This lack of a clear definition also affects the psychometric assessment of religiosity and/or spirituality, as various scales and measurement models have been developed based on various theoretical backgrounds (primarily in the Anglo-American area) since the end of the 19th century (Hill and Hood, 1999). Accordingly, Hill and Edwards (2013) provide a brief overview of reliable and valid measures of various aspects of religiousness and spirituality. Here the measures are classified by several categories that fall under two general headings: substantive measures and functional measures. In addition, they put a special focus on cultural sensitivity, as most of the instruments are so far developed within a Judeo-Christian context. Furthermore, Kapuscinski and Masters (2010) critically review the scale development practices for 24 measures of spirituality pertaining to various aspects of conceptualization and psychometric properties. In line with their findings they raise theological as well as theoretical concerns, which should inform future development and validation of spirituality measures.

The concept of Religious/Spiritual Well-Being (RSWB) was developed based the original concept of the Spiritual Well-Being (SWB) scale (Ellison, 1983; Bufford et al., 1991; see also Moberg, 1971 for the original concept of spiritual well-being). This is where we meet for the first time a separation between a transcendent space of perception (which determines the amount of "religious well-being"—RWB) and an immanent space of perception (which determines the amount of "existential well-being"—EWB). The total SWB score results by summing up both sub-scales for EWB and RWB.

In this sense, the Multidimensional Inventory of Religious/Spiritual Well-Being (MI-RSWB 48) may be considered as a multidimensional alternative to the original SWB scale. Therefore, the MI-RSWB 48 was developed in order to meet the unanimous demand for a multidimensional assessment of religiosity and spirituality (Fetzer Institute/National Institute on Aging Working Group, 1999; Unterrainer et al., 2010b). Furthermore, the theoretical background of the MI-RSWB was elaborated based on an interdisciplinary discourse of all professional groups working at the Medical University of Graz/Austria. Within this scientific study group one of the main questions was how to address religious/spiritual issues in patient treatment most adequately. Furthermore, a global definition for Religious/Spiritual Well-Being (RSWB) can be given as "the ability to experience and integrate meaning and purpose in existence through a connectedness with self, others or a power greater than oneself." (Unterrainer et al., 2011, p. 117).

Notably, there is no strict separation between immanent space and transcendent space of perception in other multidimensional inventories for the assessment of religiosity and spirituality, as for instance the Brief Multidimensional Measure of Religiousness/Spirituality (BMMRS; Fetzer Institute & National Institute on Aging Working Group 1999) differentiates between several religious (e.g., private religious practices) and spiritual dimensions (e.g., meaning), however does not consider a strict differentiation between an immanent and a transcendent area of perception (see also Johnstone et al., 2012 for further discussion) although, for example, the dimension of forgiveness is taken into account in both procedures.

In its original version, the MI-RSWB 48 comprises six dimensions, three dimensions for the immanent area of perception and three dimensions for the transcendent area of perception. All six dimensions can be summed up to a total RSWB total-score. Furthermore, marker items are given as examples in order to illustrate the meaning of the different dimensions. General Religiosity: "My faith gives me a feeling of security"; Connectedness: "I have experienced the feeling of being absorbed into something greater"; Forgiveness: "There are things which I cannot forgive" (coded reverse); Experiences of Sense and Meaning: "I have experienced true (authentic) feelings"; Hope Immanent: "I view the future with optimism"; Hope Transcendent: "I often think about the fact that I will have to leave behind my loved ones." (coded reverse). The MI-RSWB 48 scale was used in a large number of studies in clinical as well as community samples (see e.g., Unterrainer et al., 2014 or more recently Unterrainer, 2021 for an extensive overview). Subsequently, norm values for the entire Austrian

population could be presented (Unterrainer and Fink, 2013). Furthermore, the scale could also translated and validated into several different languages successfully (Unterrainer, 2021; for an recent overview). Thereby, the MI-RSWB mostly displayed appealing psychometric properties as well as robust factor structure (also in different language versions). In summary, the postulated positive association between the RSWB dimensions could be confirmed with various parameters of mental health and more adequate coping with illness, whereby the MI-RSWB sub-dimensions Hope Immanent as well as Forgiveness mostly turned out to be the strongest predictors of subjective well-being (Unterrainer, 2021).

Although the scale was generally well-received in its application, there was some critique regarding the length of the instrument, as the scale was often perceived as too extensive, especially for applications in clinical settings. Therefore, based on a data set representative for the Austrian normal population (Unterrainer and Fink, 2013), a short version of the scale was created with a total amount of 12 items (Unterrainer and Kapfhammer, 2013).

Thereby, in a first step the two psychometrically weakest scales "Experiences of Sense and Meaning" and "Hope Transcendent" were completely deleted from the inventory. As already reported by Unterrainer et al. (2010a; 2010b; see also Unterrainer et al., 2014), omitting the "Hope Transcendent" scale for the long version of the scale would have also led to a better model fit for the MI-RSWB 48. However, it was decided at that time, mainly because of content considerations, to keep the "Hope Transcendent" sub-scale within the inventory. Furthermore, the subscale "Experiences of Sense and Meaning" showed to be always the weakest in terms of content, because the psychometrically stronger scales "Hope Immanent" and "Forgiveness" already covered a broad area of "Immanent Well-Being." In a second step, the items of remaining the four scales were sorted out according to selectivity by means of reliability analysis. So only the three most selective items per scale remain in the inventory. In a third and last step, a final factor analysis and reliability analysis were conducted, whereby convincing psychometric properties of the scale could be confirmed.

The current study adds up to our previous work, which has been conducted by applying the MI-RSWB in German version. Hereby we intend to validate the same measure in a different sample by utilizing an additional and better suited approach.

Study Aims

It is intended in this study, to further contribute to the development of the MI-RSWB 12 scale by investigating its underlying factor validity more in detail. Thereby five competing models are to be tested by applying Structure Equation Modeling (SEM).

MATERIALS AND METHODS

Sample and Procedure

The sample was recruited through various social networks. Informed consent was acquired before each participant filled in the test form that included demographic questions as well as the standardized questionnaire described below. The data was acquired via the online-survey platform LimeSurvey©. Data was analyzed from all participants that were aged at least 18 years, spoke German fluently and filled in all questionnaires. The study was carried out in accordance with the Declaration of Helsinki. Ethical approval was granted by the Ethics Committee of the Medical University of Graz, Austria.

Psychometric Assessment

The Multidimensional Inventory for Religious/Spiritual Well-Being short version (MI-RSWB 12; Unterrainer and Kapfhammer, 2013) is a self-report measure which assesses different dimensions of spiritual and religious well-being. It is the shortened version of the MI-RSWB 48 (Unterrainer et al., 2010b). Therefore, it consists of 12 items, which are rated on a 6-point Likert scale ranging from 1 ("strongly disagree") to 6 ("strongly agree"). These 12 items can be summarized to four sub-scales subscales (3 items per scale). Taken together, the subscales "General Religiosity" (GR), "Connectedness" (CO), "Forgiveness" (FO), and "Hope" (HO) are assumed to reflect the total score "Religious/Spiritual Well-Being" (RSWB). Furthermore, due to the theoretical assumption of a differentiation between the immanent and the transcendent area of perception it is possible to summarize the dimensions GR and CO to the sub-score "Transcendent Well-being" (TWB) and the FO and HO dimensions to the sub-score "Immanent Well-being" (IWB). Accordingly, TWB and IWB in turn add up to the total RSWB score (Unterrainer, 2021; see also Luckmann, 1990; Yalom, 2020 for a further discussion of the theoretical underpinnings). Reliability was assessed with McDonald's ω which recent results suggest as a superior indicator compared to the frequently used Cronbachs's α (Dunn et al., 2014; Hayes and Coutts, 2020). McDonald's ω for the subscales were generally acceptable and ranged between $\omega = 0.69$ and $\omega = 0.90$. The total RSWB score showed a McDonald's $\omega = 0.77$. Furthermore, both IWB ($\omega = 0.72$) and TWB ($\omega = 0.82$) indicated acceptable internal consistencies (see **Table 1**). A list of the English as well of German items together with a short manual can be found in the **Appendix** (see A1 and A2).

Statistical Analysis and Analysis Strategy

The Confirmatory Factor Analysis (CFA) was conducted with AMOS 26. SPSS 27.0 was used for data management, descriptive statistics and bivariate correlations. Goodness-of-fit was assessed with maximum likelihood (ML) estimation in AMOS. In accordance with Kline (2015), the following global fit-indices were considered as markers for an acceptable model fit: (a) The Comparative Fit Index (*CFI*) > 0.90; (b) Tucker-Lewis Index (*TLI*) > 0.90; (c) the Normed Fit Index (NFI) > 0.90; (d) the square root error of approximation (*RMSEA*) < 0.08 and the upper bound of its 90% confidence interval < 1; and (e) $\chi^2/df < 3$. The χ^2 significance test was neglected in this analysis as marker of good model fit, as a non-significant χ^2 test is rarely obtained with large samples (Jöreskog and Sörbom, 1993; Hooper et al., 2008).

For the comparison of competing models, the Akaike Information Criterion (*AIC*) was used, which rewards models

TABLE 1 | Multidimensional inventory for religious/spiritual well-being short version (MI-RSWB 12): descriptive statistics.

								Kolmogorov-Smirnov Test	
Variable	**ω**	**M**	**SD**	**Min**	**Max**	**Skewness**	**Kurtosis**	***z***	***p***
1. General Religiosity	0.90	6.78	4.30	3	18	0.94	−0.29	6.80	< 0.001
2. Connectedness	0.69	7.83	4.01	3	18	0.55	−0.59	3.79	< 0.001
3. Hope	0.87	12.75	3.76	3	18	−0.66	−0.10	3.53	< 0.001
4. Forgiveness	0.75	12.50	3.96	3	18	−0.45	−0.76	3.90	< 0.001
5. IWB	0.72	25.25	6.08	6	36	−0.49	−0.21	2.80	< 0.001
6. TWB	0.82	14.61	7.17	6	36	0.66	−0.34	3.80	< 0.001
7. RSWB	0.70	39.87	10.64	12	72	0.17	−0.24	1.24	0.09

N = 1,097; ω, McDonald's omega; M, Mean; SD, Standard Deviation; IWB, Immanent Well-Being; TWB, Transcendental Well-Being; RSWB, Religious/Spiritual Well-Being.

that achieve a high goodness-of-fit and penalizes them if they become overly complex (Kline, 2015). In this context, the model with the smallest AIC value was preferred, with a $\Delta AIC > 2$ indicating significant differences (Cheung and Rensvold, 2002; Jovanović, 2015).

What is more, the most parsimonious model was tested for gender invariance via multigroup analysis conducted in Amos. In order to statistically evaluate the differences across the groups, a test of invariance based on a difference in CFI was performed. For this aim, the sequential constraint approach suggested by Dimitrov (2010) was carried out. In correspondence to this, first, it was tested whether the factor loading pattern is the same across groups (metric invariance) by constraining all factor loadings and comparing this model to the unconstrained baseline model. Second, to examine scalar invariance the model with constrained factor loadings was contrasted by a model with additionally constrained item intercepts. Third, for the assessment of invariance of item uniqueness this model was compared to a model which also constrained residual item variances and covariances. Finally, the last model included constrained factor loadings, item intercepts, factor variances and covariances. A non-significant difference between this model and the second model (constrained factor loadings and item intercepts) suggests structural invariance. In each step a $\Delta CFI \geq -0.01$ was the criterion by which the null hypothesis that the model was equal across the groups was rejected (Cheung and Rensvold, 2002; Dimitrov, 2010). While there is evidence that ML estimation is relatively robust in terms of using non-normal data (Nevitt and Hancock, 2001), Bollen-Stine bootstrap was used in this study to manage the effects of non-normality in the investigated dataset, as studies have also demonstrated that ML test statistic and ML parameter standard error might be affected in the case of a severe violation of assumption of multivariate normal distribution (Kline, 2015). In correspondence to this, Bollen-Stine bootstrap enables a more realistic estimation of standard errors. In accordance with Nevitt and Hancock (2001), 2,000 bootstrap samples were drawn to assess overall model fit and 250 bootstrap samples to obtain parameter estimates and standard errors.

Based on theory and previous research outlined above, five models of the MI-RSWB 12 were tested (see **Figure 1**): (1) A single factor model which loaded all 12 items onto one underlying factor of RSWB; (2) a model with four correlated dimensions of RSWB; (3) a single higher-order model with four lower order factors and one higher order factor which accounts for the shared variances by the lower order factors. In this model, the items load onto the lower order factors, while the lower order factors load onto the higher order factor; (4) a two higher-order model with four lower order factors and two higher order factor which accounts for the shared variances by two lower order factors each. In this model, the items load onto the lower order factors, while the lower order factors GR and CO load onto the higher order factor TWB and the lower order factors HO and FO load onto the higher order factor IWB; and (5) a bifactor model, including four specific dimensions of RSWB and a general factor. In the bifactor model, each item loads onto both the general factor and the specific factors. To establish model identification one factor loading was fixed to 1 for each factor in every specified model (Byrne, 2004).

RESULTS

Sample Characteristics and Descriptive Statistics

The investigated sample consisted of 1,097 German-speaking adults (744 females; 67.8%). The participants ranged in age from 18 to 69 years ($M = 26.27$; $SD = 8.00$). Most participants declared a general qualification for university entrance as their highest educational level ($n = 514$; 46.9%). 396 (36.1%) participants declared a university degree as their highest educational level, 46 (4.2%) a high school degree and, 96 (8.8%) participants stated a completed apprenticeship as their highest educational level. 29 (2.5%) participants stated that they left school without graduation. Most participants stated to be religiously affiliated to Catholicism (635; 57.9%), 358 (32.6%) were without any affiliation, 55 (5%) were protestant, 33 (3%) were members of other Christian religious communities (e.g., orthodox Christianity), while 16 (1.5%) identified themselves with other non-Christian religious communities (e.g., Buddhism). The nationality of most participants was either German ($n = 354$; 32.3%), Austrian ($n = 659$; 60%) or Swiss ($n = 50$; 4.6%), while 50 (4.6%) stated other nationalities. In regard to their current relationship status, 71 (6.4%) were married, 518 (47.2%) in a relationship, and 508 (46.3%) were single.

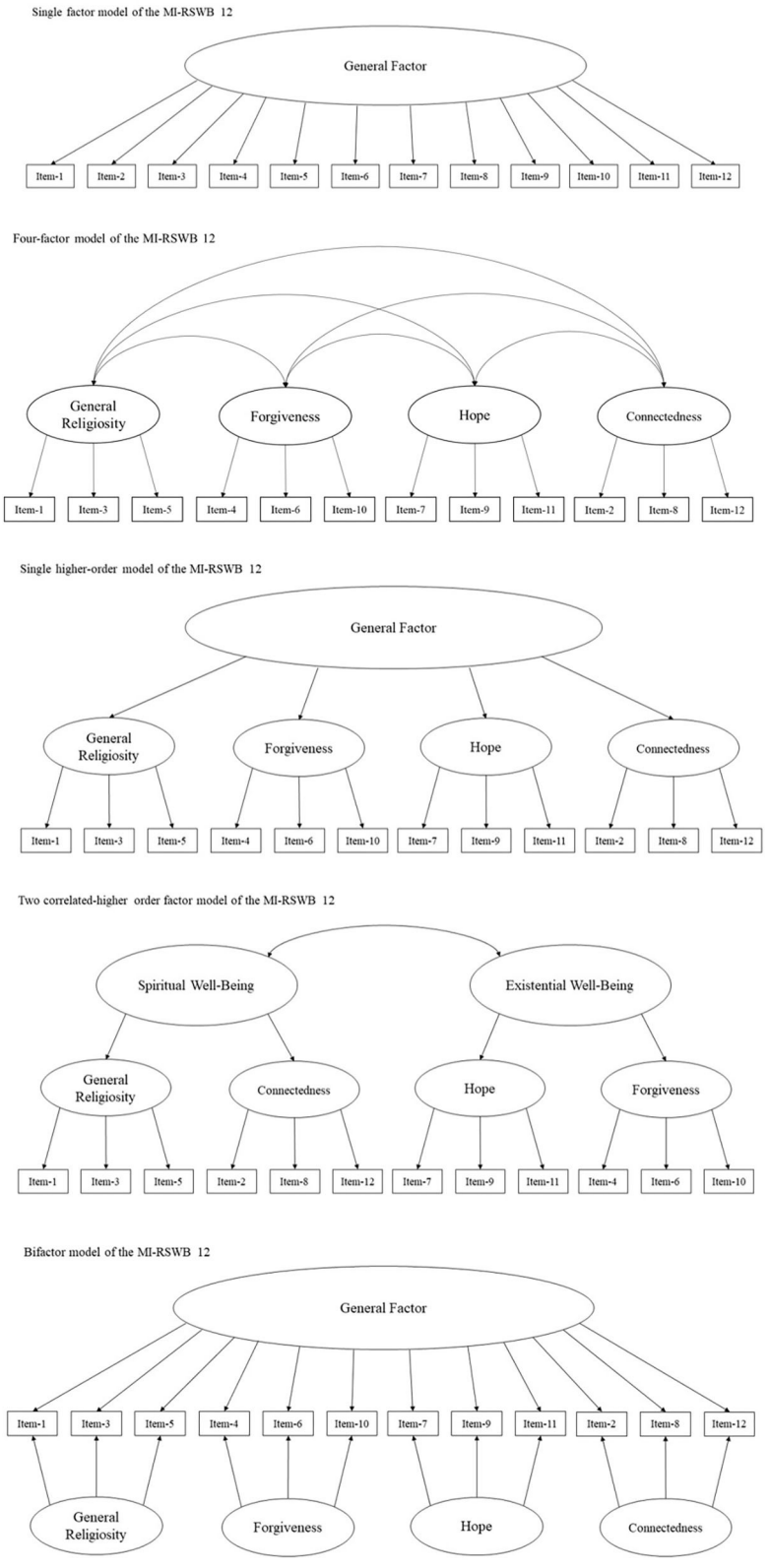

FIGURE 1 | Investigated latent factor models of the MI-RSB 12.

Regarding associations with age a small positive correlation with the MI-RSWB 12 scales GR ($r = 0.10$; $p < 0.001$) was observed, while all other scales correlations remained insignificant ($p > 0.001$). No scale showed significant sex differences (F = 6.61–F = 1.12; all $p > 0.001$). Detailed descriptions of several scale characteristics can be retrieved from **Table 1**.

Assessment of multivariate normality suggested non-normality of the data (multivariate kurtosis = 30.72, critical ratio = 27.75), hence results where bootstrap corrected.

Table 2 displays the correlation among the MI-RSWB scales. All subscales showed significant positive correlations with the RSWB-total score ($r = 0.55$–0.70; all $p < 0.001$). Furthermore, IWB was strongly related to HO ($r = 0.77$; $p < 0.001$) and FO ($r = 0.80$; $p < 0.001$), while GR ($r = 0.28$; $p < 0.001$) and CO ($r = 0.21$; $p < 0.001$) showed small correlations with IBW. This pattern was inversed for the TWB score: Large correlations were found with GR ($r = 0.87$; $p < 0.001$) and CO ($r = 0.85$; $p < 0.001$), while correlations with FO ($r = 0.13$; $p < 0.001$), and HO ($r = 0.33$; $p < 0.001$) were small.

Confirmatory Factor Analyses of the MI-RSWB 12

As shown in **Table 3** the results of the Confirmatory Factor Analysis (CFA) for the MI-RSWB 12 indicate that the single-factor model provided poor fit to the data, with none of the indices falling within the acceptable range [$\chi^2/df = 46.61$; RMSEA = 0.20 (90% CI: 0.19, 0.21); CFI = 0.54; NFI = 0.54; TLI = 0.44]. The single higher-order model showed generally acceptable fit [RMSEA = 0.05 (90% CI: 0.04, 0.06); CFI = 0.98; NFI = 0.97; TLI = 0.97], however exhibited a $\chi^2/df > 3$. In contrast, the four-factor [$\chi^2/df = 2.75$; RMSEA = 0.04 (90% CI: 0.03, 0.05); CFI = 0.98; NFI = 0.98; TLI = 0.98], two higher-order factors [$\chi^2/df = 2.84$; RMSEA = 0.04 (90% CI: 0.03, 0.05); CFI = 0.98; NFI = 0.97; TLI = 0.98] and the bifactor [$\chi^2/df = 2.97$; RMSEA = 0.04 (90% CI: 0.03, 0.05); CFI = 0.99; NFI = 0.98; TLI = 0.98] models showed overall good fit indices, with all indices falling within the acceptable range. Every model exhibited a Bollen-Stine bootstrap $p = 0.000$. With regard to the AIC values, the four-factor model demonstrated superiority compared to both the two higher-order factor model ($\Delta AIC = 5.44$) and the bifactor model ($\Delta AIC = 4.8$), while no significant differences are observed between the bifactor and the two higher-order factor models ($\Delta AIC = 0.64$).

The results of the CFA for the four-factor, two higher-order factors and the bifactor models, estimated with a bootstrap ML (250 samples), are detailed in **Figure 2**. Regarding the bifactor model, all assigned regression weights were significant ($p < 0.01$), except for the association between item 10 and the general factor ($p > 0.05$). The estimated strengths of the significant associations between the general factor and the individual items ranged from $\beta = 0.22$ to 0.74. Furthermore, the items assigned to the GR factor showed stronger factor loadings onto the general factor ($\beta = 0.66$ to 0.74; all $p < 0.01$) than items assigned to the remaining dimensions of the MI-RSWB 12 ($\beta = 0.22$ to 0.54).

Concerning the two higher-order factor model, both higher-order factors were substantially correlated ($r = 0.54$; $p < 0.01$). Moreover, all assigned associations were significant (all $p < 0.05$–0.01). The higher-order factor TWB was substantially associated with both GR ($\beta = 0.83$) and CO ($\beta = 0.79$), while HO ($\beta = 0.78$), and FO ($\beta = 0.38$) were associated with IWB. Associations between the individual items and the dimensions of the MI-RSWB 12 ranged between $\beta = 0.83$ to 0.88 for GR, between $\beta = 0.62$ to 0.67 for CO, between $\beta = 0.81$ to 0.85 for HO, and between $\beta = 0.47$ to 0.82 for FO.

With regard to the four correlated factor model, the associations between the individual items and the MR-RSWB 12 dimensions remained unchanged. Correlations between the factors ranged from $r = 0.10$ (FO × CO; $p < 0.05$) to $r = 0.61$ (GR × CO; $p < 0.01$). All remaining correlations were significant (all $p < 0.01$).

Invariance Analysis

As detailed in **Table 4** the examination of the CFI difference between Model 1 and Model 0 suggested invariance of the factor loadings across the male and female participants ($\Delta CFI \geq -0.01$). However, the CFI difference between Model 2 and Model 1 indicates that there is no complete invariance of the intercepts across the two groups. Following the recommendation to free one item intercept at a time (Dimitrov, 2010), further analysis resulted in a modified model which was labeled Model 2P. After freeing the intercept for Item 5 a $\Delta CFI \geq -0.01$ was achieved. Therefore, with the exception of the intercept of one indicator (item 5) there are invariant factor loadings and intercepts across both groups. Model 3 was obtained from

TABLE 2 | Correlations among variables.

Variable	1	2	3	4	5	6	7
1. General Religiosity	–						
2. Forgiveness	0.15***	–					
3. Hope	0.29***	0.24***	–				
4. Connectedness	0.49***	0.07	0.27***	–			
5. IWB	0.28***	0.80***	0.77***	0.21***	–		
6. TWB	0.87***	0.13***	0.33***	0.85***	0.29***	–	
7. RSWB	0.75***	0.55***	0.66***	0.70***	0.76***	0.84***	–

*N = 1,097; ***p < 0.001; IWB, Immanent Well-Being; TWB, Transcendental Well-Being; RSWB, Religious/Spiritual Well-Being.*

TABLE 3 | Confirmatory factor analysis fit statistic for the MI-RSWB 12.

Model	χ^2(df)	χ^2/df	RMSEA (90% CI)	CFI	NFI	TLI	AIC
1. Single-factor	2517.12 (54)	46.61	0.204 (0.197–0.211)	0.54	0.54	0.44	2565.12
2. Four-factor	131.77 (48)	2.75	0.040 (0.032–0.048)	0.98	0.98	0.98	191.77
3. Single higher-order factor	175.58 (50)	3.51	0.048 (0.040–0.056)	0.98	0.97	0.97	231.58
4. Two higher-order factors	139.21 (49)	2.84	0.041 (0.033–0.049)	0.98	0.97	0.98	197.21
5. Bifactor	124.57 (42)	2.97	0.042 (0.034–0.051)	0.99	0.98	0.98	196.57

N = 1,097; RMSEA, Root Mean Square Error of Approximation; CFI, Comparative Fit Index; NFI, Normed Fit Index; TLI, Tucker-Lewis Index; AIC, Akaike information criterion.

Model 2P by constraining the variances and covariances of the items' residuals. Based on the comparison of the CFI of Model 3 and Model 2P, item invariance of item uniqueness can be assumed ($\Delta CFI \geq -0.01$). Finally, Model 4 was obtained from Model 2P by imposing invariant factor variances and covariances. The difference regarding CFI between Model 4 and Model 2P remained $\Delta CFI \geq -0.01$, thus, indicating structural invariance with regard to both groups.

DISCUSSION

It was intended in this study to further contribute to the flourishing research concerning the spiritual dimension within the area of psychological well-being, whereby we applied the Multidimensional Inventory for Religious/Spiritual Well-Being (MI-RSWB) in its original version with 48 items in various research settings. Based on these positive experiences a short version of the scale was constructed, especially for the application in clinical assessment. Hereby the original number of items were reduced from 48 items to 12 items (MI-RSWB 48 vs. MI-RSWB 12), as well as the originally six sub-dimensions were limited to four (GR, CO, HO, FO). Therefore, both sub-dimensions from the original MI-RSWB 48 scale: "Hope Transcendent" (HT) as well as "Experiences of Sense and Meaning" (SM) had to be deleted (Unterrainer et al., 2014).

Based on the comparison of different structural equation models for the structural validity of MI-RSWB 12, a correlated four-factor model can be preferred. Further analysis of this model suggested structural invariance with regard to gender. Hence, it can be assumed that the four-factor model of the MI-RSWB 12 operates in the same way with regard to its underlying structure for both male and female subjects (Dimitrov, 2010). In accordance with the theoretical basic assumptions about the scale, it can be concluded that it makes sense to calculate all four dimensions of the scale (GR, CO, HI, FO). What is more, our estimated models indicate the validity of a latent bifactor structure consisting of a general RSWB factor and the four domain specific factors (GR, CO, HI, FO), as well as a latent structure consisting of the two higher order factors TWB and IWB and the four lower order factors (GR, CO, HI, FO). These results underline the high flexibility of the MI-RSWB 12 regarding its ability to measure different facets of well-being not limited to the transcendent but also within the immanent realm of perception. Following Maslow (Maslow, 1964) both aspects of well-being might be seen as related, at least to a certain extent. The results of this study which indicate a substantial correlation between TWB and IWB further underline this assumption.

Interestingly, the bifactor model—while better fitting than the single higher-order factor model—did not show superior model fit compared to the two correlated higher-order factor model or the correlated four-factor model. This is in contrast with a great proportion of the literature on bifactor models. Several authors suggest that bifactor models tend to generate better fit indices than higher-order models (see e.g., Murray and Johnson, 2013; Cucina and Byle, 2017). Some researchers even argue that the comparison between bifactor and hierarchical models might be substantially biased in favor of the bifactor model (Murray and Johnson, 2013). Hence, the results of the present study further emphasize the structural multidimensionality of the MI-RSWB 12. However, this finding might be particularly dependent on item-10, which showed no significant loading regarding the general factor of the bifactor model.

As is well-known from previous studies, the dimensions of well-being that relate to the transcendent area of perception (GR and CO) were always shown to be less strongly linked to various parameters of mental health (e.g., increased mood stability or more adequate coping strategies) compared to the parameters for Immanent Well-Being (HI and FO). In correspondence to this, according to Unterrainer (2010), and Unterrainer et al. (2012), it can be assumed that HI and FO together can be seen as a particularly strong predictor of the Sense of Coherence parameter within the Salutogenesis model of Antonovsky (1987), which in turn can be assumed as a strong indicator of more adequate stress coping.

In terms of neural correlates of MI-RSWB, a voxel-based morphometry study regarding the belief in the miracles of Lourdes (Schienle et al., 2020) reported substantial correlations between the MI-RSWB dimensions and specific areas in the brain. In detail, the region of interest (ROI) analyses showed negative associations between hippocampus volume and the total RSWB score as well as the HI sub dimension. Furthermore, GR was observed to be negatively correlated with amygdala volume. Although the long version of MI-RSWB was applied in this study, both dimensions (HI and GR), for which neural correlates were observed, can also be found in the short version of the MI-RSWB scale. However, it has to be noted, that there were also substantial neural correlates for the HT-dimension in the Schienle et al. (2020) study.

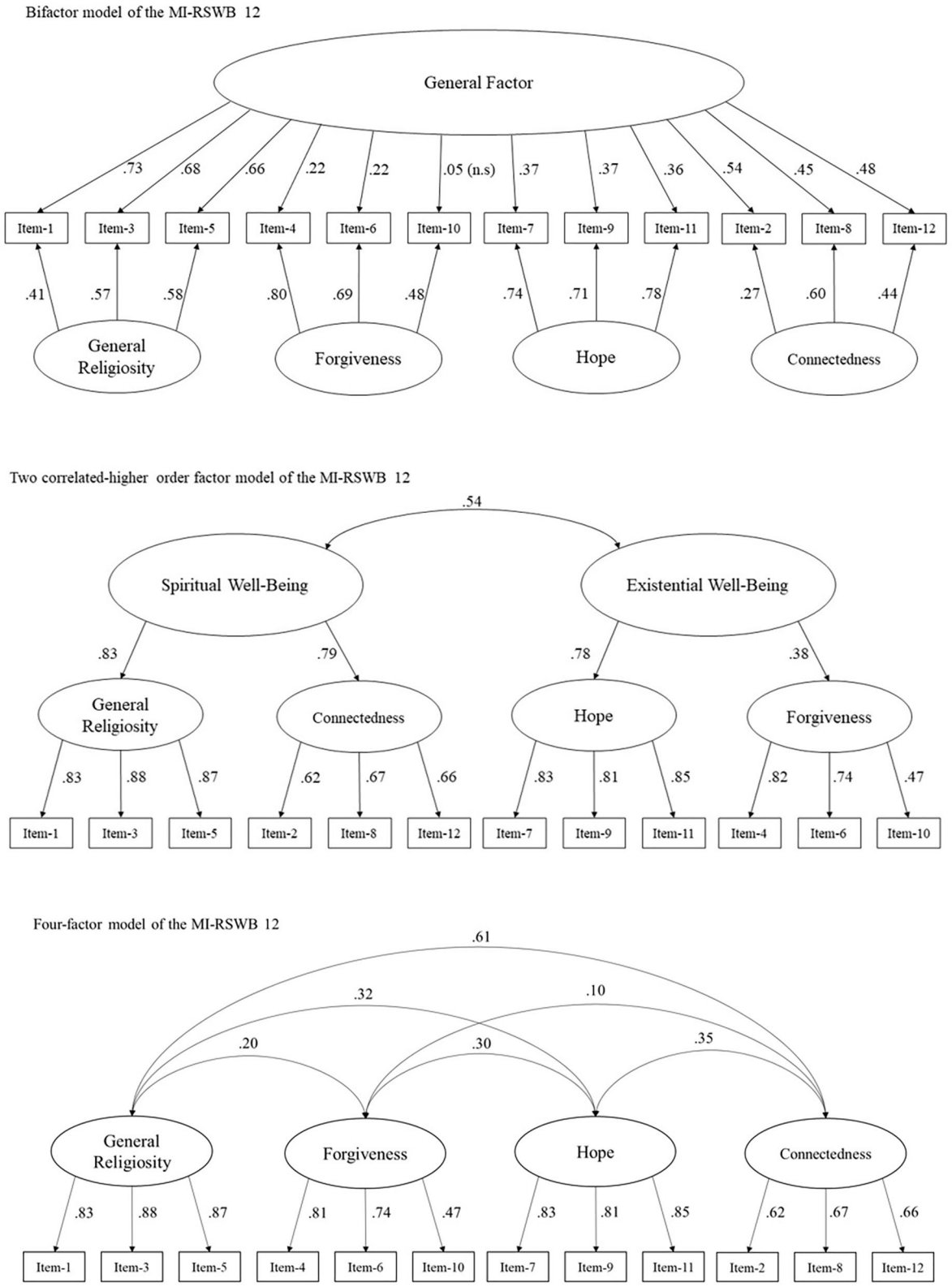

FIGURE 2 | Inter-factor correlations and regression weights of models showing an acceptable model fit.

TABLE 4 | Testing for invariance across gender.

Model	χ^2	df	Model Comparison	CFI	ΔCFI*
M0	207.145	96		0.979	
M1	218.699	104	M1–M0	0.980	0.001
M2	310.536	113	M2–M1	0.964	−0.016
M2P	251.888	112	M2P–M1	0.974	−0.006
M3	282.606	124	M3–M2P	0.971	−0.003
M4	291.889	125	M4–M2P	0.969	−0.005

*CFI, Comparative Fit Index; M0, Baseline model (no invariance imposed); M1, Invariant factor loadings; M2, Invariant factor loadings and intercepts; M2P, invariant factor loadings and partially invariant intercepts (free intercept of Item 5); M3, invariant factor loadings, partially invariant intercepts, and invariant residual variances; M4, Invariant factor loadings, item intercepts, and factor variances/covariances; *ΔCFI ≤ −0.1 signals lack of invariance targeted by the respective comparision of nested models.*

Restrictively, HT is omitted in the MI-RSWB 12 version. The reason for excluding the HT subscale for the MI-RSWB 12 is, that the HT dimension always showed to be responsible for a significant deterioration of the model fit of the MI-RSWB 48 (Unterrainer et al., 2010b). Therefore, the HT scale was retained for the long version of the scale for reasons of content, but was consequently eliminated for the MI-RSWB 12. As already mentioned, HT represents an inverse correlate of the fear of death and dying as well as the overcoming of threatening feelings such as existential fear. Traditionally, the overcoming of the fear of death and dying and its relation to psychological well-being is extensively addressed within Terror Management Theory (Greenberg et al., 1986; Burke et al., 2010; for an enhanced theoretical discussion see Becker, 1997). In correspondence to this, for instance, Aberer et al. (2018) could show that the HT dimension could be exclusively addressed by a specially developed spiritually oriented therapeutic intervention in different groups of patients with severe skin diseases. Accordingly, after the intervention the skin-patients exhibited an increased amount of HT (which mirrors inversely a decreased amount of anxiety of death and dying) in comparison to a control group. These exciting insights into clinical work definitely deserve to be examined in more detail by means of further research. Either way, this important finding could not have been gained by applying only the MI-RSWB short version.

Accordingly, the dimension of HT deserves to be further discussed regardless of the RSWB concept or in relation to it.

A similar problem occurs in terms of the "Experiences of Sense and Meaning" (SM) dimension, which was also removed within the MI-RSWB 12. It is not for nothing that experiences of sense and meaning were extensively discussed within the context of nootherapeutic approaches (Viktor Frank and his Existential/Logotherapy can probably be mentioned here as the most prominent representative; Frankl, 1963). As part of the RSWB concept, the SM sub-scale often showed the most unconvincing psychometric properties and was therefore removed. However, in terms of content, it still appears to highly relevant, especially for more psychotherapeutically oriented research questions.

Limitations and Future Perspectives

A constraint of this study is the non-normality of the investigated data which might have affected the results of the CFA. Hence, Bollen-Stine bootstrap was employed to manage the effects of the violated multivariate normal assumption in terms of corrected *p*-values for the χ^2 statistic, adjusted standard errors and confidence intervals for parameter estimates. In correspondence, the significant Bollen-Stine bootstrap might be seen as problematic regarding the global fit of all investigated models (Bollen and Stine, 1992). Consequently, this result suggests a restriction of the structural validity of the MI-RSWB.

So far, little has been done regarding the changeability of the RSWB dimensions over several measurement times. There is still a lot of work to be done here and a concise instrument seems to be preferable in many cases within a repeated measurement design. Based on the limited findings of previous research, it can be assumed that the RSWB dimensions can be changed in principle. However, these dimensions may need to be specifically addressed by means of a uniquely developed treatment protocol (e.g., Sollgruber et al., 2018).

In conclusion, the MI-RSWB 12 short scale proves to be a very reliable instrument, with an excellent structural validity. Therefore, the MI-RSWB 12 is an adequate alternative for the long form of the scale (MI-RSWB 48; Unterrainer et al., 2010b), especially regarding clinical applications in vulnerable groups, such as patients in psychiatric treatment, general medical inpatients or people in prison.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Data set can be retrieved from the corresponding author. Requests to access these datasets should be directed to HU, human.unterrainer@univie.ac.at.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical University of Graz, Austria. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All statistical analysis were conducted by JF. JF wrote the first draft of the manuscript. HU read the manuscript and made some critical comments. JF and HU revised the whole manuscript together. 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.2021.597565/full#supplementary-material

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Difference in Response to Feedback and Gender in Three Therapeutic Community Units

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Therapeutic communities (TCs) for substance abuse incorporate a system of peer feedback through written affirmations and corrections. Previous research has found that TC residents show a response to affirmations that is detectable for roughly 8 weeks, with response to corrections being of shorter duration and weaker overall. It is not clear whether and to what extent response to feedback in TCs varies between men and women. Previous research in other settings suggests that women should be more responsive to feedback than men. In order to test this hypothesis we draw on a large dataset of affirmations and corrections sent and received in three 80 bed TC units, two of which house men and one of which houses women. The analysis uses a multilevel negative binomial model, treating affirmations and corrections that TC residents receive as predictors of affirmations that they send over a 9 week period (week 0, the week during which affirmations and corrections are actually sent, and eight subsequent weeks). The model controls for gender, age, race, unit and scores on the Level of Service Inventory-Revised (LSI-R). The relationship between affirmations received and those sent is stronger for women during the initial week and on lags 1-2 and 5-8. The relationship between corrections received and affirmations sent is stronger for women on lags 2 and 8. Graphs suggest that response to affirmations falls off in an exponential curve, while that to corrections appears to include a periodic element. These results indicate that both men and women respond to feedback, but that the strength of the women's response is somewhat greater. These results suggest that any difference in suitability by gender to the feedback approach that characterizes TCs may favor women.

Keywords: therapeutic community, gender, substance abuse and addiction, substance abuse treatment, mutual aid, social network analysis

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INTRODUCTION

Therapeutic communities (TCs) are residential programs for substance abuse recovery in which mutual aid within the community of peers forms the core approach to treatment (1, 2). TCs work to bring about resident change through a combination of clear behavioral expectations, work at jobs that are necessary for the functioning of the unit, the use of staff and senior peers as role models and feedback between residents (1). Several systematic reviews and meta-analyses have found that TCs are effective in reducing substance abuse and the likelihood of re-incarceration (3–8), although agreement is not universal (9), and there is evidence

that effects decline over time, suggesting the importance of aftercare (10).

The extent to which TCs are appropriate or effective for women has also been questioned. There is evidence that women have a more communal attitude than men (11) and that women hold a more interdependent sense of self, considering their relationship with peers as being more symbiotic (12). The repeated finding that women are more active in their social networks than men also suggests that women place a high value on relationships (13, 14). Given this evidence, it is not surprising that that both peer and staff interactions are significant for retention among women in substance abuse treatment (15). However, qualitative research has found that women may have difficulty in forming meaningful relationships with peers in TCs (16), even when the TCs are gender segregated (17). Difficulty in forming peer relationships appears to be a challenge in other correctional settings, with women sometimes reporting that it is easier to form relationships with staff than with peers (18). But this issue is likely to be particularly salient for TCs, given the programs' emphasis on the entire community of staff and peers as the method of treatment (1, 2).

Outcome findings of studies of TC treatment with women have been equivocal. One randomized controlled trial conducted with 115 women found that gender responsive treatment, a manualized combination of group therapy and individual counseling, led to greater reductions in drug abuse, longer aftercare treatment and lower rates of re-incarceration than TC treatment (19). However, a randomized trial comparing gender-sensitive TC treatment to gender-sensitive cognitive behavioral therapy treatment found that TC treatment was more effective in reducing substance abuse, criminal behavior and exposure to trauma, as well as improving mental health scores (20). This would suggest that, while gender sensitivity is an issue in TC treatment, the actual modality itself may not be problematic for women; this would be consistent with meta-analytic results of the broader area of gender sensitive treatment for female offenders (21). In addition, one randomized controlled trial of unmodified TC treatment vs. cognitive behavioral therapy with female prisoners found that TC treatment led to better mental health and criminal behavior outcomes (22). A recent systematic review of treatment for female criminal offenders found little evidence in favor of any treatment (23), while another suggested that some elements of TC treatment could be beneficial in working with women offenders (24).

In light of the contradictory and somewhat complex corpus of studies on women and TCs, it is worth noting that there is a body of theory and empirical results which support the idea that women should have outcomes in TCs that are equal or superior to those of men. The ability to cooperate with peers is a critical aspect of TC treatment (25, 26). Studies suggest that women have advantages in cooperative behavior. They are more empathetic than men (27), show greater altruism (28, 29), and are more likely to resolve conflict harmoniously (30). Researchers have found women to be more cooperative in public goods games, in which members of a team choose to make or not make individual sacrifices that will benefit the group, although contextual variables can influence this (31). There is experimental evidence that women prefer to cooperate with other women and are more likely to pay money to punish peers who defect; the authors took this as indicating that women value the social interactions involved in the game over any profit to be made (32).

Moreover, there is experimental evidence that women are more likely to allow feedback to influence their behavior (33), apparently because they are more likely than men to think that the information is of value (34). This suggests that women should respond more strongly than men to the TC system of ongoing feedback between peers, which in turn is an important source of social learning in the programs (1, 2, 25).

Peer feedback in TCs comes in a variety of forms, including supervision of junior residents in work tasks, frank exchanges during group therapy, affirmations for pro-social behavior such as talking with a peer who is having a difficult time in the program and corrections for behavior that contravenes TC norms, such as demeaning a peer or even doing a poor job on a chore. While most of these forms of peer feedback go unrecorded, TCs sometimes keep written records of peer affirmations and corrections for purposes of monitoring clinical progress.

In units where such records are kept it is possible to measure resident response to peer feedback using longitudinal social network analysis (35). Since peer affirmations themselves are a form of pro-social behavior, one can treat the affirmations and corrections that TC residents receive during one time period as a predictor of the affirmations they send in later time periods. Any increase or decrease in the number of affirmations residents send following the reception of an affirmation or correction forms a measure of resident response to peer feedback.

Previous research using this method did not find any gender difference in the number of affirmations that TC residents sent (35). However, this only tells us that women and men participate in the peer feedback system at roughly similar levels. It does not tell us whether women respond differently to peer feedback than men. Since women are often more cooperative than men and appear to value social relations more highly (11, 31, 32), and since experimental evidence suggests that they are more responsive to feedback (33, 34) we would expect them to be more responsive to the peer feedback system in TCs. If so, clinicians and researchers should be somewhat cautious in altering this system when modifying TCs for women. This study therefore tests the hypothesis that women will have a stronger response than men to feedback from peers.

METHODS

Data

Data for this project was drawn from a de-identified archival database of peer and staff affirmations and corrections kept for purposes of tracking unit functioning at two units for men and one unit for women at a single community based correctional TC in the Midwestern United States over a period of several years. Each of the units included eighty beds and was segregated from the others. While the TC was located in a small city, it drew from a catchment area that included a mix of urban, suburban and rural counties. The maximum length of stay in the program was 6 months, but residents could leave sooner depending on clinical

progress. All residents were felony offenders who had chosen TC treatment as an alternative to a longer sentence in a correctional facility. The database included 1,162 male residents and 1,032 female residents.

When a resident affirmed or corrected a peer, he or she would do so using a form that included the date, his or her own name, the name of the peer, and the content of the affirmation or correction. A committee of senior residents and staff would then vet the form for legitimacy; for instance, residents were not allowed to correct a peer merely because the peer had recently corrected them. Once it was determined to be legitimate, the affirmation or correction would be read aloud at a time when the entire community was together and would then be entered into a computer database. Because these affirmations and corrections included records of sender, receiver, and the date sent they constitute a longitudinal social network.

The facility also kept records of resident age, race and scores on the Level of Service Inventory-Revised (LSI-R) (36). The LSI-R includes information on substance abuse, education level, previous offenses, employment, financial status, social support, family and marital status, living accommodations, recreational skills, mental health issues, and attitudes toward criminal behavior.

Because this is a de-identified, archival dataset that was originally gathered for clinical purposes, the Ohio State University Office of Responsible Research Practices. ruled that the data did not meet the federal definition of human subjects data.

Analysis

The dependent variable in the analysis, intended to measure the response to peer feedback, was the number of affirmations sent during a given week. Weekly affirmations were chosen over corrections as a measure of response to peer feedback because qualitative research has shown considerable ambivalence among TC residents about the use of peer corrections (37, 38). This would add random error to the analysis, and therefore any relationship between affirmations/corrections received and affirmations sent should be more easily detected than that between affirmations/corrections received and corrections sent. Testing both affirmations and corrections sent as dependent variables would have been possible but would also have increased the total number of hypothesis tests and therefore the chance of a Type I error.

The predictors of primary interest were the number of affirmations and corrections received during recent weeks of residence. In this study it was expected that women would increase the rate of sending affirmations after receiving either affirmations or corrections more than men would, thus showing a stronger response to feedback. This difference can be measured in two different ways. It is possible that women show a stronger correlation between the affirmations they send and the affirmations or corrections they receive in a given week. However, it is also possible that their response will last for more weeks, tailing off more slowly than that of men. This difference is measured as the total number of lagged weeks before the 95% confidence interval first includes no measurable response. Age, LSI-R and race were entered as demographic control variables; a squared term was entered for age and LSI-R to account for a possible quadratic relationship.

The response variable was a count of affirmations sent. Our objective was to test whether the rate of sending affirmations increases more for women than men under a condition in which the number of affirmations or corrections received has increased. We therefore considered both Poisson and negative binomial models for the errors and landed on the latter due to evidence of over-dispersion in the errors conditional on the Poisson model. We used a log link function. Our data consist of repeated weekly measures of each resident. To account for within-person correlation in the number of affirmations given, we also included an individual-level random effect. We further included TC unit fixed effects and time fixed effects that represent the week of the program that the resident is currently in to adjust for time-in-program confounding of the relationship between the exposure (received interactions) and the outcome (given interactions). The model controlled for age, gender, race and LSI-R of the individuals. In addition to measures of statistical significance, the negative binomial model yields the Incidence Rate Ratio (IRR), the percentage change in the affirmations that residents send per unit of each predictor variable. The IRR provides a valuable tool for understanding the strength of the relationship between the affirmations and corrections that residents receive and the rate of affirmation sending.

The model included a total of 8 lags for received peer interactions of both types, affirmations and corrections. Therefore, the first 8 weeks for which not all lags are available (e.g., week 8 lacks a lag for week 1, week 7 lacks lags for weeks 1 and 2) are excluded from the analysis. Both types of lags are standardized so that one unit is equal to one standard deviation. To test our hypothesis, both sets of lags are interacted with a variable *male* that indicates whether the individual belongs to a male group or the female group (male $= 1$, female $= 0$). The lag interaction coefficients represent the difference in the coefficient of each lag for males relative to females, who are represented by the lag main effects. Thus, if an interaction coefficient is negative and statistically significant, it indicates that males have a smaller positive response (or larger negative response) to received interactions than females in terms of the rate of affirmation sent. We defined statistical significance as the case when the 95% coefficient interval did not include zero.

The analysis was completed within the R statistical computing language and environment (39), and the model was constructed and fit with the "brms" addon package to R (40).

RESULTS

Descriptive statistics are in **Table 1**. The mean number of corrections received is considerably higher than the mean number of affirmations received; this does not follow the generally assumed guideline that positive reinforcers should outnumber negative reinforcers (41). The mean number of affirmations sent is unsurprisingly virtually identical to the mean number of affirmations received. All of the variables

TABLE 1 | Descriptive Statistics for resident activity and demographics.

	Mean or proportion	sd	Min	Max
***n* = 2,194**				
Total affirmations received	39.30	60.30	0	306
Total corrections received	60.70	46.53	0	301
Total affirmations sent	39.61	71.92	0	584
Age	29.90	8.76	18	61
LSI-R	25.61	5.74	7	57
Race black american	0.31			
Race other	0.01			

measuring peer feedback have wide ranges, with some residents receiving far more affirmations and corrections than others, and some residents sending far more affirmations. Roughly 31% of residents are Black American.

Table 2 gives the results of the statistical analysis, allowing for control of age, race and LSI-R. When female residents receive affirmations they send more affirmations in the same week and for 8 weeks after (Female Response to Affirmations, Lag 0-8). When they receive corrections they send more affirmations in the same week and for 3 weeks after (Female Response to Corrections, Lag 0-3). Overall male residents send more affirmations (Male Affirmation Main Effect). However, when compared to female residents, male residents respond to receiving affirmations more weakly on the initial week and lags 1, 2, and 5-8 (Male Response to Affirmations Lags 0-2, 5-8). They respond to receiving corrections more weakly on lags 2 and 8 (Male Response to Corrections, Lags 2 and 8). There are no lags in which male residents show a statistically significantly stronger response to either affirmations or corrections. Overall, therefore, female residents respond more strongly to feedback whether it comes in the form of affirmations or corrections. Residents who are older send more affirmations on average (b_age). There is no evidence of non-linearity in this relationship, and the analysis found no relationship between LSI-R score or race and the number of affirmations that residents send. Men's unit 1 is more active than men's unit 2 (Unit 1 vs. Unit 2 Males, Affirmation Main Effect).

Figures 1, **2** show the difference in response between men and women to affirmations and corrections, respectively, using a one standard error confidence interval. In the case of affirmations received (**Figure 1**) the risk ratio for female residents is consistently higher than that for male residents, although the difference slips below statistical significance during the 3 and 4 week lags. For both men and women the correlation shows a smooth exponential decline. In the case of corrections received **Figure 2** makes it clear that two factors combine to limit the number of lags on which the difference between men and women is statistically significant. The first is that the correlation between corrections received and affirmations sent is substantially weaker for both genders than that between affirmations received and those sent. The second is that the response of the male residents shows a two lag periodicity, increasing on lags 3, 5, and 7 when compared to the previous lag. The female response appears to have a somewhat weaker three lag periodicity, with increases on lags 2, 5, and 8. This combination leads to statistically significant differences on lags 2 and 8 only, in both cases favoring women.

DISCUSSION

This study tested the hypothesis that female residents of TCs would respond more strongly to changes in exposure to affirmations or corrections received from peers in terms of their own rate of giving affirmations to the community. The results supported our hypothesis, suggesting that women in the women's TC unit responded more strongly in the positive direction to increases in received affirmations and that the response lasted a larger number of weeks. The same was true to a lesser degree of received corrections. Residents showed a weaker response to corrections than to affirmations, a result that is consistent with the literature on positive vs. negative reinforcement (41). The two male units also showed somewhat different responses, consistent with previous literature on the variability of unit atmosphere in TCs (42).

While these findings are encouraging for the treatment of women in TCs, several caveats must be noted. First, the external validity of this analysis is limited due to the small number of units studied. The men's units themselves showed some variation in the number of affirmations sent, suggesting that differing unit cultures could be an alternative explanation for the differences found between men and women. With a sample of only three units we cannot rule this out. Moreover, peer affirmations and corrections are only one form that feedback takes in TCs, and it is possible that these findings would be different if we looked at other forms of feedback, for instance feedback in therapy groups. Finally, the women in this TC were segregated from men. It is possible that both men and women in facilities that do not segregate genders would show different response patterns to peers either because the stimulus came from a person of another gender (32) or because people of another gender are present, thus changing the overall social dynamic (16). All of that having been said, these findings are consistent with previous experimental studies of comparative gender responsiveness to feedback, which find women to be more responsive than men (33, 34, 43). This consistency indicates that they are likely not artifactual.

With those limitations in mind, these results have several implications for researchers and clinicians involved in substance abuse treatment. The difference in response to affirmations and corrections between the male and female units occur on multiple lags, and the IRR values suggest that these differences are not trivial. For instance, in week five male residents are roughly 13% less likely to send affirmations per standard deviation of the number of affirmations they received in week 0. A likely explanation, as found in previous experimental work on gender and feedback, is that women in TCs perceive feedback as being of more value (34).

These results suggest that women may adapt more easily to the TC system of mutual feedback. It is likely that their reaction to feedback allows them to gain more from the TC system of social learning (1, 44). It is also possible that it indicates and/or fosters a stronger identification with the community,

TABLE 2 | Results of multilevel model of response to affirmations and corrections over 8 weekly time lags, by gender.

	Est.	SE	IRR	IRR 95% CI		Significance ($p \leq 0.05$)
				Lower	Upper	
b_Intercept	-1.659	0.115	0.192	0.153	0.241	*
Female response to affirmations	0.669	0.030	1.952	1.844	2.064	*
Female response to affirmations, lag 1	0.332	0.029	1.395	1.319	1.473	*
Female response to affirmations, lag 2	0.245	0.028	1.278	1.210	1.349	*
Female response to affirmations, lag 3	0.182	0.028	1.201	1.138	1.266	*
Female response to affirmations, lag 5	0.165	0.029	1.179	1.115	1.248	*
Female response to affirmations, lag 5	0.215	0.028	1.241	1.173	1.312	*
Female response to affirmations, lag 6	0.184	0.027	1.202	1.141	1.269	*
Female response to affirmations, lag 7	0.160	0.028	1.173	1.109	1.235	*
Female response to affirmations, lag 8	0.175	0.026	1.191	1.130	1.256	*
Female response to corrections	0.166	0.030	1.181	1.113	1.247	*
Female response to corrections, lag 1	0.064	0.030	1.066	1.008	1.128	*
Female response to corrections, lag 2	0.087	0.029	1.092	1.030	1.156	*
Female response to corrections, lag 3	0.059	0.028	1.062	1.006	1.122	*
Female response to corrections, lag 4	0.024	0.029	1.025	0.967	1.084	
Female response to corrections, lag 5	0.058	0.030	1.060	0.999	1.123	
Female response to corrections, lag 6	-0.010	0.028	0.990	0.939	1.045	
Female response to corrections, lag 7	0.015	0.028	1.016	0.962	1.073	
Female response to corrections, lag 8	0.064	0.029	1.067	1.008	1.130	*
Male affirmation main effect	1.790	0.117	6.030	4.779	7.516	*
b_age	0.130	0.057	1.141	1.015	1.279	*
b_lageE2	-0.041	0.044	0.960	0.884	1.051	
b_lsir	0.033	0.050	1.034	0.935	1.146	
b_llsirE2	0.012	0.031	1.012	0.954	1.075	
b_race.AfAmer	0.088	0.112	1.099	0.883	1.372	
b_race.Other	-0.854	0.709	0.542	0.111	1.601	
Unit 1 males compared to Unit 2 males, affirmation main effect	−2.89019	0.14013	0.056115	0.042149	0.0735	*
Male response to affirmations	-0.11417	0.037693	0.892739	0.830224	0.962475	*
Male response to affirmations, lag 1	-0.13559	0.03621	0.873773	0.813823	0.934824	*
Male response to affirmations, lag 2	-0.08852	0.036683	0.915899	0.853896	0.98438	*
Male response to affirmations, lag 3	-0.06789	0.037302	0.935016	0.870935	1.006475	
Male response to affirmations, lag 4	-0.03144	0.037708	0.969733	0.898725	1.040831	
Male response to affirmations, lag 5	-0.1426	0.037075	0.867694	0.805087	0.930775	*
Male response to affirmations, lag 6	-0.0776	0.034951	0.925896	0.861713	0.990202	*
Male response to affirmations, lag 7	-0.07402	0.036406	0.929269	0.862949	0.999936	*
Male response to affirmations, lag 8	-0.1015	0.03509	0.90404	0.843736	0.966583	*
Male response to corrections	-0.03183	0.044946	0.969652	0.890574	1.058374	
Male response to corrections, lag 1	-0.03276	0.046417	0.968811	0.880963	1.056039	
Male response to corrections, lag 2	-0.08642	0.042322	0.918027	0.843666	0.996153	*
Male response to corrections, lag 3	0.047995	0.042648	1.05012	0.96291	1.141858	
Male response to corrections, lag 4	-0.02749	0.042329	0.973752	0.895851	1.053951	
Male response to corrections, lag 5	0.013187	0.04228	1.01418	0.930557	1.101034	
Male response to corrections, lag 6	-0.00065	0.038061	1.000073	0.932383	1.076677	
Male response to corrections, lag 7	0.039281	0.040984	1.040936	0.961073	1.130501	
Male response to corrections, lag 8	-0.11036	0.041037	0.896266	0.825592	0.967112	*
sd_id__Intercept	1.715259	0.052019				*
shape	0.458854	0.009793				*

The asterisks mark when a particular parameter is a statistically significant predictor.

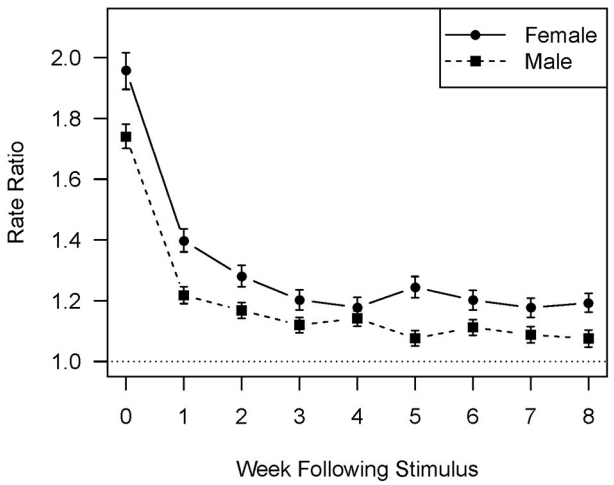

FIGURE 1 | Rate ratios comparing the rate of affirmation giving with and without the stimulus of one standard deviation increase in received affirmations by week since the stimulus and by gender.

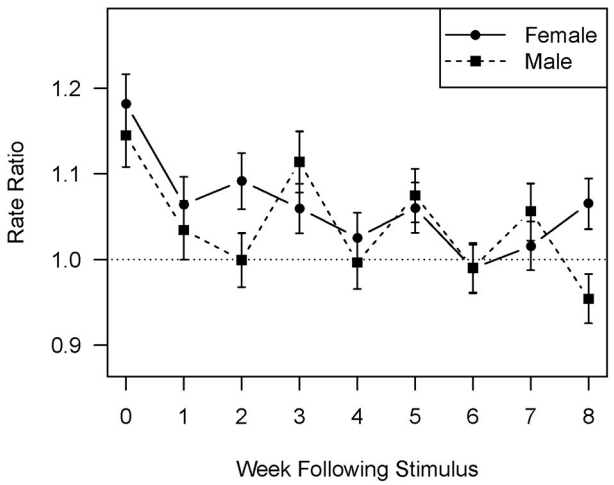

FIGURE 2 | Rate ratios comparing the rate of affirmation giving with and without the stimulus of one standard deviation increase in received corrections by week since the stimulus and by gender.

an interpretation that would be consistent with findings that women value relationships more strongly than men (30, 32). Such social identification is increasingly seen as a factor in successful treatment outcomes (45, 46). When taken together with laboratory studies that find that men are less responsive to feedback (33, 34, 43) it raises the possibility that resident training in exchanging feedback in TCs could be useful, and particularly for male residents.

This examination of gender differences in one aspect of TC treatment makes it clear that the question is not so much whether a given treatment program is appropriate for women who abuse substances a (19, 47, 48) as which specific aspects of a program are of more or less benefit for men or women, and by extension other groups. It has been argued on theoretical grounds that the TC system of corrections is inappropriate for women (47). This analysis finds no evidence for that proposition. While TC residents on the whole respond more positively to affirmations than to corrections, women do not respond less positively to corrections than do men, and to some extent respond in a somewhat more pro-social manner.

There was variation between the two men's units in the mean number of peer affirmations sent. The use of the community as therapeutic agent is central to TC practice (1, 2), and this level of variability in amount of positive feedback received from peers suggests that attaining fidelity in peer interaction is likely to be a challenge. This finding is consistent with variability between units found in other recent work on TCs (42) and, like the difference in response between men and women, raises the possibility that training for TC residents on how to exchange feedback with peers might be of value.

Consistent with earlier analysis (35) and behavioral treatment literature (41), this one found that residents responded more strongly to affirmations than to corrections; this was true for both the effect size during the initial and subsequent weeks and the length of time over which the effect was observable. This analysis adds the important nuance that response to corrections appears to be more complex than response to affirmations, with periodicity being visually evident in **Figure 2**. Such periodicity is consistent with evidence that attempts to constrain antisocial behavior can create non-linearities that lead to complex periodicities in time series (49, 50) and would be expected to add to the complexity of the clinical task of monitoring unit functioning. While there is no apparent periodic component in resident response to affirmations, it is possible that the narrowing of the difference between men and women on the third and fourth lags represents a much weaker periodic element in the time series that is not clearly visible in the graphs.

While the difference in resident response to affirmations and corrections intuitively suggests that rewards change behavior more effectively than punishments, it is important to distinguish between response to affirmations or corrections and learning from affirmations or corrections. This analysis does not preclude the possibility of long-term learning from corrections (1, 2) or the possibility that a willingness to correct peers may be part of a process of personal growth, increasing social identification with the community and role modeling that is itself important in recovery (1, 2, 45, 46, 51, 52).

CONCLUSION

Consistent with laboratory research, this study found that female residents of TCs have a stronger response to peer feedback than male residents of TCs, and that the difference in response to affirmations in particular is statistically detectable over 8 weeks. It also found a weaker overall response to corrections and a visually apparent periodicity in response to corrections. As TC clinicians adapt their programs to the needs of women, these findings support the continued use of peer feedback, while demonstrating that residents react more immediately and in a more straightforward manner to affirmations.

This analysis also shows that theory and empirical findings from outside the clinical literature specific to substance abuse treatment can be of use in understanding these complex

programs. Because TCs depend on the community of recovering peers as the primary method of clinical treatment, empirical studies of interpersonal interactions in other settings are particularly likely to be of relevance.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The dataset is currently de-identified. We can share it with individuals who wish to replicate the study. Requests to access these datasets should be directed to warren.193@osu.edu.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ohio State University Office of Responsible Research Practices. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

ND did the data analysis, wrote the methodology section, and contributed to writing the results. FD and KW did editorial work on the entire manuscript and wrote the introduction. KW wrote the results, discussion, and conclusion. All authors contributed to conceptualizing this manuscript.

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Effects of Tai Chi on the Executive Function and Physical Fitness of Female Methamphetamine Dependents: A Randomized Controlled Trial

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Purpose: Exercise improves the health and mental status of drug dependents. The way by which Tai Chi (TC) as a special exercise treatment affects executive functions (EFs) of methamphetamine (MA) dependents is yet to be established. This study aimed to explore the effects of TC on the EFs and physical fitness of MA dependents.

Methods: A total of 76 female MA dependents were randomly assigned to the exercise and control groups. The exercise group underwent three 60-min sessions of TC training per week for 12 weeks. The control group was trained with conventional exercises including the 9th Guang Bo Ti Cao and square dance. Physical fitness and EF assessments that evaluated inhibitory control (IC, go/no-go task), working memory (3-back task) and cognitive flexibility (switching task) were performed at baseline and at 12 weeks. A repeated-measures ANOVA was applied to analyze the differences of group and time.

Results: The exercise group showed decreased response time (RT) with a significant main effect of time on the go/no-go task [$F_{(1, 68)} = 9.6$, $p < 0.05$]. The interaction effect between time and group was significant on accuracy [$F_{(1, 61)} = 4.73$, $p < 0.05$], and the main effect of time was significant on RT [$F_{(1, 61)} = 4.66$, $p < 0.05$] in the 3-back task of the exercise group. Significant changes in BMI [$F_{(1, 68)} = 19.57$, $p < 0.05$], vital capacity [$F_{(1, 68)} = 6.00$, $p < 0.05$], and systolic blood pressure [$F_{(1, 68)} = 6.11$, $p < 0.05$] were observed in the exercise group.

Conclusion: These findings showed that 3 months of TC training can improve the IC and maintain the working memory and cognitive flexibility of MA dependents. Other data implied that TC may improve the physical fitness of MA dependents.

Clinical Trial Registration: http://www.chictr.org.cn/, ChiCTR1900022091.

Keywords: Tai Chi, methamphetamine, executive function, physical fitness, inhibitory control

INTRODUCTION

Methamphetamine (MA) dependence is a growing global concern that has a negative impact on public health (1). MA is reportedly the most widely used illicit drug, second only to cannabis (2). Besides the rapid increase in MA use in Europe (3) and the USA (4), the prevalence of MA use and abuse in Asian has advanced to an alarming degree (5). Approximately 9.9 million of the world's MA users are reportedly living in Asia; and ∼1.2 million MA users are residing in China in 2019 (6). Long-term use of MA and other illicit drugs can lead to impairments in the physical health of users (7–10). Several physical fitness aspects of drug dependents (e.g., motor movement, mental status, and cardiopulmonary function) are reportedly poorer than those of normal individuals (11, 12). As a highly addictive psycho-stimulant drug, MA negatively affects individuals' brain structure and function, thus, resulting in behavioral impairments (13, 14). A neuropsychological study found that individuals' cognitive function was significantly impaired after long-term exposure to MA, and such impairment was associated with the abnormal brain function and metabolism due to MA use (15). Compared with dependence to other drugs, MA dependence reportedly causes a more severe impairment in cognitive function (16).

Executive function (EF) is a critical mental process consisting of inhibition, including inhibitory control (IC), working memory, and cognitive flexibility, which are the three core functions of EF (17, 18). EFs are skills essential for mental and physical health (19). Addiction is one of the causes of executive impairments, and similarly, an inseparable relationship exists between poor EF and substance abuse (19). Generally, illicit drug dependents manifest higher impulsiveness in behavior and decision-making than healthy individuals (20–27) due to their impaired EFs. Cognitive studies suggested that individuals who are chronically exposed to illicit drugs have difficulties in execution, inhibition, and decision-making (28). IC is a factor in the prediction of successful recovery in drug dependents (16, 29, 30) and in the maintenance of addiction (31). In executive tasks, MA dependents and other illicit drug users always show poor IC under drug-related stimuli (words or sentences describe MA or scene of MA abuse) (27). Previous studies also found that alcohol, cocaine, nicotine, and Internet dependents have poorer attention span, response time (RT), and accuracy under related stimuli in some EF tasks, indicating their poor IC (32–36). Working memory is the ability to temporarily store the information in the mind; this memory is put to work during the process of executing cognitive tasks (37). A close relationship is reported between working memory and IC; IC is supported by working memory to guide individuals' behaviors to avoid mistakes. When EF is needed, the working memory will shift its function and work together with IC (19). However, drug dependents reportedly have impaired working memory (38, 39). Cognitive flexibility is built on the other two EFs (19), and accumulating evidence indicates that MA dependents exhibit impaired cognitive flexibility (39). The core EFs of the MA dependents are impaired, and the impairment is likely associated, at least in part, with continued drug seeking and using (39).

In recent years, the use of exercise as an intervention to drug dependence has attracted considerable attention (40, 41). Exercise has been proved to greatly ameliorate the EF impairments (42, 43). A systematic review also clarified the positive effects of physical exercise on the enhancement of EF (44). Acute and aerobic exercises were proved to exert positive effects on IC (45–47) according to the results of go/no-go task, which is a psychological task usually used to assess IC (48). Moderate-intensity exercise was also reported to improve working memory performance (49). Moderate-intensity exercise has good effects on EFs because the effect of moderate exercise on IC is superior to other exercises (50, 51). Meanwhile, exercise can improve the health of illicit drug dependents (52). Both short- and long-term moderate-intensity aerobic exercises can enhance their physical fitness and life quality (53). Recent research reported that physical fitness, which includes body mass index (BMI), vital capacity, flexibility, balance and muscle strength, of illicit drug dependents significantly improved after aerobic exercise (54). Withdrawal symptoms of drug users and the likelihood of relapse can also be greatly relieved and reduced by exercises (55, 56).

Tai Chi (TC) is one of the globally renowned Chinese traditional mind–body exercises with a long history. It is the most used intervention method among Chinese tradition exercises because it can mobilize many parts of the body (e.g., dynamic posture control, symmetrical body activities, and body–hand–eye coordination) and reach a certain exercise intensity simultaneously. TC has attracted an increasing amount of attention as a potentially effective method to improve brain health and cognition, and to slow brain aging (57, 58). Several systematic reviews and meta-analysis reported the improved cognition and EF in older adults after TC exercise (59, 60). Studies using brain function test instruments all showed improvements in parameters related to decision-making ability and IC after TC intervention compared with other exercises (61, 62). Nevertheless, studies focusing on the effect of TC on EFs of MA dependents are relatively few. Researchers have focused on the effects of TC on physical and mental health of both male and female drug users, and they reached the consensus that TC exercise has positive influences on mind-body health, specifically on cardiopulmonary function, physical functional performance, and mental status (63–65). A related study provided evidences of the remarkable effects of TC on blood pressure, vital capacity, flexibility, and aerobic endurance in drug users (66). Significant improvements in the physical fitness of hand grip, sit-and-reach, push-up and balance ability, and decreased craving were observed after several months of TC intervention in amphetamine-type dependents (54). Similarly, enhanced life quality of illicit drug users was found following 12 weeks of TC exercise (67). TC also had a beneficial effect on the depression and anxiety symptoms of drug dependents (68). Therefore, TC may be an effective intervention for the physical fitness and EFs of female MA dependents.

Exercise is reportedly beneficial for illicit drug dependents. As a traditional exercise, TC has potential application in the rehabilitation of illicit drug dependents. However, few studies investigated the effects of TC on the EFs of illicit

drug dependents. Accordingly, the present study aimed to investigate the effects of TC training on the EFs (IC, working memory, and cognitive flexibility) and physical fitness of female MA dependents. Considering that illicit drug dependents showed improvements in cognition after exercising (41, 69), we hypothesized that TC would exert a positive impact on the EF and improve the physical condition of MA dependents.

MATERIALS AND METHODS

Design

The study is a single-blind randomized controlled trial (ChiCTR1900022091), in which the effect of TC on the EF and physical fitness of MA dependents was examined.

Potential participants were recruited by posting research information in the Shanghai Female Mandatory Detoxification and Rehabilitation Center (SFMDRC). All the participants took part in the study voluntarily. Subjects who participated in the trial and completed the whole study under regulations were rewarded with increased frequency of family calls. Eligible participants were randomized in a 1:1 ratio to the exercise or control group. The randomization sequence was created by SPSS version 25.0 and was unknown to the research staff performing the study procedures. All participants were scheduled to complete a 12-week intervention program post-randomization. The results of EF tasks, including go/no-go, 3-back and switching task, which related to individuals' IC, working memory, and executive control, were measured at baseline and after the intervention. Physical fitness parameters were also assessed simultaneously. The Institutional Review Board of Shanghai University of Sport and Chinese Clinical Trial Register approved the study. Informed consent was obtained from all participants in accordance with the Declaration of Helsinki.

Participants

The inclusion criteria were as follows: (1) female, aged 18–65 years old; (2) reported history of using MA; (3) no severe medical or mental disease; and (4) educational attainment of primary school or above. The exclusion criteria were as follows: (1) currently diagnosed with Axis I psychiatric disorders, neurological illnesses or trauma affecting the central nervous system; (2) underwent pharmacological treatment with psychotropic medications during or before the study; (3) have anti-social personality disorder and borderline personality disorder; and (4) unwillingness to accept the assigned intervention conditions. Eighty participants were enrolled. Among them, four were excluded for not meeting the criteria. Among these four, three were excluded due to personnel mobilization, and one was excluded due to judicial detention. The final sample comprised 72 participants (**Figure 1**).

Physical Fitness Measurements

Blood pressure was measured using OMRON 7113, and the average value was calculated after three consecutive measurements. The maximum lung capacity was recorded after two measurements using an electronic spirometer (FCS-10000, China). A stopwatch was used to measure the length of time

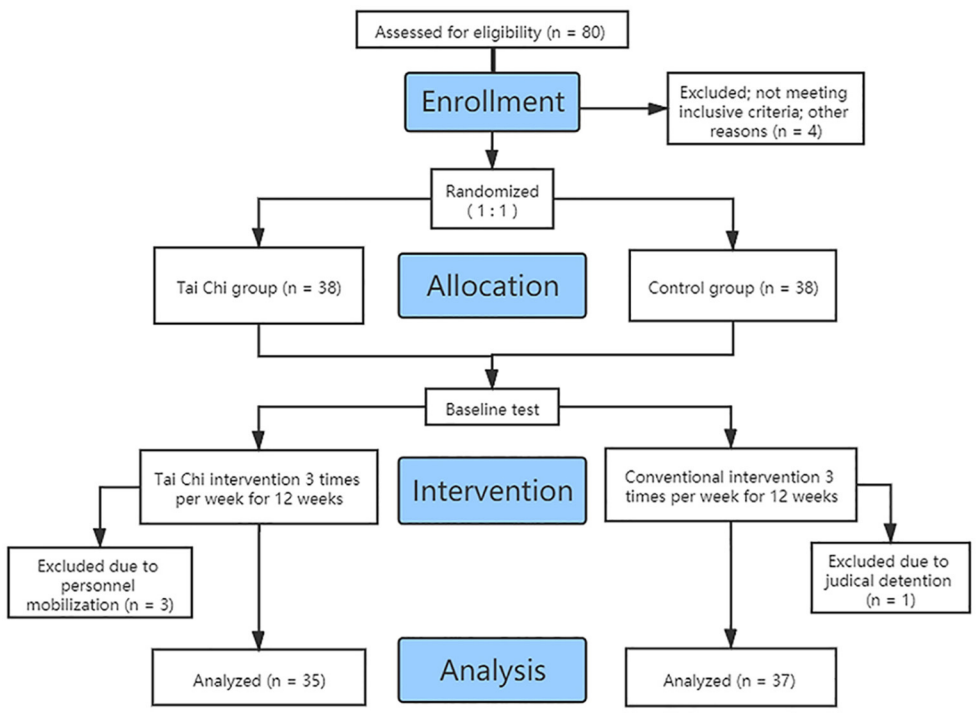

FIGURE 1 | Flowchart of participant enrollment.

the subjects stood on one leg with eyes closed, which reflected their balance ability. Timing was terminated when subjects moved their legs or opened their eyes. The average value was calculated after two measurements. A sit and reach tester was used to measure the flexibility index. The maximum distance was recorded after two measurements. BMI was calculated as weight in kilograms divided by height in meters squared. A grip strength device was used to measure hand grip. Subjects were instructed to grasp the device for a few seconds while exerting their maximum strength. **Table 1** summarizes the demographic characteristics and physical fitness parameters of the two groups at baseline.

Intervention

The exercise group performed a 40 min TC session thrice per week for 12 consecutive weeks. The TC intervention was conducted in the afternoon every Monday, Wednesday, and Friday in the SFMDRC. They were trained in TC, which was based on a simplified 24-form TC that included Ye Ma Feng Zong, Shou Hui Pi Ba, Dao Juan Hong, and other TC styles. Each session consisted of 5 min warm-up, 30 min TC exercise and 5 min cool-down. Participants in the exercise group were instructed by a professional TC instructor two sessions per week. The other session was instructed by a rehab administrator who had been trained for a certain time before the study. The exercise intensity of TC is around 4.5 METs (Metabolic Equivalent of Energy), and individual's heart rate is ∼100/beat a session (67).

The control group was trained with conventional exercises, including the 9th Guang Bo Ti Cao and square dance, under the supervision of administrators. The Guang Bo Ti Cao was designed by the China General Administration of Sports, which was divided into eight sections lasting 5 min. The square dance is a moderate-intensity exercise based on the basic movements of aerobics. Each session in the control group involved muscle stretching as warm-up (5 min), square dance and two rounds of Guang Bo Ti Cao as the main intervention (30 min) and cool-down (5 min). The interventions of the two groups were conducted simultaneously in the SFMDRC with short breaks of <60 s and controlled by supervisors.

Outcome Assessment

Primary Outcome Assessment

The go/no-go and switching tasks were selected in the study to assess the core EFs of IC and cognitive flexibility, as they were classic and widely used tasks in psychological studies (19). N-back task, which is often used to assess working memory, was also selected (70). The main analysis was focused on RT and accuracy results. All cognitive tasks were performed manually on a laptop using E-Prime 2.0 software.

Go/No-Go Task

The stimuli were positive (go stimuli) and inverted triangle (no-go stimuli) of the same size (7 × 7 cm) on a gray background placed at the center of the display (brightness set at 60 CD/m^2). Subjects were instructed to press "F" on the keyboard when the positive triangle appeared as quickly and accurately as possible and to remain seated when the inverted triangle appeared. The stimuli were presented for 100 ms at random order followed by a blank screen with a duration of 1,500 ms. The whole procedure included 20 trials for exercise and 200 trials for the formal task. The accuracy and go RT data were recorded (**Figure 2**).

3-Back Task

Each trial consisted of a fixation in the center of the screen for 500 ms, followed by 45 numbers presenting continuously for 500 ms with a duration of 2,500 ms. Subjects determined if the presented number matched the next-to-last letter and to respond as quickly and accurately as possible. The task

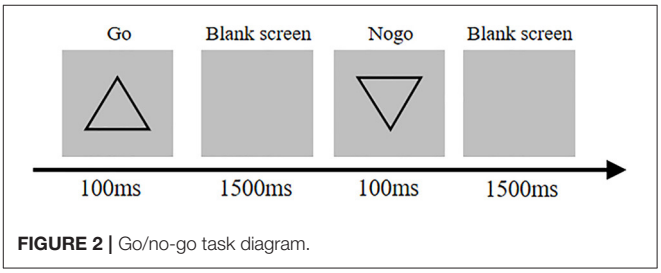

FIGURE 2 | Go/no-go task diagram.

TABLE 1 | Details of the anthropometric information and physical fitness parameters ($\bar{x}$ ± SD).

Variable	Exercise (n = 35)	Control (n = 37)	T-value	p-value
Age (year)	39.31 ±10.33	39.37 ± 9.28	−0.024	0.981
Height (cm)	159.97 ± 5.96	161.94 ± 5.41	−1.449	0.152
Weight (kg)	61.87 ± 8.18	66.66 ± 9.93	−2.204	0.031*
DBP (mmHg)	73.2 ± 10.28	74.29 ± 10.05	−0.447	0.656
SBP (mmHg)	113.74 ± 15.49	109.91 ± 16.16	1.012	0.315
Vital capacity (ml)	1,941.57 ± 551.9	1,978.63 ± 533.7	−0.286	0.776
Flexibility (cm)	11.84 ± 8.76	13.45 ± 6.43	−0.877	0.383
Balance (s)	16.89 ± 12.46	17.71 ± 14.14	−0.260	0.796
BMI (kg/m^2)	24.13 ± 2.64	25.4 ± 3.46	−1.726	0.089
Hand grip (kg)	26.01 ± 5.81	26.67 ± 5.49	−0.492	0.624

DBP, diastolic blood pressure; SBP, systolic blood pressure; flexibility, sitting forward bending value; balance, one-leg stand with eyes closed; BMI, body mass index.
**Displayed as $p < 0.05$.*

included two conditions, namely, congruent (number matched) and incongruent (number does not match). A short practice trial was given before the formal trial began. The whole procedure comprised 20 trials. The accuracy and RT data were recorded (**Figure 3**).

Switching Task

Each trial consisted of a fixation in the center of the screen for 500 ms. This was followed by a stimulus for 500 ms on the screen with an interval duration of 1,000 ms. When the color of the letter turned blue, subjects were instructed to determine whether the whole part (large letter) was S or H and then press the corresponding key (S or H). When the color of the letter appeared green, they were asked to determine whether the part (small letter) was S or H and then press the key (S or H). The formal task included nine sets of stimuli, each comprising 20 trials. The stimuli for each task were presented randomly, and the whole procedure comprised 240 trials. The RT of correct response data were recorded (**Figure 4**).

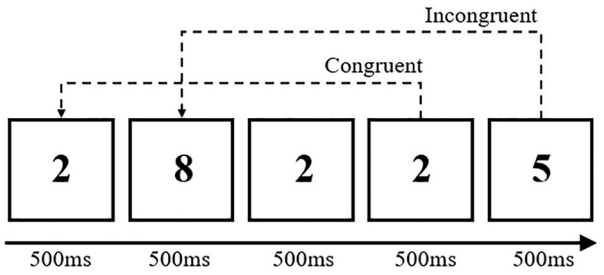

FIGURE 3 | 3-back task diagram.

FIGURE 4 | Switching task diagram.

Statistical Analysis

Data were analyzed using SPSS version 25.0. The data for each task were expressed as mean ± SD. Preliminary analyses were conducted to ensure that participant factors did not differ between groups. Univariate analyses also examined whether the observed effects differed depending on participant's characteristics. For the 3-back task, the RTs (congruent and incongruent) and accuracy (congruent and incongruent) were analyzed using 2 (group: exercise vs. control) × 2 (time point: pre-test vs. post-test) repeated measures analysis of variance (ANOVA). The go RT, accuracy (go, no-go) in go/no-go task and RT in switching task were analyzed using repeated measures ANOVA. Physical fitness parameters assessed before and after exercise were analyzed using repeated measures ANOVA. The statistical significance was set at $p < 0.05$.

RESULTS

Primary Measurements

Go/No-go Task

The analysis of accuracy revealed significant main effects of time [$F_{(1, 68)} = 9.6$, $p < 0.05$, $\eta^2 = 0.12$], condition [$F_{(1, 68)} = 43.4$, $p < 0.001$, $\eta^2 = 0.39$] and the interaction between time and condition [$F_{(1, 68)} = 20.52$, $p < 0.001$, $\eta^2 = 0.23$]. *Post-hoc* test showed that the overall post-test (97 ± 0.3%) accuracy was higher than the pre-test (96 ± 0.2%) accuracy and that the no-go accuracy (95 ± 0.5%) was significantly lower than the go accuracy (99 ± 0.3%). Simple effect analysis showed that the overall pre-test accuracy (94 ± 0.7%) under no-go condition was significantly lower than post-test accuracy (96 ± 0.4%, $p < 0.01$), but the accuracy under the go condition did not differ between time and condition ($p > 0.05$).

RT analysis revealed a significant main effect of time [$F_{(1, 68)} = 16.86$, $p < 0.001$, $\eta^2 = 0.2$]. *Post-hoc* test showed that post-test (408.23 ± 6.52 ms) RT was lower than pre-test (426.65 ± 6.45 ms) RT (**Table 2** and **Figure 5**).

3-Back Task

The analysis of accuracy showed the significant main effects of time [$F_{(1, 61)} = 15.43$, $p < 0.001$, $\eta^2 = 0.20$], condition [$F_{(1, 61)} = 17.59$, $p < 0.001$, $\eta^2 = 0.22$] and an interaction between time and

TABLE 2 | Behavioral data for the go/no-go task in the exercise and control groups (mean ± SD).

Condition	Exercise ($n = 35$)		Control ($n = 37$)	
	Pre-test	Post-test	Pre-test	Post-test
Go accuracy (%)	99 ± 1.0	99 ± 1.0	99 ± 2.0	98 ± 6.0
No-go accuracy (%)	93 ± 6.0	96 ± 4.0	94 ± 5.0	97 ± 4.0

RT, response time.

group [$F_{(1, 61)} = 4.73$, $p < 0.05$, $\eta^2 = 0.07$]. *Post-hoc* test showed that the post-test (37 ± 2.0%) accuracy was lower than the pre-test (45 ± 2.0%) accuracy and that the overall incongruent accuracy (46 ± 2.0%) was significantly higher than the congruent accuracy (36 ± 2.0%). Simple effect analysis showed that the overall post-test accuracy (35 ± 3.0%) of the control group was significantly lower than the pre-test accuracy (47 ± 2.0%) (**Figures 6A,B**).

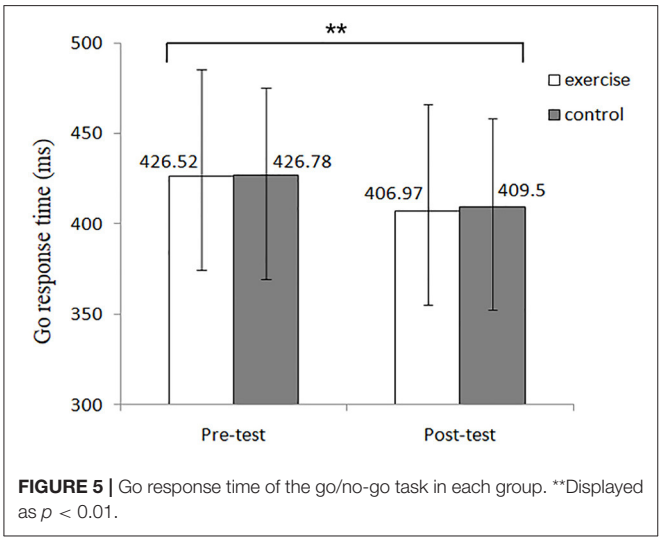

FIGURE 5 | Go response time of the go/no-go task in each group. **Displayed as $p < 0.01$.

The analysis of RT revealed significant main effects of time [$F_{(1, 61)} = 4.66$, $p < 0.05$, $\eta^2 = 0.07$]. *Post-hoc* test showed that the overall post-test RT (622.73 ± 16.45 ms) was significantly higher than the pre-test RT (575.59 ± 20.68 ms) (**Figures 6C,D**). No other interaction effects were observed.

Switching Task

RT analysis showed no significant main effects of time and interaction between time and group ($p > 0.05$) (**Table 3**).

Secondary Measurements

Results of physical fitness parameter analysis indicated significant differences in the within-group factor in terms of systolic blood pressure [$F_{(1, 68)} = 6.105$, $p < 0.05$, $\eta^2 = 0.082$], vital capacity [$F_{(1, 68)} = 5.998$, $p < 0.05$, $\eta^2 = 0.081$] and BMI [$F_{(1, 68)} = 19.569$, $p < 0.05$, $\eta^2 = 0.223$] after 12 weeks of TC intervention. No significant difference

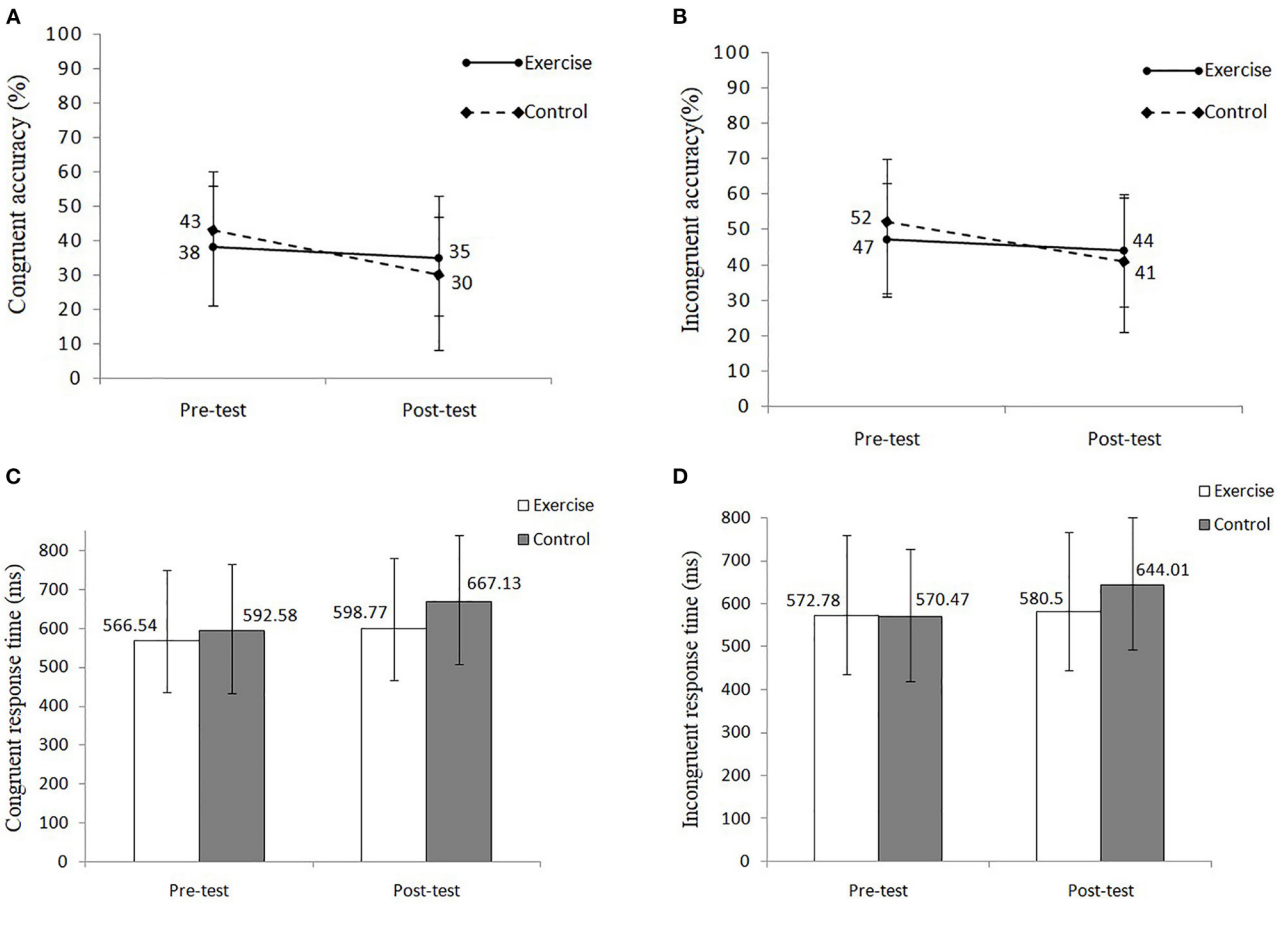

FIGURE 6 | (A) Congruent accuracy of the 3-back task in each group. **(B)** Incongruent accuracy of the 3-back task in each group. **(C)** Congruent response time of the 3-back task in each group. **(D)** Incongruent response time of the 3-back task in each group.

TABLE 3 | RT of switch task in the exercise and control groups (mean ± SD).

Condition	Exercise ($n = 35$)		Control ($n = 37$)	
	Pre-test	Post-test	Pre-test	Post-test
RT (ms)	128.58 ± 131.08	129.67 ± 109.21	132.47 ± 140.17	141.82 ± 117.39

RT, response time.

TABLE 4 | Physical data in the two groups pre- and post-intervention (mean ± SD).

Variable	Exercise ($n = 35$)		Control ($n = 37$)		Within-group	Between-group	Time × group interaction
	Pre-test	Post-test	Pre-test	Post-test	*F*-value	*F*-value	*F*-value
DBP (mmHg)	73.2 ± 10.28	71.29 ± 8.1	74.29 ± 10.05	73.69 ± 9.34	1.496	0.745	0.409
SBP (mmHg)	113.74 ± 15.49	105.57 ± 16.07	109.91 ± 16.16	105.14 ± 12.41	6.105*	0.732	0.421
Vital capacity (ml)	1,941.57 ± 551.9	2,163.86 ± 635.7	1,978.63 ± 533.7	2,056.46 ± 551.6	5.998*	0.084	1.390
Flexibility (cm)	11.84 ± 8.76	12.27 ± 8.53	13.45 ± 6.43	13.63 ± 6.71	0.353	0.717	0.055
Balance (s)	16.89 ± 12.46	18.76 ± 14.13	17.71 ± 14.14	17.84 ± 15.36	0.065	0.318	1.491
BMI (kg/m^2)	24.13 ± 2.64	23.6 ± 2.57	25.4 ± 3.46	25.08 ± 3.36	19.569**	3.676	1.263
Hand grip (kg)	26.01 ± 5.81	26.13 ± 5.2	26.67 ± 5.49	27.18 ± 5.05	0.669	0.483	0.242

Data were analyzed with repeated measures ANOVA.
**Displayed as $p < 0.05$.*
***Displayed as $p < 0.01$.*
DBP, diastolic blood pressure; SBP, systolic blood pressure; flexibility, sitting forward bending value; balance, one-leg stand with eyes closed; BMI, body mass index.

was found between groups and interactions of group × time in systolic blood pressure, vital capacity and BMI (**Table 4**).

DISCUSSION

The present study provided the initial evidence on how TC training affects the EFs and physical fitness of MA dependents. The provision of a supervised TC training thrice per week for 3 months improved the IC of MA dependents. Meanwhile, their working memory and cognitive flexibility remained stable until the end of the intervention. Positive changes in blood pressure and vital capacity were also observed after 3 months of TC training.

EF deficits, such as response inhibition, decision making, and cognitive flexibility, were found in MA dependents (15, 71). The cognitive performances of illicit drug users can be recovered after a long period of abstinence (72). Meanwhile, exercise can reverse the neurological damage caused by drug dependence (72). The combination of exercise and pharmacological therapy, as an indispensable method of drug withdrawal management, exerted an overall positive effect on drug users (73, 74).

Executive Function

Inhibitory Control

In the go/no-go task, higher accuracy was observed in the exercise group after the TC intervention under no-go condition, whereas lower accuracy was observed in the control group under the go condition in the post-test. Lower RT was found in the exercise group under the go condition in the post-test (**Figure 5**) compared with the control group.

The positive results in the exercise group were also similar to a previous study which reported that TC intervention can enhance individuals' IC and EF (62). Evidence proved that moderate-intensity aerobic exercise can enhance the executive control ability of both MA addicts and normal individuals (75, 76). TC was considered an integration exercise of aerobic exercise and cognitive training, which may exert more potential effects on executive cognitive ability (62). It was found through a brain research that TC exercise can activate the prefrontal cortex (PFC) and increase oxyhemoglobin and total hemoglobin in this brain region (77). This kind of enhanced brain activation was considered to be correlated with improved cognitive performances (62). Additionally, the effects of TC exercise on mind–body benefits were reportedly more significant than those of regular aerobic exercise (63). A dose–response relationship was also found between the length of TC training and the improvements in EF of individuals. Electrophysiological investigation showed that individuals who consistently participated in TC exercise showed better IC during EF tasks than those in the regular exercise and control groups (61). Therefore, MA dependents may receive facilitated IC through 12 weeks of TC training and may gain benefits from long-term TC training.

Working Memory

Although the literature showed evidence that exercise can ameliorate the working memory (78), the present study failed to

discover positive changes through the 3-back task. The adverse trend of accuracy and RT in the control group was more obvious than that in the exercise group (**Figure 6**). Moreover, the exercise group maintained relatively stable levels of accuracy and RT. Previous studies also demonstrated the positive effects of TC on the working memory of normal older population (60). One possible mechanism explained by the researchers was that TC training enhances and activates the brain activity of individuals (77). The movement form of TC is characterized by repetition, similarity, complexity, and diversity. During TC practice, the route and name of each movement needed to be memorized repeatedly, which may require the utilization of the working memory of MA dependents. Therefore, TC training has the potential to stabilize and maintain working memory.

Cognitive Flexibility

In previous studies, TC enhances individuals' switching function (79). One research found that individuals' overall cognitive function, processing speed and attention improved after TC intervention (60). Although no significant improvement was found in the present study, the post-test results of the control group showed higher RT compared with baseline and the exercise group, whereas a stable RT was observed in the exercise group. The cognitive flexibility of MA dependents can be well-maintained through TC training.

Physical Fitness

Improvements in Physical Function

Exercise can improve the overall health and basic life quality of MA dependents (80) and is associated with notable improvements in cardiopulmonary health in individuals using MA (52). This study showed significant differences in systolic blood pressure and vital capacity in the exercise group, which was in accordance with many previous studies (81–84). TC exerted influence on the activity of parasympathetic nervous system and the sensitivity of baroreceptor, thereby leading to the positive change of blood pressure (85–87). The vital capacity of the exercise group increased from 1,941.57 ± 551.9 ml to 2,163.86 ± 635.7 ml. This result was similar to a previous study that found MA dependents showed remarkable improvements in vital capacity after moderate-intensity TC intervention (88, 89). TC exercise was also been suggested to normalized BMI in MA users (66). Similarly, decreased BMI was found in the exercise group in the current study, which was the same as the findings of a previous TC intervention study (90).

Balance and Flexibility

The duration of one-leg stand with eyes closed increased in the exercise group compared with baseline, which was similar to the finding of another study (54). The fact that TC can improve balance ability for all kinds of people has been proved by many researchers (91, 92). Although no significant differences were found in balance ability, the prolonged standing time indicated that TC had the tendency and potential to improve the balance ability of MA dependents. No significant change in flexibility was observed between the two groups, which was different from the finding that suggest long-term TC practice can increase flexibility (54). However, the improved flexibility found in this study was achieved from 1-year TC intervention, which was longer than the duration used in the current study. Therefore, insufficient duration of intervention may explain the results of our study.

Possible Mechanism

Numerous studies confirmed the benefits of aerobic exercise on cognitive function (93, 94). The present study showed that TC maintained and improved EFs of MA dependents to some extent. The general mechanism can be explained as follows: Exercise increased the concentration of brain-derived neurotrophic factor (BDNF) (95, 96), which is an important substance that causes neuroplasticity in the brain (96). Exercise training interventions can improve BDNF levels in healthy adults (97, 98), and BDNF has long been implicated in cognition (99). The training-induced BDNF changes reportedly induce cognitive improvement through hippocampal and peripheral levels in humans (99). A neurophysiological study showed that TC improves individuals' memory and other component of EF possibly *via* the upregulation of BDNF (79). Second, MA can cause reduction in striatal and cortical cerebral blood flow *via* dopamine receptor D2 (124) (100), and the blood-brain barrier of individuals can be impaired under the induction of MA (101). However, several studies proved that exercise attenuated MA-induced alterations in neurogenesis and oxidative stress in brain microvessels and protected against blood-brain barrier impairment (102, 103). The neurophysiological effects of exercise to improve blood flow, neurotransmitter levels and brain health have all been proved by evidences (104). This may be the possible mechanism by which TC maintain the EFs of MA dependents in a steadier status. Additionally, as a mind-body exercise, the mindfulness during exercise may influence the brain region involving EFs, such as the anterior cingulate cortex, which is intensely activated during exercise (105). The improvement in EF may due to the neurological flexibility or structural and functional changes in the brain caused by mindfulness practices (106). Additionally, research suggested that long-term TC exercise may contribute to the neural substrates of EF (107).

Therefore, we infer that the improvement of EFs in MA dependents with cognitive deficits may be affected by the combination of the mechanism mentioned above. However, further studies are still necessary to clarify the mechanism.

Limitations

This study has several limitations. First, participants were all managed by administrators in the drug rehabilitation center. Thus, the blinding of the study may be affected by the relationship between administrator (intervention supervisor) and participants, as they may already know the supervisor. Second, although the general exercise intensity of TC was mentioned in the study, tools or instruments were not used to monitor the exercise intensity of participants in the current study, which may influence the experimental results. Additionally, the use of prolonged intervention duration will add reliability to make up the current study's limitation of having a relative short intervention period. The baseline test on detailed information (e.g., use of drug type, year of drug use, and duration of

abstinence before the study) will address the limitation in future studies. The effect of TC exercise on male drug users to enrich the research field can be the focus of future studies, instead of concentrating on females only.

CONCLUSION

Three months of moderate-intensity TC exercise improved the IC, maintained working memory and cognitive flexibility of EFs and ameliorated the physical function of female MA dependents. TC was an effective exercise intervention for drug users. However, some changes of EF parameters were not remarkable, which may be due to the short intervention time. Thus, the long-term effects of TC on EF should be explored in the future.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Institutional Review Board of Shanghai University of Sport. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SM participated in the design of the study and drafted the manuscript. LR conducted the design of the study, exercise intervention, and partial manuscript writing. ZD participated in the design of this study, coordination of intervention conducted in Shanghai detoxification, and rehabilitation center. YS participated in manuscript revision and study design. All authors read and approved the final manuscript.

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"I Wish I Had Help Earlier. We Could Have Been Happier Sooner." Overcoming the Bystander Effect in the Care for Alcohol-Dependent Parents

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Parental alcohol dependency is associated with risks for the well-being of their children. However, guiding these families to support is often complicated. We interviewed 10 alcohol dependent parents, and held 3 focus group interviews with child welfare social workers, and alcohol and other drug workers. We identified a reluctance to act among professional and non-professional bystanders. Family members, neighbours, teachers, and general practitioners are often aware of parental drinking problems, but are reluctant to discuss them with the parents or to alert services designed to support families. The aim of this paper is to share the experiences of parents and show that parents appreciate interventions if done in a certain manner. Although parents were reluctant to discuss their drinking problem, they considered these problems as symptoms of underlying severe distress. They were highly motivated to get help for these underlying problems and wondered why they were not questioned about their distress by those around them. The silence of others reinforced pre-existing feelings of worthlessness and hopelessness. In this paper we analyse other's hesitation to intervene as a form of the bystander effect, and make suggestions on how this bystander effect can be overcome.

Keywords: alcohol misuse, parenting, child well-being, qualitative research, bystander effect

INTRODUCTION

Substance misuse can have severe detrimental effects on the life of users themselves. When they are a parent, substance misuse can also make it difficult to meet all the responsibilities of parenthood and can negatively affect their children's lives. Children of substance dependent parents often report a lower well-being later in life compared to children of non-substance dependent parents (Barnard and Barlow, 2003; Kroll, 2004).

Although these families seem in need of professional support, the care for these families seems to be complicated for several reasons, for example because of taboos surrounding parental addiction (Young et al., 2007; Osterling and Austin, 2008; Forrester and Harwin, 2011; Oliveros and Kaufman, 2011; Niccols et al., 2012).

We did an explorative study in the Netherlands to investigate the views of parents and professionals on the main bottle necks in care, and how they imagined possible solutions. In this paper, we want to discuss one of the findings of our study: reluctance to act, which was found both among professional and non-professional bystanders, that is people close to struggling families like neighbours, befriended parents at school, friends, family.

We will first outline our method. Second, we will look into the frustrations of professionals and parents regarding intervention, and their observations of the reluctance of various kinds of bystanders to acknowledge apparent signs of distress. Combining insights from studies on the bystander effect with the needs and hopes of parents, we will make recommendations on how the bystander effect can be overcome. We will show how bystanders can play an important role in motivating families to seek support by showing compassion and acknowledging the broader life struggles of the parents.

METHOD

The aim of the broader research was an explorative study in how the care for families with parental alcohol dependency could be improved. The aim of this paper is to look into the findings on reluctance to act, and the potential positive role bystanders can play.

We conducted a series of qualitative interviews in the Netherlands with 10 alcohol dependent parents aged 30–50, with a mean age of 42 years. Three parents were recruited in a long-term residential family treatment program that is specifically for parents struggling with addiction. Seven parents were recruited in a short-stay (from 2 weeks up to 3 months) detoxification facility. These parents underwent detoxification followed by in-patient therapy. We interviewed six alcohol dependent mothers and four fathers. At the time of the interviews, parents had between one and four children, aged 1–22 years. Six parents had an alcohol dependency only, four parents currently had an alcohol dependency only but used to be addicted to other substances previously (heroin, cocaine, GHB, speed, diazepam).

Interviews were conducted individually at their homes or within the care facility, depending on the respondent's preference. Interviews lasted about 1 h. We used a combination of a semi-structured questionnaire and a timeline narrative approach (Berends, 2011). Respondents were first invited to tell their life storeys and to elaborate on life events relevant to their substance dependency and parenthood. Additionally, specific questions were asked about their experiences with the treatment facilities and child welfare. They were also asked about strategies that would, according to them, be necessary to improve care. We decided to focus specifically on alcohol dependency, because this is the most prevalent type of substance misuse for parents, and studies have indicated that alcohol misuse is under-detected and its impact is underestimated (Harwin and Forrester, 2002, p. 41).

We also conducted three focus groups with professionals: two with child welfare workers ($n = 5$), and one with workers in alcohol and other drug (AOD) services ($n = 6$). Professionals were asked to reflect on how care could be improved for families in which there is parental alcohol abuse.

All interviews were recorded, fully transcribed verbatim, and analysed in NVivo, a software package that facilitates analysis of qualitative data. Selected quotes were translated from Dutch to English by the first author.

The qualitative data is analysed at four levels: (i) interpretative content analysis, to identify typologies of ethical issues, (ii) thematic analysis, built on open and axial coding, to identify factors across different typologies; (iii) values-discourse analysis, to identify ethical frameworks and thinking strategies; and (iv) a narrative analysis of case studies (Charmaz, 2011; Wertz et al., 2011). Two researchers (AS & DH) analysed the data independently, to insure inter-rater reliability. Inter-rater reliability was established in a dialogical rather than a quantitative way. This paper mainly uses insights from (ii) thematic analysis and (iv) narrative analysis.

Early Intervention, Presumed Care Avoidance, and the Knowledge of Bystanders

The first prominent finding was that professionals identified the lack of early intervention as the main barrier to effective care. They presumed that this difficulty to early intervention was caused by parental care avoidance: parents concealed their problems from professionals until their situation had severely escalated. However, parents did not support this view of being care-avoidant. Secondly, we found that also parents expressed the wish that they had had help earlier. This seemed a promising finding: that both parents and professionals hoped that these families found their way to care sooner. But how can this be realised? The third remarkable finding was that both parents and professionals described that those close to families with parental substance dependency were often aware of the struggles of these families, but did not know what to do. In the rest of this paper we will explore the significance of this group of bystanders in the process of motivating alcohol dependent parents to seek care. We will first discuss the observation of professionals and parents that bystanders often are aware of the distress these families face, and could potentially play an important role in motivating parents to seek treatment. We will then look at the lessons learned from research on the bystander effect, and make recommendation for policies based on promising best practises.

The Knowledge of Bystanders

What puzzled both parents and professionals alike was that, in their experience, those close to struggling families were often aware of parental distress but were reluctant to act on these signals. This held true for professionals such as General Practitioners (GPs), teachers at kindergartens and schools, health care providers, as well as non-professionals like family members, neighbours, friends, and befriended parents at playgrounds and school. Professionals and parents stated that they thought that these bystanders could play an important

role in helping parents to seek help, professionally and non-professionally.

One of the child welfare workers described a case in which a mother struggled with borderline personality disorder and a severe drinking problem. At a certain point, her children, who were 8 and 12 at that moment, became so scared of her that they locked themselves in their room. The mother literally tried to smoke them out by creating a fire before their bedroom door. It was only at this crisis point that the child welfare services got involved.

> How bad have things become if the mother needs to almost literally burn the house down before we help the children. That is outrageous. You asked about ethical dilemmas… Then I wonder… How can this happen? While the network knows about it, the GP knows about it. The school has suspicions. Yes, then I think that our system of care in the Netherlands is severely negligent. (Timothy, child welfare worker)

The case ended with the children being placed out of the house to live with their uncle, and the mother drinking herself to death. Another child welfare worker described a case that made a strong impression on him. He was intensively working with a mother of a 2 year old child. He knew she had mental health problems, but she successfully managed, with the help of her father, to conceal her drinking problem. He found out by accident when he paid an unannounced visit. It shocked him that he failed to notice it, and that others—the cleaning lady, childcare, the father—knew but did not notify him.

Professionals themselves also described that they sometimes found it hard to intervene, or to discuss parenthood.

> When in my personal life, I hear storeys about a mother who drinks too much, I also think 'do I have to report that? I don't even know that person.' (…) I understand how hard it is. As child welfare agents, we ask a lot from people. Even for me, as a professional, I sometimes find it hard, there are no easy answers. (Samantha, child welfare professional)
>
> I remember well that at a certain moment I had to discuss with a client something that was not functional in their relationship with their children. (…) The moment you start talking about that, you are going to talk about the most vulnerable part of a client. You're going to talk about being a parent and their relationship with their kids. I had to cross eight barriers before I finally had the guts to talk about it with. (Oscar, addiction professional)

Several parents stated that they would pick up their children from school or walk around the neighbourhood while being intoxicated, hence no one ever started a conversation about it with them.

> I would wake up in the morning and feel miserable. I would drink two glasses of liquor. After that, I would make a cup of tea, but after the tea, liquor again. I would drink like that all day. Preferably not until I was smashed, but I couldn't always control it. Looking back, I think I was more intoxicated than I thought. (…) But I don't know how bad it was, because no one ever said something. (Barbara)
>
> Drinking apparently changed me, because people in the neighbourhood started to eye me, but no one ever said something. (Steve)

Another respondent, Monique, is a 36 year old single mother with three children aged between 8 and 13. She drank to cope with severe domestic violence. She states:

> I wish I had help earlier. We could have been happier sooner. (…) But I wasn't capable myself of seeking help. But think about it: the school knew I was drinking. The police had been at our door so many times, but they never did anything to help the children. (…) I wish they had intervened earlier. (Monique)

She felt that it was clear that there were enough signals that she was struggling but no one around her reached out to help her:

> Look, if the police got 23 reports of domestic violence, why didn't they start enquiring after the third time? Why didn't they think: 'Let's have a look, let's talk with this lady.' (…) Even if from the outside the children look alright. (…) If the parent smells like alcohol in the morning, the school should report it sooner. (Monique)

One of Monique's neighbours later told her that already for 5 years she had suspicions that Monique was struggling.

The experiences of support workers and parents showed that those surrounding these families often were aware of the problems, but were not sure what to do or how to start a conversation. Studies from child abuse seem to support these findings (Paquin and Ford, 1996).

Lessons Learned From the Bystander Effect

Very little research has been done on the deliberations and experiences of people surrounding alcohol dependent parents. Until more research is done, we will draw parallels with research on the bystander effect, and with research on why professionals are reluctant to comply with mandatory reporting laws.

The bystander effect was first described by Latane and Darley (1968) when a group of bystanders failed to intervene when a young woman was killed in the middle of the street. Over 30 people reportedly witnessed the event, but no one helped.

When analysing the interviews, we noticed that the situations that the respondents described seemed to be a variation of the bystander effect: many people in their environment noticed their distress and alcohol abuse, yet no one talked to them about this and no one intervened. The situation the parents describe differs from a paradigmatic case of the bystander effect in two ways. First, the bystander effect only describes how bystanders fail to protect someone from a perpetrator. In the case of parental alcohol dependency we are not merely interested in whether or not bystanders should intervene when parents harm their children; rather, we are mainly interested in the period before that: responding to parental distress in itself to prevent (potential) future harm to children, without regarding the parent as a perpetrator but as someone in need of care.

Second, the bystander effect describes how strangers fail to intervene, whereas we are concerned with people close to the families who fail to intervene. Some of the literature on the bystander effect in reporting child abuse is useful here, because this literature reflects on the complex nature of people close to a family intervening in family matters (Christy and Voigt, 1994; Hoefnagels and Zwikker, 2001; Taylor et al., 2016). However, our main point of interest is different and we focus on the distress that precedes or facilitates any alcohol abuse.

Now that we have identified a variation of the bystander effect surrounding parental alcohol dependency and any underlying distress, the question arises how the effect can be overcome. Latane and Darley (1968) analysed why bystanders fail to intervene, and itemised five steps in successful intervening. First, the bystander must notice that something is happening. Second, they have to interpret the event as a matter of urgency. Third, the person must decide that it is his or her responsibility to intervene. Fourth, the bystander has to decide how he or she wants to intervene. Finally, the intervention must be carried out.

Research by Christy and Voigt (1994) on how to overcome the bystander effect in reporting child abuse revealed that feeling responsible and being certain about how to intervene predicted whether bystanders would intervene. Our interviews extend these findings to the case of parental distress. Based on our interviews with parents, we will outline that, and how, parents would like others to intervene.

Our goal is not to shame loved ones of people struggling with alcohol dependency. We also do not wish to diverge the responsibility to seek help from parents to others. Rather we try to show that parents struggling with alcohol dependency often long for someone to support them, rather than actively avoid care, and we will provide strategies of how people could best guide them to care. The impression we have is that loved ones and bystanders often want to help, but do not know how and that parents indeed are very reluctant to some kinds of interventions and ways of being approached but are very open if not even desperate for other approaches.

Bystanders: Respecting Privacy or Reinforcing Feelings of Worthlessness?

Before we outline how parents would like bystanders to intervene, we will first contemplate on the reasons bystanders might have not to intervene. We do not know why bystanders do not intervene. We know from the literature that in case professionals fail to comply to laws of mandatory reporting, they do so because they are afraid that they unjustly interfere in private matters, and that this will harm the care relationship (Kalichman, 1999; Alvarez et al., 2004) more than it will contribute to a bettering of the overall situations of those they might report about. Something similar might hold true for non-professional bystanders.

There is a certain reluctance to intervene in private matters, and problematic consumption of alcohol and domestic violence are often (erroneously) perceived as private affairs. One way to respond to these signs of distress is by looking the other way andgive people some privacy regarding their family problems. In general, people wish to respect other's privacy and autonomy (Kalichman, 1999; Alvarez et al., 2004). However, the parents we interviewed experienced this concern for privacy not as signs of respect and dignity, but instead rather as forms of apathy and indifference. Unfortunately, by turning a blind eye to the problems experienced by the families, the parents' pre-existing feelings of worthlessness were exacerbated.

One of the parents we interviewed, explained that the very fact that no one offered help even though many people knew about her struggles—first with her violent partner, later with her being traumatised and isolated, and finally about her abuse of alcohol—actually reinforced her feelings of worthlessness and hopelessness. She acquired this low self-esteem already as a child, but being ignored in her struggles reinforced her negative feelings about herself and made her feel unworthy of help. She felt trapped in a vicious circle.

> The only message I got during my childhood was: 'you shouldn't have existed. You are worthless and will never amount to anything'. If that is the only experience you have ever had in your life then the fact that others do not seem to respond to your struggles only reinforces this feeling. You think at school: 'Look, they never ask how I am doing, they just let me be'. (Monique)

For Monique, recognition of her underlying problems and an offer of help would have been key to addressing her drinking problem earlier. These findings are in line with earlier observations made by Kalichman (1999) who argues that if clients know that professionals could help or could report problems, but the professionals refrained from doing so, the clients might interpret this as a sign that the professional is unwilling to get involved, or as a sign that the clients might be unworthy to receive care and help. Something similar seems to hold true for non-professional bystanders.

The interviews with parents seemed to indicate that parents do appreciate intervention. However, there seems to be a certain tension between the statements of the parents that they wished other intervened, and the general image of these parents as care avoidings concealing their problems. We asked parents what they thought of this tension, and they indicated that they could feel very threatened by certain interventions. However, they also indicated how they would like to be approached.

Breaking the Bystander Effect: Compassion for Life Distress

Parents indicated that they felt very threatened by interventions directly questioning their drinking or their parental skills.

When she was asked to specify who should have intervened, and how, Monique acknowledged that initially she would not have been open to receive help for herself or for her children:

> I knew I would have become very angry. That was also what the head of school said to me. She said: 'I knew you were drinking, and I knew you had problems, but the kids seemed to be doing okay. (. . .) If I would have called Child Welfare Service, you would have gotten very angry, and maybe you would have physically attacked me'. And yes, I think I would have done that, because if I had been drinking, I would have been furious [with her intervention]. Don't

> threaten my children, or you will get into a fight with me. And that is the ambivalent part: on the one hand, you are hoping so hard for someone who pressures you to seek help...

Monique had clear ideas on how parents should be approached in order to make it easier for them to accept care. She stated that conversations from concerned bystanders should focus on care and be done with compassion; accusations or criticism should be avoided. Offers of support should not primarily focus on her drinking, but on the underlying problems.

> They should have a conversation with the parent. Not in an accusing way, like 'oh, you are an alcoholic' (…) but: 'Is there something we can do to help you?' (…) if the intention is care, and not accusation, that is very important. (…) When you are addicted, you feel immediately criticised as a parent 'ah, you are not taking good care of your children', I am very sensitive to that.

Offering support for her personal problems would have been a good way to also address her alcohol abuse and its effect on her family life.

Respondent Steve had a similar experience. When asked if anyone had ever offered him help with his drinking problem, he said "no." When questioned whether or not he would have found it helpful or not, he replied:

> I wouldn't have liked it, but I think it would have helped me. (…) If my brothers and my sister, if they would have said: 'Steve, what is happening with you? Is there something that is worrying you? Are you bottling things up?' Then maybe I could have shared my feelings surrounding my father's death, and things might have been different. Then I would have had support earlier. (…) Then I wouldn't have decided to go overseas [to smuggle drugs]. Then I wouldn't have had the gaol sentence. I could have had a more normal life than now.

He reported that his son's non-judgmental attitude had motivated him to seek care. His son told him:

> Dad, I don't mind if you start drinking again. It doesn't matter, I will still visit you, because I know who you are, and you always have a good attitude. I will love you just as much, only you will not be able to experience much of my life. Since if you keep drinking, you will only have three years left to live.

The respondents described their drinking problems as a response to severe distress in their lives. For example due to persistent domestic violence, or childhood trauma, but often due to complicated, long-term life adversities. One parent described how years of fertility treatments, combined with complications during childbirth and severe behavioural problems of her daughter, made her quit her job, put strains on her marriage and resulted in her drinking habits. Another respondent described how his first child suffered from reflux and would scream for hours and days on end, triggering a war trauma he thought he had dealt with 10 years ago. Because he no longer worked in the army, he was not sure if he could confine to a therapist about his trauma, or whether he was legally obliged to keep silent about this experiences. This, in combination with some deaths in the family, and the affair of his wife fuelled his drinking habits. Drinking was a coping strategy for most parents that helped them to deal with their issues in the short-term, but obviously in the long term worked seriously against them. Although they knew that their drinking habits were unhelpful, they would prefer others to address their underlying distress rather than their drinking problems as such.

Our interviews showed that parents would have liked bystanders to respond to their distress. Parents stated that they did not mind if others interfered with their private matters, as long as their intention was to support and not to judge, and as long as their questions were aimed at teasing out the underlying stresses and not solely on their drinking habits. This attitude of genuine interest in the distress parents experience could have motivated them to seek treatment for their trauma and as a consequence possibly also for their drinking habits at a much earlier phase.

Inspiring Practises

As Christy and Voigt (1994) argue, the spell of the bystander effect can be broken by increasing a sense of responsibility and educating people on how to act. Parents indicated that they are in need of compassionate response by bystanders. There are several practises in public health that already do focus on these aspects and that might inspire also good practise in the context of guidance to care of alcohol dependent parents. The Australian campaign "R U OK?" (Mok et al., 2016; Ross and Bassilios, 2019) which encourages people to ask those in their community who might be distressed: "Are you okay?" could be a relevant example in this regard Even though the goal of that campaign is quite different and targets suicide-prevention, the means invoked to that aim seem to be inspiring for the current context as well. The focus is on giving bystanders some—mental—resource to reach out and thereby to open up a way for distressed people to feel connected. In a similar way, also the T'Mental Health First Aid' (MHFA) program is an early prevention program that aims at making the general public feel more comfortable to approach people who apparently are in distress and to identify signs and symptoms of distress (Kitchener and Jorm, 2006; Hadlaczky et al., 2014).

Most of the current public health campaigns around distressed families focus on the importance of reporting. Again, no data are available on why laypeople fail to report, but there are some data on why professionals feel uncomfortable with mandatory reporting systems, although in many countries they are obliged by law to do so (Thompson-Cooper et al., 1993; Goldsberry, 2001; Lecluijze, 2015). Professionals report that they often are not sure whether the signs they see are grave enough to report, they fear that they unjustly accuse someone, they are unsure what will happen with their report and they fear that the situation would worsen for the already struggling family. In sum, they fear that if they officially reported the parents they would harm their caring relationship with the family and in the end to more harm than good (Kalichman, 1999; Alvarez et al., 2004). People often feel uncomfortable with reporting, but do not know what they could do otherwise. As a consequence, many fail to intervene or provide support altogether. Our study shows how concerned bystanders can engage with parents, that way, reporting might probably

become less pressing as more parents become motivated to seek support. Otherwise, bystanders could discuss with parents their concerns and their wish to notify supporting professionals. That way, reporting might feel less like "snitching" to bystanders, and more as a sign that they take the welfare of the family seriously.

Professionals have the know-how to help these families, but often feel that the problems are concealed from them. People surrounding these families often know that these families are struggling, but do not know what to do. One solution is to motivate bystanders to report signs of distress that they notice, another—additional—solution is to educate bystanders on what they can do to enhance parental motivation to seek care.

Our findings show that a more promising approach might be to stimulate bystanders to take responsibility to break the isolation of these families by showing a genuine interest in the underlying causes of their distress,

Limitations of the Study

Since this was an explorative, grounded theory type of study, we only studied the role of bystanders indirectly: through the reports of parents and child welfare and addiction professionals. More research is needed on the experiences and contemplations of other bystanders., like professionals working at institutions parents and children attend for other reasons such as schools or child care centres and non-professional bystanders, like neighbours, friends or other parents at the playground.

Another characteristic of our study is that the data was collected from respondents who were already in treatment rather than those who are still reluctant or actively concealing their drinking behaviour. Some had already completed an intensive, in-patient family treatment of 9 months or had been in detoxification. Most respondents had already strongly benefited from care. So the results might not be representative for alcohol dependent parents who are still denying their alcohol dependency and are not in care. At the same time, it must also be said that the characteristic care-avoidance of (most) alcohol dependent parents would make it difficult to identify and recruit such parents for research purposes. However, most of the participating parents went through that phase as well, so they do remember their previous feelings and views well. The present article still provides important insights in how parents would have liked to be approached and guided toward sources of support and what had made them reluctant or defensive.

Our empirical data is collected among alcohol dependent parents, but not among parents with other drug-addictions (although some respondents had experience with other substances in the past). Whether our findings would also hold for them or for parents with multi-drug usage cannot be answered.

CONCLUSION

Our interviews revealed that people (GPs, teachers, neighbours, family, friends) surrounding families in which parents struggle with problematic alcohol use are often aware of their distress, but are reluctant to intervene. This treatment gap is already well-known. The same counts for the insight that a non-judgmental approach toward parents with substance dependency can help them seek support. However, our study shows that, regardless of this state of knowledge, parents still experience stigma, and there is still a treatment gap—both in the eyes of parents as professionals.

By linking this treatment gap to the bystander effect, we hope to give new impulse to bridging the gap. One insight from general studies on the bystander effect is that it can be overcome when people know how to act.

We have provided some strategies on how to counteract the inertia and uncertainty caused by the bystander effect, guided by what distressed parents articulated as needing at the time of the intervention to open up and seek help. From the perspective of parents, effective access to care encouraged by empathetic professionals and other bystanders enquiring about "personal distress" and showing an interest in the parents as persons (not alcoholics) whilst encouraging them to seek help. However, this concern would be counterproductive if the bystanders focused mainly on any overt problems with alcohol misuse. Parents would feel that they were not being taken seriously, particularly if they regard their alcohol misuse as a symptom of underlying life stresses rather than as the actual cause of any troubles they have in leading their lives and parenting their children. Moreover, a focus on drinking problems would make them feel to be judged almost by definition as incompetent parents and may fear losing their children in child-custody cases. As a consequence, they might indeed avoid care altogether and not even dare to engage in any professional intervention. A non-judgmental approach that shows direct and explicit interest in any underlying troubles of the parent and that offers concrete help for these issues might, in the end, be the most encouraging and effective way for parents to also seek support for their alcohol dependency. However, the causes of their alcohol dependency should be acknowledged first, before the symptoms can be dealt with.

Of course, there are particularly serious or acute cases which require immediate action to ensure child safety and well-being. The aim of this article, however, is to contribute to the prevention of these situations by adequately responding to signs of parental distress by bystanders. An approach focussing on the underlying problems might not only contribute to motivating parents to seek treatment, but might also contribute to sustainable changes in these families.

One cause of the bystander effect is that people do not act because they feel they do not know how they should act. Research shows that many people feel uncomfortable with (mandatory) reporting systems (Thompson-Cooper et al., 1993; Greipp, 1997; Kalichman, 1999; Goldsberry, 2001). These bystanders fear that the vulnerable families they want to help would feel scrutinised and disciplined rather than supported. Our research shows a different way in which bystanders can react to signs of parental distress and we point toward possibilities to use these in public health campaigns.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because restrictions from the ethics committee. Requests to access the datasets should be directed to Anke Snoek (a.snoek@maastrichtuniversity.nl).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethical Committee of the Academic Hospital Maastricht and Maastricht University, positive advice has been granted (no 164216). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AS designed and set-up the study together with DH. AS conducted the interviews, made a first analysis, and drafted the manuscript. DH conducted an independent analysis of the data and substantially contributed to revisions of the manuscript. WM and MV helped with the recruitment of respondents. BD, WM, MV, and GD all extensively commented on previous versions and significantly contributed to the final version of the manuscript. All authors agree with the final version.

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How Resilience Promotes Mental Health of Patients With DSM-5 Substance Use Disorder? The Mediation Roles of Positive Affect, Self-Esteem, and Perceived Social Support

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Objectives: The existing studies found that resilience is a salient trait that can significantly affect people's psychological well-being with substance use disorders (SUDs). However, few studies examined how the mechanisms are connected between resilience and mental health among patients with Diagnostic and Statistical Manual of Mental Disorders—fifth edition SUD. This study investigated the mediation effects of positive affect, perceived social support, and self-esteem on the effect of resilience on perceived stress and life satisfaction in SUD patients.

Design: A total of 415 patients diagnosed with Diagnostic and Statistical Manual of Mental Disorders—fifth edition SUD from the south of China joined the research.

Outcome Measures: The study applied Connor–Davidson Resilience Scale, Positive and Negative Affect Scale, Multidimensional Scale of Perceived Social Support, Rosenberg Self-Esteem Scale, and Satisfaction with Life Scale to measure patients' resilience, positive affect, self-esteem, perceived social support, perceived stress, and life satisfaction.

Results: Structural equation model analysis revealed that positive affect and self-esteem partially mediate the relationship between resilience and perceived stress. In contrast, positive affect and perceived social support partially mediate the relationship between resilience and life satisfaction.

Conclusion: The findings provide insights for evidence-based substance abuse intervention that positive affect, self-esteem, and perceived social support can conditional the effects of resilience on promoting the mental health of SUD patients.

Keywords: substance use disorders, resilience, mental health, positive affect, self-esteem, perceived social support

BACKGROUND

Substance use disorders (SUDs) have been widely considered a global threat, posing enormous risks to individual well-being and cohesion of societies (1). As one of the overarching social problems, numerous studies have examined the correlations between SUD and psychological processes. Many studies show that perceived stress and life satisfaction are two prominent factors that play significant roles in influencing addiction severity and integral well-being (2).

Perceived stress is defined as individuals' cognitive appraisals over their stress level (3). Numerous addiction theories have depicted the theoretical linkage between perceived stress and substance abuse (4–6). For example, *tension reduction theory* (6) and self-medication hypothesis (5) postulate that chronic perceived stress is one of the primary motivations of taking illicit substances, which may temporarily alleviate psychological distress. Empirical findings also reveal that exposure to stress and post-traumatic stress disorder can increase illicit drug consumption level, frequency, and severity (7–11). Further, clinical observations suggest that substance users with higher perceived stress tend to report higher relapse rates (12, 13). Therefore, exploring the strategies to reduce perceived stress among people with SUD is of great importance for minimizing SUD's detrimental impacts and enlarging both the physical and mental well-being of people with SUD.

Life satisfaction is conceptualized as an individual's cognitive appraisal regarding their life's overall satisfaction (14). Life satisfaction has been used as a complementary method for assessing psychological well-being (15). Wide ranges of studies suggest that low life satisfaction is one of the salient predictors of some psychological disorders, including SUDs (2), anxiety (16), depression (17), and internet addiction disorders (18). Individuals with high life satisfaction report a lower level of substance abuse and mental health disorders (16). Life satisfaction has also been implemented as a diagnostic tool for SUD rehabilitation (19). Thus, exploring the potential mechanisms that boost life satisfaction among patients with SUD is crucial for combating the physical and psychological distress, promoting SUD rehabilitation processes.

RESILIENCE

Resilience has been regarded as one of the most critical determinants closely correlated to perceived stress and life satisfaction (20, 21). The definitions of resilience are generally based around two concepts, adversities and positive adaptions, conceptualizing individuals' capacity to bounce back when exposed to ranges of misfortunes (22, 23). The recent studies tend to define resilience, beyond the scope of a trait, as a dynamic psychological process that is susceptible to demographic factors [e.g., population, time, and place; (24)] and tends to promote other psychological traits [e.g., affect balance, self-esteem, and perceived social support; (23, 25)].

The relationships among resilience, perceived stress, and life satisfaction have been well-documented. A substantial body of studies conducted in the populations of non-users have shown that individuals with a higher level of resilience are reported to have lesser perceived stress in life events (20, 26, 27). Studies also suggest that people with higher resilience tend to experience a higher level of life satisfaction (28). However, although theoretical and empirical studies have suggested the associations among resilience, perceived stress, and life satisfaction, few focused on exploring the underlying mechanisms among them, especially among patients with SUD.

POSITIVE AFFECT, SELF-ESTEEM, AND PERCEIVED SOCIAL SUPPORT AS MEDIATORS

Based on the existing theoretical and empirical studies, three items were the potential mediators in the impacts of resilience on perceived stress and life satisfaction. The first potential mediator is positive affect, whose definition was distinguished from positive emotion in history, but both have been used interchangeably nowadays (29, 30). Positive affect is conceptualized as the "pleasant ends" that can produce adaptive outcomes for flourishing individuals' mental and physical health (29). Fredrickson (31) suggests that positive affect is encompassed by the *broaden-and-build theory* (31–33), which denotes that positive affect can broaden mindsets by building enduring bio-psycho-social resources (e.g., social connections and coping methods), then achieving long-term adaptive outcomes such as happiness (34), psychological growth (35), creativity (36), immune function (37), reduction of an inflammatory response (38), and physical pain release (39). Studies have demonstrated that positive affect has an interactive relationship with resilience (40, 41) and life satisfaction (42, 43). Meanwhile, studies also identify that positive affect can significantly and effectively buffer the adverse impacts of perceived stress by widening thought–action repertoires, which facilitate generativity and behavioral flexibility (44). Based on theoretical and empirical studies, we hypothesized that positive affect would be the first mediator in the present study.

Extant studies indicate that self-esteem may be the second mediator. The widely accepted definition of self-esteem refers to the individual's general evaluation toward themselves (45, 46). However, there is a dispute regarding whether self-esteem is a component of resilience, the present study aligned with the mainstream perspectives which treat self-esteem as a separate concept (47–50). People with high self-esteem are motivated to maintain positive evaluations of themselves, further denoted by *terror management theory* (51). The theory depicts that self-esteem works as a buffer for anxiety-related events and various threats, promoting and maintaining a positive self-evaluation [e.g., (45, 51)].

Numerous empirical studies have shown that resilience can significantly facilitate self-esteem (25, 48, 52). Meanwhile, self-esteem is reported as a strong predictor of life satisfaction (45, 53, 54). Although rare attention has been paid to the association between self-esteem and perceived stress (55, 56), the terror management theory (51) posits that self-esteem is beneficial

for preventing individuals from the impacts of the anxiety-related event, a salient predictor of perceived stress (57). Thus, the present study hypothesized that self-esteem is the second mediator in the impacts of resilience on perceived stress and life satisfaction in SUD patients.

Perceived social support is identified as the third mediator of the links. Although there is a statement that a supportive relationship is a key refinement of resilience, Pangello et al. (58) suggest that further research with regard to the overlaps between resilience and other concepts is needed, as the definitions and operationalizations of resilience are inconsistent. Therefore, the current research regarded perceived social support as an independent concept. Perceived social support reflects the individual's judgment over the general availability of support from relational and social boundaries (59).

The relationship between resilience and perceived social support has been documented by a wide range of studies (60–62). A majority of research focuses on examining the effects of perceived social support on resilience, suggesting that individuals with high perceived social support are reported with a higher level of resilience (60, 61, 63). A small group of studies explored how resilient people broaden their social networks and acquire supports from the established network. For example, Sexton et al. (64) suggested that resilient people are more likely to express their thoughts and find sympathetic friends, which are the salient factors for reducing psychological burdens (62). Furthermore, perceived social support has been identified with the roles of maintaining physical and mental well-being (65–69). Notably, groups of studies have found that people with high perceived social support are reported with a higher level of life satisfaction (70, 71), whereas some studies suggest that perceived social support has a negative association with perceived stress (72, 73). Based on the present observations, we hypothesized that perceived social support is the third mediator of the study.

CONTEXT OF SUBSTANCE USE DISORDERS

Many social studies emphasize that psychological processes are susceptible to contextual and situational factors (74, 75). SUD is one of the significant contextual factors that can contribute to a wide range of variances in an individual's biological homeostasis (76, 77), psychological states (78, 79), relational and social boundaries (80), occupational performance (81), and cultural beliefs (82).

The present study focused on examining how underlying associations are shaped between psychological traits and mental health within the context of SUD. People with SUD may suffer more physical, psychological, relational, and social difficulties and challenges than non-users. For example, due to discrimination and social exclusion, studies showed that people with SUD report a lower level of perceived social support than non-users (83). Also, the relationship between support-giver and patients has been altered by bio-power, formed through designated interventions (59). Therefore, how the psychological traits are associated with mental health within the context of SUD is uncertain.

PRESENT STUDY

To reveal the uncertainties, the present study dedicated to examining whether positive affect, self-esteem, and perceived social support mediate the effects of resilience on perceived stress and life satisfaction, respectively. Based on the previous studies, we hypothesized that resilience exerts effects on perceived stress and life satisfaction via positive affect, self-esteem, and social support among people with SUD (**Figure 1**).

METHODS

Participants and Design

The participants were comprised of 415 (322 males and 93 females, excluding one missing data) patients with SUD. All participants were recruited from two rehabilitation centers in the south of China. Nine demographic characteristics were measured in the study: age, sex, education, marital status, annual income, employment, months of detoxification, and substance types. The inclusion criteria of the study were as follows: age of 18 years or more, right-handed, normal color perception, regular and stable cognition, diagnosed with SUD within the last 12 months, and the voluntary willingness to participate. The exclusion criteria included: cognitive disabilities, psychiatric impairments, and a history of acute heart, kidney, and liver diseases, and the unwillingness to participate. As there were few missing values, we adopted listwise deletion for the cases with more than two missing values and mean imputation for the cases that had one missing value. The details of the demographic characteristics of 415 participants are shown in **Table 1**.

Procedure

The study was approved by the Ethics Committee of Nanjing Medical University, which thoroughly considered the interests of human rights, ethics, and procedure safeties. All participants showed informed consent before involving in the study. Participants were sequentially allocated into separate meeting rooms where self-report scales took 30 min on average to ensure confidentiality. At least a research assistant was available for assisting when the participants were filing the scales.

Measures

The present study applied the Connor–Davidson Resilience Scale [CD-RISC; (84)] for assessing the patients' resilience. The CD-RISC is a five-point Likert scale (from 0 = *not true at all* to 4 = *true nearly all the time*), which is designed to measure an individual's resilience level. The CD-RISC has 25 items with a total score ranging from 0 to 100. The scale assesses participants' optimism, strength, and toughness. The score reflects the level of resilience the individual experienced. Many studies have shown the satisfactory reliability and validity of the Chinese version of CD-RISC (85, 86). The Cronbach's α of CD-RISC was 0.906 in this study.

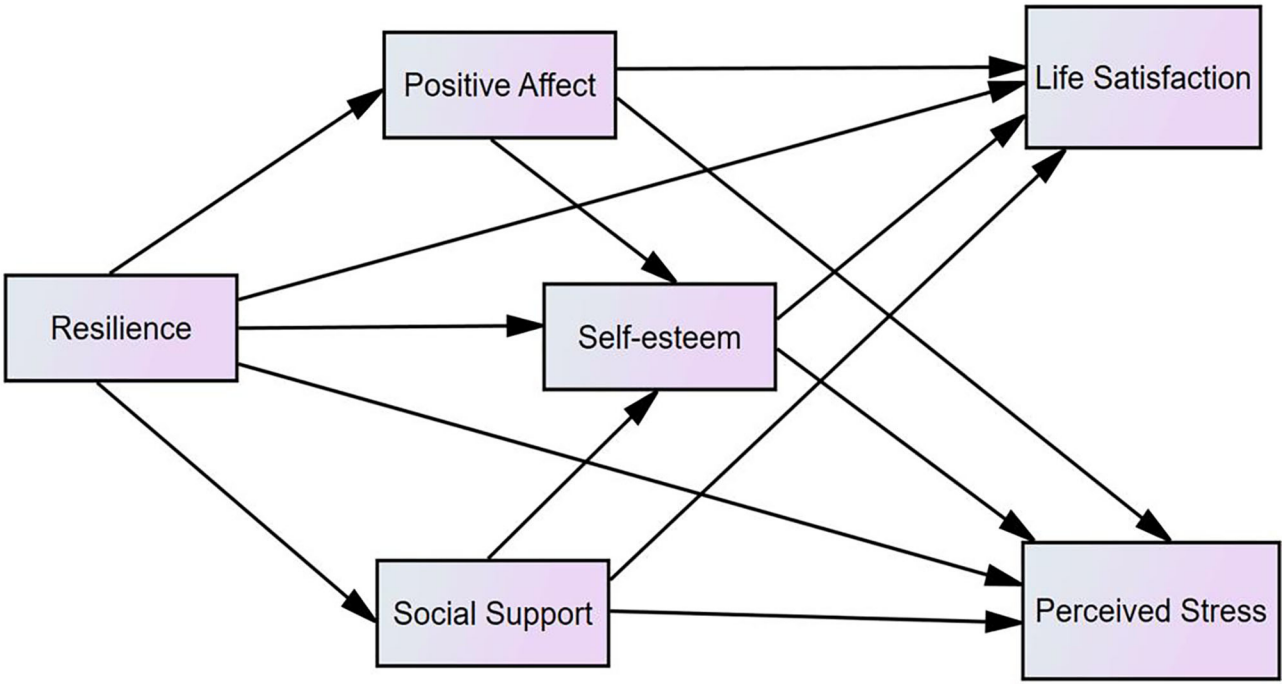

FIGURE 1 | The hypothesized model ($N = 415$).

Positive and Negative Affect Scale (PANAS) was developed by Watson et al. (87) to evaluate individuals' positive and negative affect. The PANAS is a five-point Likert scale (from 1 = *very slight or not at all* to 5 = *very strong*) consisting of 20 items. Half of the items are subjected to the positive affect subscale (items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19). In this study, only the positive affect subscale was applied. The Chinese version of PANAS has been reported good reliability and validity (88). Cronbach's α of PANAS in the present study was 0.846.

Multidimensional Scale of Perceived Social Support [MSPSS; (89)] was used to measure participants' perceived social supports. The MSPSS incorporates three subscales, perceived family support subscale (items 3, 4, 8, and 11), perceived friend support subscale (items 6, 7, 9, and 12), and perceived specialist support subscale (items 1, 2, 5, and 10). The MSPSS is a seven-point Likert scale (from 1 = *very strongly disagree* to 7 = *very strongly agree*). The sum of items reflects the degree of an individual's overall perceived social support. The Chinese version of the MSPSS has been widely applied and showed satisfactory reliability and validity (90, 91). The Cronbach's α of the MSPSS in this study was 0.910.

Rosenberg Self-Esteem Scale [RSES; (92)] was used to assess the participants' self-esteem. The RSES is a four-point Likert scale (from 1 = *strongly disagree* to 4 = *strongly agree*), containing 10 items. The RSES was scored by summing total items after reverse-scoring negatively stated things (items 3, 6, 8, 9, and 10). Studies showed that the Chinese version of RSES has good reliability and validity (85, 93). Cronbach's α of RSES in this study was 0.656. According to (94), it is reasonable when Cronbach's coefficient is above 0.6. Although Cronbach's α of RSES is not as high as other variables, it is acceptable for the following research.

Perceived Stress Scale [PSS; (3)] was applied to measure participants' perceived stress. The PSS is a five-point Likert scale (from 0 = *Never* to 4 = *Very Often*), containing 14 items in which half of the items are positively stated (items 4, 5, 6, 7, 9, 10, and 13). The score of PPS is calculated by totaling all items after reverse-scoring the positive statement. The score reflects the level of individuals' perceived stress. The Chinese version of PSS's reliability and validity has demonstrated satisfactory consistency (95). Cronbach's α of PSS in this study was 0.729.

Satisfaction with Life Scale (SWLS) was used to evaluate an individual's life satisfaction. The SWLS includes five brief statements that can be rated by seven choices (from 1 = *strongly disagree* to 7 = *strongly agree*). The total score is measured by summing up each item. Satisfactory reliability and validity of SWLS in the Chinese population have been reported by many studies (96, 97). Cronbach's α of SWLS in this study was 0.838.

Diagnostic and Statistical Manual of Mental Disorders—fifth edition-based diagnostic questionnaires were administrated to assess participants' addiction severity. Eleven diagnostic criteria were embedded in 11 items in four categories in the questionnaire: impaired control over substance use (items 1 to 4), social consequences (items 5 to 7), risky use of the substance (items 8 to 9), and pharmacological indicators (items 10, 11). The 11 criteria include: symptoms of withdrawal, craving, tolerance, hazardous use, chronically use substantial amounts, substantial time on use, repeated attempt to abstinence, interpersonal issues

TABLE 1 | Sample characteristics.

Sample characteristics		Total ($N = 415$)		Male		Female	
		M	SD	*n*	%	*n*	%
Age (20–61 years)	Male	39.17	9.19	–	–	–	–
	Female	36.18	8.94	–	–	–	–
		n	%				
Gender	(1) Male	322	77.6	–	–	–	–
	(2) Female	93	22.4	–	–	–	–
Education: ($n = 404$)	(1) Elementary school and below	76	18.3	64	19.9	12	12.9
	(2) Middle school	222	53.5	166	51.6	56	60.2
	(3) High school	78	18.8	63	19.6	15	16.1
	(4) College and above	28	6.7	18	5.6	10	10.8
Marital status: ($n = 410$)	(1) Single	128	30.8	98	30.4	30	32.3
	(2) Married	140	33.7	106	32.9	34	36.6
	(3) Divorced	132	31.8	105	32.6	27	29.0
	(4) Widowed	10	2.4	8	2.5	2	2.2
Annually income(yuan/year): ($n = 402$)	<10,000	106	25.5	67	20.8	39	41.9
	10,000–50,000	132	31.8	97	30.1	35	37.6
	50,000–10,0000	84	20.2	73	22.7	11	11.8
	100,000–200,000	44	10.6	38	11.8	6	6.5
	>200,000	36	8.7	35	10.9	1	1.1
Work status: ($n = 412$)	(1) Unemployment	210	50.6	158	49.1	52	55.9
	(2) Famer	21	5.1	17	5.3	4	4.3
	(3) Worker	15	3.6	13	4.0	2	2.2
	(4) Individual business	97	23.4	86	26.7	11	11.8
	(5) Servicer	19	4.6	11	3.4	8	8.6
	(6) Company stuff	22	5.3	17	5.3	5	5.4
	(7) Government stuff	1	0.2	1	0.3	0	0
	(8) Others	27	6.6	17	5.3	10	10.8
Months of detoxification: ($n = 404$)	(1) <1 month	50	12.0	33	10.2	17	18.3
	(2) 1–3 month	89	21.4	77	23.9	12	12.8
	(3) 3–6 month	71	17.1	48	14.9	23	24.7
	(4) 6–12 month	66	15.9	46	14.3	20	21.5
	(5) >12 month	128	30.8	109	33.9	19	20.4
Drug types	(1) heroin	108	26.0	82	25.4	26	27.6
	(2) methamphetamine	282	68.0	216	67.1	59	63.4
	(3) marihuana	9	2.2	6	1.9	3	3.2
	(4) ketamine	5	1.2	5	1.6	0	0
	(5) Morphine	3	0.7	3	0.9	0	0
	(6) MDMA (ecstasy)	3	0.7	1	0.3	2	2.2
	(7) Others	5	1.2	3	0.9	2	2.2

related to substance use, social network collapses, absence from social and occupational events, and substance-related social and psychological issues. The addiction severity was calculated by counting the number of matched criteria. The Cronbach's α coefficient of the diagnostic question was 0.731.

Data Analysis

In this study, sample characteristics, the descriptive statistics, and the intercorrelation analysis were measured via IBM SPSS Statistics version 22. Following Anderson and Gerbing (98), a two-step approach was used to analyze the three mediators' mediating effects. Firstly, the measurement models that contain all variables were examined by whether the indicators could well-represent each latent variable. Secondly, we use the maximum likelihood estimation to test the structural model in the AMOS 24.0 program. Furthermore, we created several parcels using the random assignment method to control the inflated measurement errors generated by multiple items of latent variables (99).

Moreover, we use AMOS 24.0 with maximum likelihood estimation to do the path analyses. According to Hu and Bentler (100) and Siedlecki et al. (101), eight indices were used to assess the goodness-of-fit of the path models: chi-square

TABLE 2 | Means, standard deviations (SD), Alpha, reliabilities, and intercorrelations among study variables after controlling gender and age.

Measure	Mean	SD	Alpha	1	2	3	4	5	6	7	8
(1) Income	–	–	–	1							
(2) Addiction severity	7.30	1.94	0.731	−0.186**	1						
(3) Resilience	77.60	16.36	0.906	0.227**	−0.112*	1					
(4) Positive affect	25.42	7.19	0.846	0.171**	−0.152**	0.360**	1				
(5) Social support	52.62	13.53	0.910	0.118*	−0.080	0.486**	0.151**	1			
(6) Self-esteem	26.44	3.71	0.656	0.158**	−0.098	0.403**	0.226**	0.312**	1		
(7) Life satisfaction	16.45	6.55	0.838	0.160**	−0.081	0.278**	0.218**	0.281**	0.143*	1	
(8) Perceived stress	40.94	6.09	0.729	−0.008	0.107	−0.400**	−0.204*	−0.223**	−0.342**	−0.106*	1

α, *Cronbach's alpha.*
**Correlation is significant at the 0.05level (2-tailed).*
***Correlation is significant at the 0.01level (2-tailed).*

($\chi 2$) statistics, a root-mean-square error of approximation, standardized root mean square residual, goodness-of-fit index, Tucker–Lewis index, comparative fit index, Akaike information criterion (AIC), and expected cross-validation index (ECVI). Specifically, if chi-square ($\chi 2$) statistics <3, root-mean-square error of ∼ <0.08, and the upper bound of its 90% confidence interval <0.1, standardized root mean square residual < 0.08, goodness-of-fit index >0.90, Tucker–Lewis index > 0.90, and comparative fit index >0.90, the model will be considered as an acceptable fit model. Furthermore, the goodness-of-fit indices of AIC and ECVI were used to compare two or more models. A smaller value of AIC and ECVI indicated a better fit of the hypothesized model (102) and a higher potential replication (103).

RESULTS

Preliminary Analyses

The results of descriptive statistics (including mean, SD, Cronbach's α coefficients) and the intercorrelation analysis for all variables after considering sex and age as covariates are presented in **Table 2**. The results indicated that income was significantly and positively correlated with resilience, positive affect, social support, self-esteem, and life satisfaction, whereas income was negatively correlated with addiction severity. Additionally, the results suggested that addiction severity was significantly associated with resilience and positive affect. Further, all intercorrelations between resilience, positive affect, perceived social support, self-esteem, life satisfaction, and perceived stress were statistically significant.

According to Podsakoff et al. (104), we need to examine whether there was contamination using common method variance because self-report questionnaires measured all variables. We used the principle components factor analysis to examine a total of 76 items. The results showed 17 factors that revealed neither a single nor a general factor in this study, and the first factor would explain 19.69% of the variance. Therefore, the common method variance in this study was not a problem. Moreover, the factor analysis showed that 19 items in SWLS and PSS scales produced four factors, which indicated that the significant correlation between life satisfaction and perceived stress was not driven by method bias. The first factor explained 21.59% of the variance.

Mediation Analyses

Without the mediator variables, the direct paths from resilience to life satisfaction ($r = 0.278$, $p < 0.01$) and to perceived stress ($r = -0.400$, $p < 0.01$) were significant. Firstly, based on the hypothesized model (**Figure 1**), we built Model 1 with three mediator variables (positive affect, social support, and self-esteem) with two direct paths from resilience to life satisfaction and perceived stress. The revised model suggested a satisfactory fit to the data, and all standardized path coefficients were significant, except for the three paths: positive affect to self-esteem ($\beta = 0.005$, $p = 0.868$), perceived social support to perceived stress ($\beta = -0.013$, $p = 0.307$), and self-esteem to life satisfaction ($\beta = 0.027$, $p = 0.846$; **Table 3**). Then, we built Model 2 by eliminating the three insignificant paths of Model 1. The test results of Model 2 were satisfactory, and all the paths were significant.

Then, the study tested whether mediators (positive affect, social support, and self-esteem) mediate the relationship between resilience and life satisfaction. Based on Model 2, Model 3 was built by eliminating the direct path from resilience to life satisfaction in Model 2. In Model 3, the revised model test results were satisfactory, and all the paths were significant. To compare Model 2 and Model 3, we used a chi-square difference test, which showed the model's fit decreased [$\Delta\chi 2$ (1, $N = 415$) = 8.382, $P < 0.001$]. Model 2, as yet, reported the best results regarding the goodness of fit.

Also, to test whether the mediators (positive affect, social support, and self-esteem) would mediate the relationship between resilience and perceived stress, we built Model 4 by eliminating Model 2's direct path from resilience to perceived stress. In Model 4, the revised model test results were satisfactory, and all the paths were significant. Model 5 was built by eliminating direct paths from resilience to life satisfaction and perceived stress in Model 2. The test results were also satisfactory with all the significant paths. We used a chi-square difference test to compare Model 4 with Model 5, and the results showed that the fit of the model decreased [$\Delta\chi 2$ (1, $N = 415$) = 8.278,

TABLE 3 | Fit indices among competing models after controlling gender and age.

Regression weights	Model 1	Model 2	Model 3	Model 4	Model 5	Target value
χ^2	404.810	405.877	414.259	416.683	424.961	
df	164	167	168	168	169	
χ^2/df	2.468	2.430	2.466	2.480	2.515	<3
RMSEA	0.060 [0.052,0.067]	0.059 [0.052,0.066]	0.060 [0.052,0.067]	0.060 [0.053,0.067]	0.060 [0.053,0.068]	<0.08
SRMR	0.0619	0.0620	0.0638	0.0600	0.0619	<0.08
GFI	0.914	0.914	0.913	0.913	0.912	>0.90
TLI	0.900	0.902	0.900	0.900	0.900	>0.90
CFI	0.922	0.922	0.920	0.919	0.917	>0.90
AIC	538.810	533.877	540.259	542.683	548.961	
ECVI	1.301	1.290	1.305	1.311	1.326	

N = 415; RMSEA, Root Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residual; []:left number, the lower bound of its 90% confidence interval < 0.1; right number: the upper bound of its 90% confidence interval <0.1; GFI, Goodness-of-Fit Index; TLI, Tucker-Lewis Index; CFI, Comparative Fit Index; AIC, Akaike Information Criterion; and ECVI, Expected Cross-Validation Index.

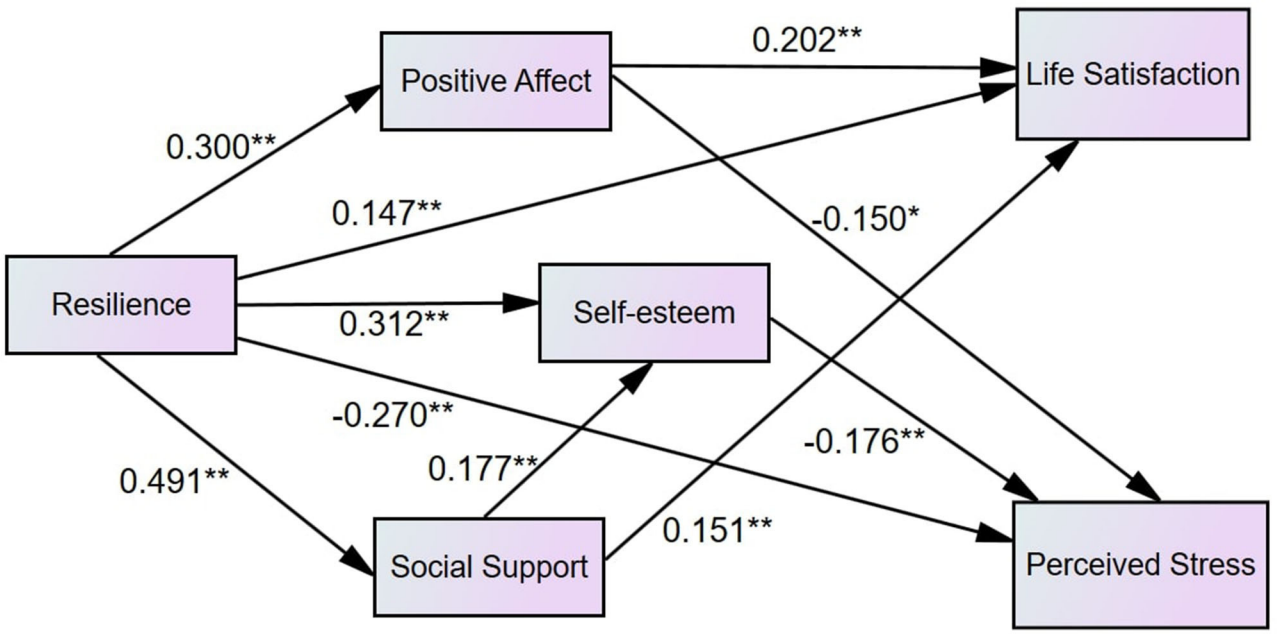

FIGURE 2 | The finalized model after controlling gender and age ($N = 415$). The path coefficients are standardized. For the pictorial purpose, covariates are omitted from the figure.

$P < 0.001$]. Then, we compared the other goodness indices among five competing models, which are shown in **Table 3**. As a result, Model 2 was chosen as the most suitable model, and the final mediation model is shown in **Figure 2**.

Indirect Effects

The indirect effects of the model were assessed by the bootstrapping procedure method in AMOS 24.0. Referring to the recommendations of (105), due to the original data set ($N = 415$), 10,000 random samples were generated after controlling the effects of sex and age. **Table 4** shows the indirect effects and their corresponding 95% confidence intervals, which indicated that all the indirect effects were significant. The results supported the fact that the association between resilience and life satisfaction is partially mediated by positive affect and perceived social support through two two-path mechanisms (resilience → positive affect → life satisfaction, resilience → perceived social support→ life satisfaction), and the relationship between resilience and perceived stress is partially mediated by positive affect and self-esteem through two two-path mechanisms (resilience → positive affect → perceived stress, resilience → self-esteem → perceived stress) and one three-path mechanism (resilience → perceived social support → self-esteem → perceived stress).

DISCUSSION

Numerous attempts have been made to explore how to reduce perceived stress and improve life satisfaction in non-user groups

TABLE 4 | The indirect effects of the final mediational model after controlling gender and age.

Number	Model pathways	Point estimates	95%CI	
		β	Lower	Upper
1	Resilience→ Positive affect→ Life satisfaction	0.060	0.028	0.110
2	Resilience→ Social support→ Life satisfaction	0.074	0.017	0.134
3	Resilience→ Positive affect → Perceived stress	−0.045	−0.048	−0.027
4	Resilience → Self-esteem→ Perceived stress	−0.055	−0.101	−0.021
5	Resilience → Social support→ Self-esteem→ Perceived stress	−0.015	−0.033	−0.005
6	Social support→ Self-esteem→ Perceived stress	−0.031	−0.065	−0.009

(20, 26, 28), but few focus on the individuals with SUD. To our knowledge, this is the first study designed to reveal the underlying mechanisms among resilience, perceived stress, and life satisfaction in people with SUD. We designed the study on SUD people examining whether and how resilience is associated with life satisfaction and perceived stress. The findings revealed that resilience reduces perceived stress via positive affect and self-esteem and enhances life satisfaction via positive affect and perceived stress among SUD patients.

The findings of the direct effects from resilience to perceived stress and life satisfaction demonstrated that most of the non-user groups' findings regarding the relationships among resilience, perceived stress, and life satisfaction could be replicated on people with SUD. In particular, the findings suggested that the participants who scored higher in resilience were reported to have lower perceived stress and higher life satisfaction, which are in line with the corresponding studies conducted among non-user groups (26, 28, 42). These observations may provide robust evidence for specialists and policymakers of substance abuse treatment and rehabilitation that resilience plays an effective role in mitigating perceived stress and promoting life satisfaction in substance users.

Findings also suggested that positive affect and self-esteem are two mediators of the relationship between resilience and perceived stress, supporting the study's hypothesis. These findings align with previous empirical research that resilience is negatively correlated with perceived stress (20). The theoretical underpinnings for the findings are that coping strategy promoted by resilience facilitates mental flourishing (29), the core component of positive affect, and positive self-evaluation (45), the prominent factor of self-esteem. Then, positive affect and high self-esteem promote enduring psychological resources, which may effectively buffer against the perceived stress (31). Although perceived social support's mediation effect on the relationship between resilience and perceived stress was not significant, the findings showed that perceived social support was involved in a three-path mediation (resilience → perceived social support → self-esteem → perceived stress). These findings may provide a valuable perspective on substance abuse treatment and rehabilitation. The involvement of promoting positive affect and self-esteem in rehabilitation programs among SUD patients can conditional the effects of resilience on decreasing patients' perceived stress.

The findings also indicated that the relationship between resilience and life satisfaction is mediated by positive affect and perceived social support in people with SUD, providing evidence to our hypothesis. Those findings are consistent with previous empirical research that focused on the correlations between resilience and life satisfaction (21). The theoretical interpretation of the findings is that coping strategies facilitated by resilience can stimulate the processes of psychological resource integration (106), the salient component of positive affect, and shape healthier social connections, the outstanding predictor of perceived social support (107), which further raise cognitive self-appraisals over life qualities. The findings correspond with the fact that individuals with positive affect and strong social boundaries are more easily satisfied through life events (43, 108). However, the mediation effect of self-esteem was not significant in the relationship between resilience and life satisfaction, which is opposite to the studies conducted in non-user groups (28, 109). Overall, the findings may offer an implication for SUD treatment and rehabilitation that projects focus on boosting SUD patient's life satisfaction is recommended to involve the practice of building patient's resilience, positive affect, and perceived social support.

CONCLUSIONS

In conclusion, the present study has filled the gap in how resilience reduces perceived stress and promotes life satisfaction in SUD individuals. The study identifies that positive affect and self-esteem partially mediate the relationship between resilience and perceived stress. In contrast, the perceived social support and positive affect partially mediate the relationship between SUD patients' resilience and life satisfaction. The study may offer empirical perspectives on projecting and advancing substance abuse treatment and rehabilitation programs to reduce perceived stress and enhance life satisfaction.

LIMITATIONS

The present study has several limitations. First, the study lacked a control group (e.g., people without SUD). Second, the present study was cross-sectional research, which is disadvantageous in drawing a causal conclusion. Therefore, involving experimental and longitudinal research methods are highly recommended

in future studies. Third, given that self-report questionnaires collected all data, although measurements had shown reliability and validity, contamination cannot be entirely ignored due to social desirability (e.g., desirability for decent scores). The semi-structured interviews are recommended to be introduced in the future to reduce respondents' subjectivity. Finally, the participants' age ranged from 20 to 61 years, so it is uncertain whether the findings can be replicated in the younger and older groups. Future studies that consider these factors may generate more accurate outcomes.

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 Ethics Committee of Nanjing Medical University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CY, YZ, and MX jointly drafted and conducted the manuscript. CY and MX contributed equally to this work. CY contributed to the processes of modeling and data analysis. YZ contributed to literature review, discussion, revision, and proofreading. MX contributed to data collection, participated in the writing, and finalized the manuscript. All authors read and approved the final manuscript.

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"I Grew Up Amidst Alcohol and Drugs:" a Qualitative Study on the Lived Experiences of Parental Substance Use Among Adults Who Developed Substance Use Disorders Themselves

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Experiencing parental substance use (PSU) has been associated with a heightened risk of developing substance use disorders (SUDs) in offspring. The primary goal of this study was to explore perspectives of adult children with lived experience of PSU who also developed SUDs themselves through first-hand experience. This study was conducted in Flanders (Belgium). A qualitative exploratory research design was applied. Seventeen semi-structured interviews were conducted with adult children of parents with SUDs (range: 29–48 years) who themselves had developed SUDs. All interviews were audio-taped and transcribed verbatim. Three overarching themes emerged through thematic analysis: 1) loneliness and neglect in childhood; 2) stigma and the self; and 3) the role of social connection in substance use and recovery. The narratives highlighted the central role of feelings of loneliness, isolation and belonging among children of parents with SUDs in childhood and adulthood. Increasing public awareness on the impact of PSU on children and accessible support is needed to overcome stigma and remove barriers to social inclusion for children of parents with SUDs. Findings may prove valuable in informing policy, program and treatment development aimed at breaking maladaptive intergenerational cycles.

Keywords: substance use, intergenerational, adult children, stigma, lonelineness, trauma, childhood, adulthood

INTRODUCTION

Generational continuity in the use of substances has gained attention for several decades (1–4). There is growing evidence showing that several biopsychosocial factors may contribute to heightened substance use risk in children of parents with substance use disorders (SUDs) (5–7), indicating that both genetic (8–10), and environmental factors (11, 12) play an important role in the heightened susceptibility to and manifestation of SUDs later in life (13–15).

Growing evidence shows an association between early life stress and adversity and heightened risk for developing SUDs in adolescence (16–24), which is a critical window for initiation, experimentation, and establishment of more regular patterns of substance use (25–32). A substantial proportion of the relationship between childhood adversity and substance use in adolescence is mediated through individual, interpersonal and community factors (33, 34). Evidence suggests that associations between cumulative stressors and adolescent substance use are moderated or mediated by genetic factors (e.g., related to cortisol regulation) (21, 35, 36), intrapersonal factors (e.g., executive cognitive function, self-esteem, impulsive behavior, inhibitory control, temperament) (37–41), or interpersonal factors (e.g., household and peer influences) (42–51).

Experiencing parental substance use (PSU) has been particularly associated with a heightened risk of developing SUDs in offspring (3, 52–57). Since PSU may impede parenting and the provision of a nurturing environment (58–60), the role of environmental and household stressors in the heightened risk of substance use continuation across generations has increasingly gained attention, with a particular focus on parental influences (e.g., parenting skills, parental inhibitory control, parental monitoring and discipline, parental modeling, harsh parenting) (42, 56, 61–65).

The Current Study

The last decades, there is a growing interest for the group of "adult children" from various dysfunctional family backgrounds. To date, only a small body of qualitative research has explored perspectives of adult children that have been raised in a context of PSU. The primary goal of this study was to explore perspectives of adult children with lived experience of PSU who developed SUDs themselves through first-hand experience. When we refer to "adult child," we are referring to a person who is currently 18 years of age or older, asking them to reflect on their past parent-child relationship. Our findings are intended to engender a deeper understanding of adult children's lived experiences of growing up with PSU that can inform both public perceptions and clinical and public health efforts to support families with PSU. This study addresses the following research questions:

- How do adults who have SUDs reflect on their upbringing in a context of PSU?
- How do adults who have SUDs reflect on pathways toward substance use initiation and early recovery?

METHODS

The present study is nested in a broader qualitative doctoral study at Ghent University (Belgium) on growing up in a context of PSU. Face-to-face semi-structured interviews with 46 adult children who were raised in a context of PSU were conducted, of which 17 had developed SUDs themselves. Only the interviews conducted with these 17 participants are analyzed here. Ethical approval was granted by the Ethics Committee of the Faculty of Psychology and Educational Sciences (Ghent University) (EC Reference 2018/42). Before interviewing, oral and written informed consent of the participants were obtained. Consent to digitally record interviews was granted and participants were informed that only the interviewer (first author) would have access to the recordings. Participants participated in the study on a voluntary basis. Names and potentially recognizable features have been altered or omitted to protect participants' privacy.

Context of the Study

This study was conducted in Flanders, the Dutch speaking northern part of Belgium and a highly populated urban area (∼6.5 million people). In recent years, Flanders has been faced with an increasing prevalence of drug use, with alcohol (licit), cannabis, cocaine, and ecstasy (illicit) being the most prevalent substances (66). In Belgium, the social cost of licit and illicit substances is estimated to be considerably high (67). Individuals with SUDs are characterized by high health care needs and use of health care services in Belgium (68), affecting individuals and their families adversely.

At the time the participants of this study were children (±1970–1990), the health care services available to individuals with SUDs fell under federal jurisdiction. The geographical spread of alcohol and drug services was limited, with a total absence of a family perspective in treatment systems. Resources for child and youth care services were also scarce and addiction in the family was either overlooked or strongly condemned, leading to the separation of children and their parents. Since the last decade, the Federal Government has conferred on powers to The Flemish Community, which is currently the competent authority for issues relating to social welfare and mental health care. Since this transfer of powers, the Flemish government puts increased emphasis on recovery-oriented and community-based services and care as an alternative to institutionalization (69, 70). In recent years, the government gradually upscaled funding for substance use prevention and treatment services, including outpatient and inpatient programs for parents with SUDs and children—albeit limited—(71–73), and harm reduction initiatives (74).

In spite of increased financial or other operational resources for prevention and treatment programs targeting individuals with SUDs in Flanders, parenting while experiencing SUDs remains to be a highly stigmatized condition (64). What's more, parental substance use often has a powerful impact on decisions about termination of parental rights (75). Child and youth care services tend to approach mental health conditions related to SUDs with the primary intention to protect children from harm, which is reflected in lack of interagency collaboration between substance use treatment agencies and child and youth care services. Recently, an increasing demand for developing legal measures that can protect unborn children from prenatal and preconceptual harm arose, especially in the context of maternal substance exposure. In the margins of a broader international tendency toward governmental involvement relating to pregnancy and substance use (76–79) and in the absence of a legal regulatory framework, legislative proposals and decrees on prenatal protection are currently debated. These proposals are primarily aimed to

impose mandatory decisions on unborn children (e.g., out-of-home placement prior to giving birth) and forced admission to inpatient treatment (80).

Study Design and Data Collection

Given the relative lack of prior published studies on the perspectives of adult children who were raised in a context of PSU in Flanders and internationally, a qualitative exploratory research design was applied (81). This allowed the researcher to explore a topic with limited coverage within the literature and allowed the participants of the study to contribute to the development of new knowledge in that area. The current research is one of the first studies to explore the experiences of adult children who were raised in a context of PSU, focusing on childhood as well as adulthood experiences on substance use.

Data were collected between November 2018 and December 2019. A purposive sample was selected to study this topic in-depth. Adult children were recruited through two outpatient and three inpatient substance use treatment services in urban and inner-city areas in Flanders. Eligibility criteria included being aged 18 years or older, having experienced PSU as a child, and having received a SUD diagnosis according to DSM-5 criteria (82). This diagnostic status was established through clinician's written reports and verbally confirmed by the participant to the interviewer. Potential participants were given written and verbal information about the study by the interviewer or a member of staff at the recruitment service and, if they expressed interest, were offered the opportunity to participate in an interview at a time convenient to them. Participants were informed they were contributing to a study on the experiences of growing up in a context of PSU. All interviews were conducted either in a private room at the service from which they were recruited or in a quiet local café, by the first author (FM). The average duration of the interviews was 109 min (range: 66–197 min). All interviews were audio-taped and transcribed verbatim in participants' and interviewer's same Dutch native language, by which all interviews were conducted. The interviewer transcribed the interviews during the data collection, which enabled her to check the quality of the data (83).

Participants

The participants were 17 adults (range = 29–48 years; mean = 35 years), all of whom had one or both biological parents (one stepparent) either actively addicted or in recovery from a drugs ($n = 9$) or alcohol ($n = 8$) addiction (**Table 1**). Twelve participants identified as male, five as female, and all identified as White. Participants' educational levels varied, all had completed primary school, the minority had completed college or university ($n = 3$). All participants had received a SUD diagnosis according to DSM-5 criteria, and reported receiving current ($n = 14$) or prior ($n = 3$) substance use treatment episodes, trying to maintain early recovery (stabilized substance use or cessation). None of the participants reported having experienced prenatal alcohol or drug exposure. Of the eight participants with parents with drug use disorders, seven were male. Eight participants reported current (on probation; $n = 2$) or prior ($n = 6$) incarceration. Three participants said they were in a current relationship and seven had children. Polysubstance use was common in both participants and their parents. Cocaine, amphetamine and heroin were among the most reported primary substances of choice, next to alcohol.

Information about parents was collected by family history information from the respondents. The majority of participants reported having lived in a socially unstable situation during childhood (e.g., family living arrangement, economic hardship, housing instability, parental mental health conditions). Four participants referred to frequent relocations during childhood. Six participants reported having experienced extreme poverty during childhood. Employment status among parents varied from both paternal and maternal unemployment ($n = 2$) to different kind of jobs that parents tended to hold. When parents were employed, respondents often reported isolation in parents outside of work. Only two participants reported episodes of parental substance use treatment. Five participants reported having experienced parental incarceration during childhood.

Interview Guide

Semi-structured open-ended questionnaires were used as method for data collection. At the start of the interview, each participant was asked a short series of demographic questions (such as age, family composition, what type of substances parents used,…) to enable the interviewer to construct a genogram to understand the family structure. The remainder of the interview was then semi-structured in format, and started with a broad question asking participants to describe general feelings and experiences related to their childhood. The interview guide used during each interview was honed to probe for participants' recollection of childhood experiences related to PSU and perspectives on pathways to substance use initiation and early recovery. Six primary open-ended interview questions guided each interview (**Table 2**). At the end of each interview, participants were invited to contribute any information they felt was important but had not been covered in the interview. A timeline approach was adopted throughout the interviews as an integral tool for structuring the complexity of participants' experiences (64, 84). This visual approach was also used to increase respondents' control in directing the interview, acting as a middle ground between the interviewer and the respondent (85).

Data Analysis

Data analysis was initiated soon after data collection, allowing the authors to become more aware of emerging categories and themes (86). Using Braun and Clarke's (87) six phase thematic analysis framework for qualitative data analysis, the transcribed data were inductively analyzed. First, all transcripts were subjected to a "first reading" with comments written in the margin. Initial *in vivo* coding was then used to summarize data segments line-by-line (e.g., "feeling isolated"), followed by a second round of axial coding to disaggregate data into broader analytic terms and to define relationships between initial codes (e.g., "substance use to cope with isolation"). Initial and axial codes were used to conceptualize the data by summary and to help condense content for comparison between transcripts. After coding, potential subthemes were identified (e.g., "continued

TABLE 1 | Participants' characteristics.

Characteristics	Number ($N = 17$)
Adult children	
Gender	
Male	12
Female	5
Age	
28–34	7
35–40	8
41–48	2
Primary substance of choice	
Alcohol	1
Illicit drugs	16
Age substance use onset	
Early onset (5–9 years)	5
Early-mid onset (10–15 years)	8
Mid-late onset (16–18 years)	4
Current treatment	
Outpatient	4
Residential (on probation)	8 (3)
Prison-based program	2
Prior treatment	
Outpatient	1
Residential	2
Current incarceration	2
Prior incarceration	6
Subjected to child protection proceedings as a child	3
Parents	
Gender of parent(s) with SUDs	
Father	11
Mother	1
Both	5
Primary substance of choice	
Alcohol	9
Illicit drugs	8
Reported specialized substance use treatment admission in one of the parents	2
Participation in self-help groups	2
Prior or current incarceration	6

TABLE 2 | Interview guide (simplified version).

Engagement question	Could you tell me a bit more about how you experienced your childhood?
Exploratory questions	- Could you tell a little bit more about how you experienced family life as a child? - Have you ever received support related to your needs as a child? - How old were you when you first started using substances? - Can you describe in what context you started using substances? - Did any particular event in your life serve as a major turning point that caused you to enter treatment? - What factors have enabled or hindered your own recovery process in adulthood?
Exit question	Is there anything else you would like to share that is important to you as being a child of parents with substance use disorders?

substance use as a fulfillment of relational needs"). From these subthemes, many were combined to form overarching main themes (e.g., "the role of social connection in substance use and early recovery"), whereas others that were less representative were discarded (e.g., "sensation-seeking"). These main themes were repeated throughout the data set and represent the most widely shared experiences that adult children perceived as being central to their childhood and adulthood experiences. After identifying three main themes, related quotations from each transcript were reviewed to ensure that the final themes accurately represent the patterns observed. Finally, the themes were defined and refined by selecting and further analyzing quotes that exemplify each theme within the context of each case. Refinement and clarification of themes occurred collaboratively among research team members until we solidified these themes and excerpts. Quotes have been translated to English by the first author. We stayed as close as possible to the literal translation and errors specific to the native language in which the interviews were conducted, have been corrected to aid readability.

RESULTS

The primary aim of this analysis was to explore adult children's childhood experiences with PSU and their own experiences of substance use initiation and recovery. The analytic process resulted in the identification of three major themes: "loneliness and neglect in childhood," "stigma and the self," and "the role of social connection in substance use and recovery." Each of these themes contains multiple subthemes, which will be discussed in more detail below.

Theme 1: Loneliness and Neglect in Childhood

Loneliness and Social Connection

When respondents reflected on their childhood, the most frequently reported theme was the feeling of being completely alone as a child.

> *Because of the addiction of my parents, I never had a family. I also had a hard time having friends who accepted me, it made me feel alone a lot. Even today. (Nora, 28 years old)*

Some respondents expressed feelings of humiliation because of experiencing PSU. Saraï revealed:

> *As a child, I used to feel alone a lot, because you always have to hide something. Your parents are drug addicts, you can't say that to anyone. You feel humiliated [pause]. In many ways. (Saraï, 36 years old)*

All participants expressed having experienced shame about their rearing environment as a child.

> *I was always in-between like 'this is just normal' and 'I hope no one will ever know', because I did not wanted to be known as (–) [pause]. There is a shame. (Raul, 35 years old)*

Reaching out for support as a child was reported to be shame-inducing and evoked feelings of guilt toward parents. As a result, children avoided disclosure about their childhood experiences and stressors present in the home. In some cases, this perceived stigma caused whole families to be isolated from the outside world or supportive others. Scott described how his mother was reluctant to help and how he feared professional involvement as a child:

> *She pushed them [professionals] away, she didn't see her drug usage as a problem. Professionals had no control over it. (…). As a kid, I didn't say much either [pause]. That could have led to misery (…). It's me who had to go home every day. (Scott, 29 years old)*

One respondent stated how he "did not dare to talk to care providers or teachers, because of serious threats from his father about what would happen" if the child disclosed. Even when problems were obviously impacting children severely according to respondents' narratives, they felt that relatives or professionals took no further action, leaving them feeling alone and sometimes betrayed as a child. Most of the respondents reported that their parents never reached out for help either, which resulted in perceived social isolation.

Childhood trauma and neglect

Narratives revealed that stressful environmental factors, including emotional and material neglect, endangered several respondents' physical and mental health as a child. Almost all respondents expressed a lack of parental warmth, with some respondents referring to "being neglected or abandoned." Four respondents disclosed to be sexually abused as a child. Physical abuse was also frequently reported.

> *Beating me and giving those strange punishments… Locking me up in the bathroom all day, without light, without food, ehm… [pause]. Or having to sleep on the floor, and she… I mean, me on a tiled floor (…), while she was lying on a mattress, ehm… (Scott, 29 years old)*

The vast majority of the respondents reported childhood chronic stress. This stress primarily stemmed from unpredictability and insecurity in the home environment, parental unavailability, parental violence, and financial or material hardship.

> *A parent who uses drugs usually isn't there, doesn't like to take drugs in front of children, goes somewhere else. My parents had no source of income and had to fetch their drugs everywhere. (Saraï, 36 years old)*

Several respondents pointed out to have been used for obtaining and providing for parents' alcohol or drugs. Home environments that were characterized by parental drug use, generally held more links with poverty (e.g., no coverage of basic needs, being consistently food insecure), witnessing household substance use (access to drugs in the immediate social environment), exposure to drug-related activities in the home (drug dealing and consuming), parental incarceration or criminogenic activities, or experiencing parental drug withdrawal or overdose. The long-lasting impact of childhood trauma appeared from the narratives, which often resulted in mental pain that lingered into adulthood.

> *I feel like I keep returning to it [adverse childhood experiences] [pause]. And when I sleep, I dream about it, everything comes right back… so I wake up with it everyday. (Christoph, 43 years old)*

The majority of respondents indicated ever having experienced suicidal ideation and four respondents spoke about attempted suicide. Several respondents expressed resentment toward their parents but also toward the wider society for not having received the needed support during childhood. Saraï, who found her mother after a heroine overdose when she was 8 years old, reported:

> *I've realized that everything I'm in now, has revolved around my family. That pain, losing everything,… [pause]. My destructive behavior originated from it. (…) I've always used to feel so alone. (…) You get mad at society: 'I've been maltreated as a child, and you didn't do a thing'. (Saraï, 36 years old)*

Theme 2: Stigma and the Self

A second important theme that emerged through the thematic analysis revealed how respondents' upbringing had contributed to a lack of positive self-esteem and interpersonal difficulties. This influenced how respondents navigated the social environment beyond the home, which further influenced perceptions of social isolation and stigma.

Self-esteem and interpersonal connection

Narratives revealed how self-doubt and low self-esteem resulted from respondents' childhood experiences. Because of confusion about what happened in the home environment, several respondents reported to attribute household problems or parental behaviors to themselves as a child.

> *By all those factors… I thought as a child: 'Indeed, I'm failing… I'm a monster… I'm bad'. Those were my beliefs. And they still are. Because… why do such bad things happen to me? (…) I felt like a burden. (Astrid, 33 years)*

Due to familial secrecy and shame around PSU, several respondents experienced feelings of alienation.

> *At some point, I went to school, and I started to feel myself different from other people. The other children could count on their parents if anything happened; we didn't have that. (Saraï, 36 years old)*

The narratives elicited how all respondents had, each in their own different way, developed internal or external problem behaviors that stemmed from their upbringing.

I'm functioning and no one would ever think that I had a problem, but… [pause]. Inside, having this minus one level of self-worth… I think this opened a nice door for drugs, because then you can escape and then you can feel happy, chemically happy. (Jenny, 39 years old)

Difficulties with interpersonal connection was a frequently reported theme throughout the interviews. Some respondents mentioned how, due to being devaluated as a child, they psychologically distanced from others to avoid further negative or painful experiences. This in turn impacted close relationships from childhood through adulthood, and sometimes led to social isolation.

Nobody knows what was going on in childhood. You are always playing scene, you're never your true self. In order not to show to the outside world that you're different, you try to assimilate. Always hiding, hiding yourself, hiding your feelings, hiding everything. (Christoph, 43 years old)

Navigating the Social Environment Beyond the Home

Several respondents expressed a lack of understanding about their childhood in their social environments. They pointed out a lack of awareness in society about the impact of childhood experiences through adulthood and a lack of openness to talk about it.

If I had to say that to other people in society, how will they think about it? That's exactly what I want to emphasize. That's exactly what you're ashamed of [as a child]. You cannot (–) If I were to say that to someone who's employed, or who is practicing everyday… I cannot talk about it, they do not understand the situation I'm in now [pause]. Preconceptions originate from it, but sometimes you just wish you could say that. (Scott, 29 years old)

Respondents pointed out that schools could have a greater role in intervention and support for children of parents with SUDs. Several respondents mentioned that schools should instill a culture of awareness about the impact of PSU on children, and establish a climate in which children feel safe to have a conversation with a trusted adult. Respondents emphasized the value for children of parents with SUDs of being offered opportunities to talk, and having a trusted adult or a support network that extends through childhood, where children can talk openly about sensitive subjects such as PSU.

As a child of addicted parents, above all, I think it's important to keep communicating. You shouldn't think: 'I'm feeling down, I'm going to be a burden'. (…) Not cutting yourself off, I think that's important (…). In the past, I always used to be on my own (…). If children know that they can talk about it and that they're not in it alone, I think it can really help. (Nora, 28 years old)

I wish I've had a mentor. (…) Someone I could lean on. A father figure, a teacher who's designated (…). I missed that. Getting attention, getting affection. Someone who won't let go of me and does say so: 'I won't let go of you'. (Scott, 29 years old)

Respondents reported they grew up in an environment where they have often seen their parents using alcohol or drugs as an answer to problems (e.g., relational, financial, judicial), which one respondent referred to as "an environment not being fostering to further development and choices made later in life."

As a child, you automatically end up in that kind of environment too. When you grow older, you start to notice: you have made certain decisions, stupid decisions, you are in debt, you are in poverty… you automatically meet these same people too. (Titus, 31 years old)

Several respondents stated that they always ended up with people that also used drugs, in one way or another, or that they appear to find and seek others with similar inclinations.

We had to relocate a lot during childhood. I always had to make new friends. That wasn't always easy, but each time when I met someone, it was guaranteed a user. It must have been written on my forehead. (Raul, 34 years old)

Through data-analysis, it became clear that childhood trauma, financial hardship, social isolation, and substance use often ran across generations. The feeling of "being stuck in an endless cycle of disadvantage" regularly popped up from the narratives. Respondents framed the difficulties they had encountered or still are encountering in life (e.g., financial or employment difficulties), as a recurring circle of *"not contributing to society"* that they found (or still find) hard to break. Scott referred to the impact of addiction on multiple life domains.

In such a situation, when the parents have never worked, it is more likely that the child will not work either… Because they never seen it at home, because they don't know how to apply [for a job]. [pause] It's not just the addiction itself, it's everything around it. [pause] And that's what costs society money. (Mauro, 45 years old)

Theme 3: The Role of Social Connection in Substance Use and Recovery

All respondents had developed SUDs throughout their life and were in the early stage of recovery from SUDs at the time of the interview. Without assuming that motivation for substance use initiation and recovery arises solely out of environmental or interpersonal influences, the specific role of social relationships in substance use initiation, continued substance use, and recovery stood out from the narratives and will be further detailed below.

Substance Use initiation

Parental Influence

The majority of the respondents reported they first came into touch with alcohol or drugs in the home environment. Hence, substance use initiation among respondents was frequently found to be explicitly or implicitly entwined in the nature of parent-child relationships. A first striking dynamic according to the narratives, was parents' active providing of alcohol or drugs.

I grew up amidst alcohol and drugs. My father was a drug dealer. When I was thirteen, my father was busy at the table one night. I

saw white powder everywhere. I wondered 'what is that?', he said 'get your finger wet, I'll show you how to do it'. There was a tube lying there and he sniffed it. First, it was only in the weekend. But it quickly progressed toward a daily basis. When I was 15, I started basing cocaine, cleansing it with ammonia and put in on a pipe. (Neil, 33 years old)

Because respondents had frequently been exposed to alcohol- or drug-related activities in the home environment from an early age and considered it to be "normal" and part of everyday life, their tolerance toward the perceived level of seriousness of risks (e.g., consumption methods) and the degree of substance use severity they set for themselves was reported to be higher. They normalized or minimalized their own substance using behavior.

When I did that for the first time, I was aware that it was wrong, but still I did it. However, I've also seen what drugs [heroin] my father and stepbrothers were taking, so I thought it couldn't get any worse than that: 'it's just amphetamines and cocaine', but that's just as bad of course. (James, 38 years old)

Some respondents had the feeling that drugs were deployed by parents as a means to forging a relationship with their child, since parents came to realize that drug-related activities were facilitative for regulating a parent-child relationship.

I think my dad gave me drugs, just to establish a friendship. He didn't do that from a father position, I think, but to having at least something together. I don't know why I didn't understand it was wrong. (Raul, 35 years old)

Several respondents reported that they had developed a drug-mediated relationship with their parents throughout adolescence.

I was aware that when my father was in the kitchen with a closed door, I wasn't allowed to enter. I've never seen my father sniff a line. But when I was fourteen, I also started using, together with my father. (Naomi, 36 years old)

There has never been father-son-bonding between us. Only drug-bonding. (Neil, 33 years old)

Another striking dynamic according to the narratives, was children's early curiosity. Due to parents' habituated behavior and alcohol or drugs preoccupation, some children reported they became curious about its effects, which lowered the threshold to start using.

I often threw my mom's stuff away, and I've often asked her to quit. Eventually, I started wondering why she couldn't quit. (…) I'm not going to blame her that I started using, but I did wonder why she couldn't stop, and what was at the root of it. (Naomi, 36 years old)

Some respondents reported that, as a kid, they subconsciously copied their parent's drug using behavior.

When I was 6 years old, we received complaints from teachers. At noon during lunch, crumbs of my bread lay on the table. I gathered those crumbs together, and started sniffing them with a straw. (Philip, 39 years old)

Peer Influence

While some respondents reported parents to be a major contributor to substance use initiation, others associated substance use initiation with peer involvement. Respondents often had to grow up quickly, which was for example due to having to rely on oneself from a very young age, or permissive parenting. As a result, respondents were given a lot of freedom from an early age, and ended up on the street quite early, where they encountered (mostly older) peers. Many reported to have quickly been engaged in "wrong environments."

I was home alone every weekend (…). I started smoking weed with friends from an early age. I started to hang out on the street when I was 14-15 years old. I immediately hang out with guys aged 22-23, never with same-aged peers. That's also why I started cocaine so early, those guys were already on it… When I was 16, I was already committing robbery, and I was already engaged in extortions. (Titus, 31 years old)

Respondents mentioned different peer settings where they encountered substances (leisure, school,…). Often, it started with being offered only one pill, or only using during the weekend; but this quickly progressed into more intensive use.

Continued Substance Use as a Fulfillment of Relational Needs

Interviews revealed how continued substance use fulfilled several relational needs, of which the most outstanding were the need for belonging, and coping with loneliness and isolation. As such, continued substance use was marked by coping with underlying affective difficulties, in which "the need for belonging" served as an enabler of continued substance use in the face of isolation. Respondents reported about continued substance use in terms of a change from an enjoyable activity with peers, feeling comfortable and self-confident being in the company of other people when using, and how it the longer the more led to isolated and more risky substance use behavior.

The most reported function of substance use among respondents was to have a sense of belonging and to expand social bonds, since the use of substances increased the ability to talk, personal openness and self-confidence.

It allowed me to get to know a lot of people. (…) In the longer term, I had a lot of friends, and I could turn to everyone. (Philip, 39 years old)

Several respondents reported having a hard time finding an identity in the world in adolescence and emerging adulthood, since childhood was often only about "survival," with their later social competence being put in jeopardy. Sometimes, the difficulty in establishing and maintaining connections with others led to susceptibility to and increased need for using substances.

I had finally found something to be more social, which was mainly the reason for my drug use... I usually don't say a word, I'm often shy, and with drugs, alcohol, ecstasy, cocaine… you can just chat with everyone. (Titus, 31 years old)

Less relationship reward had been available to respondents during childhood and adolescence, which often drove them back to substances, which from respondents' narratives appeared to function as a relational substitute. Using substances helped several participants to feel the pleasure and the basic need of connectedness and personal fulfillment. However, this "habit" further isolated them.

Talking about my feelings as a child? I took my usage [pause]. My best friend [pause]. It didn't say anything back... It didn't comment... It always made me happy… It always made me feel good [pause]. Drugs were my best friend. (Neil, 33 years old)

Interviews elucidated that substance use also served as a response to early stressors associated with the home environment. On the longer term, continued substance use had in several participants the additional function of coping with negative early life experiences and stress derived from childhood trauma.

My usage was more like a way out… Stress was building up all the time and I had to let go of that stress, but I couldn't be released of it... The stress we used to live in... Because parents who are drug addicts, they lose everything after a while. They lose their house, bailiffs come in… The worst things happen to you as a child. (Saraï, 36 years old)

As the substance use intensified, the function of substance use evolved from rather a "social activity" and being able to form relationships, to "using alone" (e.g., because friends were not there during the week), which led to increased isolation. Respondents mentioned that in response to that isolation, alcohol or drug use helped them cope. This cycle led to physical or psychological dependence over time, whereby respondents indicated to "just need" the substances. This led to increased loneliness and isolation, whereby loneliness and substance use perpetuated each other.

I didn't come out anymore, I had bad friends… I became completely socially isolated. Even though social contact has never been easy to me, you always want to belong somewhere… But after a while, you're not doing anything anymore, you can't keep your job because you get so tired… (Nora, 28 years old)

In the beginning it's fun, but it doesn't last. If you take it [cocaine] for a while, you don't come out anymore, you stay in your house, you hide yourself. I completely detached from people, I wanted to be alone. (Titus, 41 years old)

Respondents stated that on the longer term, substance use led them to cope with psychosocial problems such as problems related to work and employment, family problems, social exclusion, depression, and suicide attempts. However, the fact that the usage fulfilled a particular need for belonging, made them persist. Consequently, respondents reported reduced motivation to engage in the pursuit of relationships. Instead, they increased substance use, which they themselves thought was becoming dangerous at some point.

I've always been able to hide that I was addicted. I knew it about myself, but no one knew it around me. I was able to hide it all so well, because I did everything alone… buying from only one person and done. Nobody knew about it [pause]. You pretend to live a normal life, but in the end, you're actually feeding something very lonesome, something that's getting dangerous. And I realized it, but I didn't dare to do something about it. (Saraï, 36 years old)

Behavior Change and Early Recovery

From the narratives emerged how social relationships functioned both as enablers and challenges to behavior change and early recovery. These processes of change appeared not to be linear "one-time success attempts," but they rather were characterized by circularity between continuous contemplation, specific challenges and opportunities, and several endeavors. Respondents' motivation to change often originated from critical moments (e.g., hospitalization, overdose), which confronted them with the repetitiveness of patterns ("not wanting to walk the same path as my parents"). This opened up contemplation of treatment admission among several respondents.

Relational Enablers

Through analysis, it became clear how relational enablers could boost respondents' ability to successfully navigate challenges during stable periods of use and early recovery. Some respondents indicated that, what motivated them to treatment admission, retention, and early recovery, were positive role models being in sustained recovery, who kept the hope alive that "recovery is possible." These persons were able to give advice to respondents based on their own lived experience of addiction and recovery. Some respondents drew strength from these persons, others indicated that they were looking for someone who had overcome addiction in the face of adversity.

I've followed the example of my mother. She makes me believe that it's still possible… at any age. That it's never too late. My mom has a good life now, that's what I'm also striving for. (Kian, 35 years old)

Among the respondents who had children themselves, most indicated that their own children were a motivation for recovery. Because respondents had never seen a good example, they wanted to approach things differently for their children. They wanted to be available as a parent, which leveraged their motivation for treatment. Also parent-child contact during treatment appeared to be a factor promoting treatment adherence.

I want to be there for my daughter. Because I know, I've never had that myself. If she comes to visit now and she leaves, I have to put her in the car seat. She always says: 'daddy, are you coming home with us?'. That's heavy. Then I say: 'daddy first has to heal before daddy's coming back home'. (Raul, 34 years old)

Throughout the narratives, the importance of the quality of the support from relatives emerged. Regular visits or contact and

experiencing unconditional support was perceived to be highly meaningful and often impacted contemplation. The quality and unconditionality of relationships, especially through bad times (e.g., after being convicted, after an overdose), increased motivation for change.

> *My stepfather came to visit me every day in prison. Every single day. Once he told me – I will never forget those words: 'You've made a mistake, but even if you commit murder, you will forever be my son'. That's when my eyes really started to open: 'now is the time to pick myself up again and tackle my addiction'. (James, 38 years old)*

Just as several respondents expressed hope from relationships with close relatives, two participants particularly drew hope from spirituality both as a basis for dealing with things from the past in a different way other than drug use, and in overcoming addiction vulnerability.

> *Buddhism is what keeps me in the state of trying to be as controlled and as safe as possible. It helps me to redesign things in my mind. I need a very structured life and by practicing Buddhism, I can keep going. It helps me to more easily and more quickly answer to my vulnerability… like, waves will come, but… (Jenny, 39 years old)*

Relational Challenges

One of the most recurring challenges to recovery was parents and other close relatives' involvement in substance-related activities or active addiction (e.g., using or selling drugs). This often caused respondents to relapse after stable periods of use or post-treatment. Being alcohol- or drug-free for the first time (outside of a controlled environment), and knowing how and where to quickly get drugs, appeared to be a challenge for early recovery. It turned out that after periods of quitting drugs for a while, or after being discharged from treatment, parents were still facilitative for respondents' relapse into drug use.

> *I just had quitted taking GHB for one week – right, one week isn't that long, but it is one week nonetheless. We agreed that he was just coming to visit me, but he brought me drugs. Of course I take it. (Naomi, 36 years old)*

After treatment discharge, respondents often had made the decision to break up with former negative interpersonal relationships and all the regular contacts they had before/during active addiction, aiming for sustained recovery on several life domains. Consequently, parents were often the first and only people they could turn to. Hence, respondents often ended up back at the "source," where a lot of risk was involved. One respondent explained how he became involved in drug-related activities again after release from prison.

> *I had quit using drugs at that time. But the moment I got out, I had no shelter and no one to turn to. I also had debts. My father said, 'Titus, you can live with me on the condition that I can earn a lot of money'. (…) I've taught him how to sell cocaine, I had to teach him how to compose drug packages, how to deal with drug dealers, how much he was allowed to sell, … how everything works. (Titus, 31 years old)*

Another important impeding factor to early recovery that showed up from the interviews, were conflicted family relationships, since respondents' SUDs often had damaged family ties. As a result, respondents were unable to turn to family after stable periods of use or after treatment, because of shame (e.g., family members had found respondents after an overdose) and feelings of guilt toward their family (e.g., respondents threatened or put pressure on their families for financial purposes), which also arose from situations and accidents experienced during active addiction (e.g., hitting parents).

While the lack of a supportive social network led to relapse among several respondents, some respondents reported desperate attempts, due to the lack of a network where they could or dared to turn to, not wanting to be a burden to family members who already had been exposed to enduring stress.

> *I tried to commit suicide twice, so that I was no longer a burden to my family. (…) I've used [drugs] for 23 years, those people have also suffered for 23 years. (Neil, 33 years old)*

Moreover, respondents did not want to go back to their old (substance using) networks after being discharged from treatment or after stable periods. Hence, some of the respondents ended up in isolation or homeless, which pushed them back into prior networks and substance using behaviors (e.g., using heroin as a remedy for fighting the cold), and served as an impediment to achieving sustained recovery.

> *I was not allowed to go to my stepdad, because I had a very bad relationship with my family because of my [drug] use, so I ended up on the street. (…) I called my cousin, 'can I come to you?', so I lived with him for a few months, but he was also a user. (…) I also lived in my car for a few months. (…) I had nothing left other than my car, so… (…) I sat around the table with my cousin, as we ran out of money. We started to commit thefts and burglaries throughout the country. We broke into all the schools to have money for drugs. (James, 38 years old)*

Also the relationship with the non-using parent or other relatives was often broken, so that respondents ended up in isolation, which lowered the threshold to substance use and suicidality.

> *I was no longer allowed in my mother's house, the bond with her was completely broken. (…) All those friends around me, they were all [drug] users. Lost my job… (…) I thought I'd jump in front of the train. I was on the verge. I ultimately ended up in the emergency department with an overdose of drugs and medication. (Raul, 35 years old)*

A last important theme that emerged from the interviews was the sucking power of the environment that respondents were in during active addiction. This was an environment from which respondents could not easily withdraw, which often put pressure on early recovery processes. Detaching from negative peer influences after being discharged from treatment was often a necessary decision, but not an easy one which took a long

time, since respondents were often still indebted to people from their (ex-)networks.

> *They told me: 'Titus, you know way too much'. I said 'I'm never going to talk', I never did. (…) They have seen: 'Titus does never talk, he did never betray us', and they said 'Titus, It's all right, go live your life, go to your child, but don't come near us anymore; and don't do business, don't use drugs'. (Titus, 31 years old).*

DISCUSSION

This study allowed a deeper understanding of previous work, by considering adult children of parents with SUDs' lived experiences of growing up with PSU in childhood and adulthood. Three themes were identified from the analysis: 1) loneliness and childhood trauma and neglect; 2) stigma and the self; and 3) the role of social connection in substance use and recovery. The implications of the findings will be discussed in the next section of the paper.

Our research adds to growing scholarly literature on the long-term impact of adverse childhood experiences (ACEs) and PSU on mental health and SUDs later in life (88–90). PSU has been associated with increased risk of offspring experiencing adversities during both childhood and adulthood (91, 92). Our findings contribute to the understanding of how PSU can cause a variety of harm to children, which may be related to unsafe family environment and long-standing stress (60, 93). Furthermore, this study showed how adult children faced loneliness and mental health stressors in childhood, and how this can contribute to mental health and substance use issues in later life (88, 91). Previous studies also pointed to the high burden and prevalence of multiple childhood adversities in children of parents with SUDs and in other substance using populations (94, 95). Therefore, this study highlights that preventive interventions for children of parents with SUDs constitute an important public health issue. Findings can contribute to shape the perspective of stakeholders, including the general public on growing up in a family with PSU. From this study, it is clear that early interventions that address common risk factors and multiple consequences of growing up with PSU should be available to children living with PSU and their parents. The role of relatives, teachers and professionals in the recognition and identification of children of parents with SUDs and to attend to their unmet needs by taking action (96) was emphasized. This study stipulated the need for increased social support that may buffer against negative consequences of exposure to PSU in childhood and adulthood.

This study provides insight in mechanisms that may contribute to feelings of loneliness, shame, social isolation, low self-esteem and lack of social support experienced by children of parents with SUDs (97–100). In this sense, the effects of secondary stigma became apparent for those relatives who are associated with stigmatized individuals, including parents with SUDs (101–105). It may be prudent to note that in this sample, parents did not receive substance use treatment during offspring's childhood and adolescence, what may possibly be explained by, amongst others, the impact of stigma and discrimination on parents' willingness to seek help and preventing access to treatment (103, 106, 107). However, stigma in families with PSU is constructed in relation to social norms (108, 109).

Further, this research pointed to the social stigma surrounding PSU. Given the disruptive effect of stigma on family cohesion in families with parental substance use, with relatives often experiencing to be "invisible" (99), this study emphasizes the need for applying a developmental and interactional perspective on social support to children and parents with SUDs, as stated by Newcomb ((110), p. 54): "Social support can no longer be considered strictly an external force impinging upon the individual; rather, it must be viewed as an evolving developmental and interactive process between an individual and his or her social environment." Although children of parents with SUDs experience need for connectedness and receiving social support from trusted adults (97, 111), which has been shown to be protective in this group of children at-risk (112), feelings of shame and self-blame related to the upbringing may hamper help-seeking in children, with implications for long-term mental and physical health (104, 113, 114). Previous studies showed that also among parents with SUDs, other mental health difficulties often co-occur (115). Our study supports the need for systemic and stigma-reducing interventions to support children of parents with SUDs (60, 116, 117).

In line with Hoffman and Su (118), this study shows how parental substance use puts adolescents at significant risk of becoming involved in substance use and association with substance using peers. Peer substance use has shown to be more predictive for adolescent substance use, in comparison with parental drug use (47). Peer substance use and exposure to substance using friends have been strongly associated with adolescent substance use, both in offspring of parents with SUDs (119) and without SUDS (118). However, evidence is clear that the negative impact of growing up with a parent with SUDs on offspring substance use initiation and further progression toward SUDs is heightened when the child associates with substance using peers (119), what could be explained by wanting to receive validation and satisfy their need for belonging (120). Parental monitoring and family relationship quality indirectly predict later substance use by way of deviant peers (121). Deviant peer affiliation is clearly an important avenue for intervention when seeking to interrupt the intergenerational transmission of SUDs. Hence, findings underscore the importance of early assessment and intervention for peer relationships in adolescent offspring of parents with SUDs. Further, research points to the importance of conventionality (122) and quality (123) of peer relationships in mitigating adolescent SUDs risk. Given the fact that having fewer substance using peers has shown to be beneficial to adolescent substance use (122), and that the quality of adolescent peer networks predicts positive SUDs outcomes (124), promotion of prosocial bonding and peer groups, enhancing quality of peer relationships, and involvement in prosocial activities may be particularly salient for children with heightened genetic risk for developing SUDs (119, 123).

Recent studies found an association between loneliness in adolescence and health risk behaviors (125), including substance use (126). Given that this study points to the central role of

feelings of loneliness, isolation and belonging in the progression toward SUDs, helping experience offspring of parents with SUDs human connectedness is an important part of prevention and intervention efforts. As the results show, offspring's attachment to substances fulfills underlying relational needs, serving as a substitute for human connectedness (127). As such, this study supports the hypothesis that SUDs represent, at least in part, a misplaced striving for connection [(127), p. 2]. Building prosocial support and qualitative interpersonal relationships may be an important mechanism for alleviating loneliness and may lead to decreasing substance use in an attempt to modulate loneliness and the need for belonging.

Finally, this study expanded research on SUDs and recovery by examining how interpersonal influences and social isolation affected substance use and recovery in adult children of parents with SUDs (128). In particular, this study improved understanding of how parent-child and other interpersonal relationships can both operate as a catalysator in the trajectory toward substance use initiation, as well as challenging in striving toward early recovery. Although families have been identified as a primary context of care for young adults' substance use treatment processes (129), this study showed that the family context among adult children of parents with SUDs is often not facilitative for their treatment and recovery processes. In line with evidence on the importance of relationships and social resources needed for initiation and maintenance of addiction recovery (130–137), this study confirms the importance of interpersonal relationships and social resources in readiness to change and early stages of recovery (131, 138–143). Although the importance of social networks in improving early and more sustained recovery outcomes has been established (144), this study provides insight in how family, parent and peer support systems can both inhibit and encourage recovery in offspring of parents with SUDs. Consequently, specific components of early recovery social networks, such as network size (133, 139, 145), quality (146), and density (138) have proven to be important factors in recovery outcomes. Strong associations have been found between ongoing contact with substance users and continued substance use (147). Contrarily, stronger identification with non-using groups, social networks including more people in recovery and fewer people in active use have been associated with improved treatment and recovery outcomes in emerging adulthood (133, 148–151). This study suggests the need to ascertain the exact nature of social networks and the social contexts within which they are developed (152). Prior to tailored treatment planning, the nature of social network support should be systematically assessed. Research provides additional evidence that many persons in substance use treatment possess non-substance using family or friends who are willing to support recovery efforts (153). Activating non-substance using family and friends has shown to provide potential pathways to help persons with SUDs access and benefit from community support (154, 155). Moreover, given that early recovery stages are sensitive periods for experiencing loneliness and social isolation (138), which has been associated with SUDs (156–158), adult offspring with SUDs may benefit from strategies to build and sustain prosocial connections and recovery-supportive networks (159), that prepare them for "normal everyday living" (137) and "outside living" in a way that promotes positive relational enactment.

Limitations and Further Research

This study has contributed to a neglected area of research with regard to the lived experiences of PSU among adult children who developed SUDs themselves. However, limitations of this study have implications for the generalizability and validity of the findings. A first constraint is due to the study design. By relying solely on one-off clinical interviews, the study findings remain bound to the context in which this research is conducted. Future research is needed to validate the study findings by adopting structured survey assessment (e.g., standardized questionnaires). In addition, to understand the significance of the study findings, it is important to consider that this study was delimited by investigating only adult children of parents with SUDs' perspectives. Future research is needed to include parents' views to more closely examine the influence of specific factors, such as severity of substance use on caregiving and parent-child relationships. Also, due to a lack of information on parents' socioeconomic background, it is not clear how study findings may have operated differently across socioeconomic contexts. In addition, the data does not represent first-person accounts of direct childhood experiences, but of adults retrospectively reflecting on childhood experiences after having been in substance use treatment. This may have impacted both what participants viewed as relevant information to share during the clinical interviews, and also what can be understood as their own experience vs. what they have come to understand as a general experience of people who have parents who use substances. Another important limitation concerns the representativeness of the sample. This was a clinical sample of 17 mostly male, all-White adults from the Flemish Region. Future research is needed to know whether the views expressed are representative of this broader population. Finally, participants eligible for inclusion in this study were selected based upon the criterium of having a history of PSU. In the interest of understanding the specificity of vulnerability and protective processes, study findings need to be complemented by examining environmental protective factors and resilience among children with heightened genetic vulnerability who did not develop SUDs themselves (160–162). Knowledge of resilience factors may inform more targeted prevention and intervention efforts to optimize support for families experiencing PSU.

CONCLUSION

This study investigated the lived experiences of PSU among adult children who also developed SUDs. A constellation of socio-relational and other environmental factors play a role in the intergenerational transmission of SUDs. Although these factors cannot be considered in isolation and need to be examined from an holistic biopsychosocial viewpoint, this study has illustrated that family, parent and peer environmental factors play a role in accounting for offspring outcomes; in particular, that environmental factors can influence the

impact of high genetic risk regarding SUDs development in offspring. Children of parents with SUDs are at heightened risk for early stress, social isolation and developing SUDs, which, in the absence of adult buffering support, may affect adolescent and adult mental health. Social support and qualitative, prosocial relationships may contribute to prevent intergenerational continuation of SUDs over the lifespan. However, social support changes as a result of transactions between a person and his/her social environment, and must therefore be individually adjusted within existing constraints and contexts. Developmentally stable, positive and strong social bonds over the lifespan are of utmost importance for discontinuing the cycle of intergenerational SUDs. Therefore, reducing public stigma of SUDs in families and reinforcing and enhancing affected children's skills in persevering with help-seeking is imperative to foster a safe and nurturing family environment.

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 Ethics Committee of the Faculty of Psychology and Educational Sciences, Ghent University (EC Reference 2018/42). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM wrote the manuscript and was responsible for general ideas, conducted the interviews, made a first analysis, and drafted the manuscript. SD and WV designed the study. ED and WV provided feedback on the data-analysis process and substantially contributed to the final version and revisions of the manuscript. SD did editorial work on the entire manuscript. All authors approved the manuscript for publication.

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The Strengths and Barriers Recovery Scale (SABRS): Relationships Matter in Building Strengths and Overcoming Barriers

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There is a well-established relationship between isolation and both morbidity and mortality in the context of addiction recovery, yet the protective effects of intimate and familial relationships have not been adequately assessed. The current paper uses the European Life In Recovery database to assess the association between relationship status and living with dependent children on recovery capital of people in recovery from drug addiction, operationalised by the Strengths And Barriers Recovery Scale (SABRS). The study participants were drawn from the REC-PATH study and supplemented by a second sample recruited by the Recovered Users Network (RUN) across various European countries, resulting in a combined sample of 1,313 individuals completing the survey, primarily online. The results show that, in recovery, those who are married or co-habiting reported significantly greater recovery strengths and fewer barriers to recovery, and reported greater gains in recovery capital across their recovery journeys. Similar associations are found for participants who have dependent children living with them. There is also some indication that this association is stronger for female than for male participants. Finally, having more people that one can rely on and a greater proportion of people in recovery in the social network are both linked to greater recovery capital and greater self-reported growth in recovery capital. We conclude that this study provides further evidence in favour of a "social cure" in recovery, in which close familial ties are associated with stronger recovery resources.

Keywords: addiction, recovery, connectedness, social relations, strengths, substance use disorder, barriers

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INTRODUCTION

Recovery from drug addiction is an emerging area of empirical research. There is a growing consensus on definitions, with general agreement that recovery is a journey characterised by dynamic and non-linear growth in health and wellbeing, sobriety and active participation in a range of social and societal roles and activities (Betty Ford Institute Consensus Group, 2007; UK Drug Policy Commission, 2008; Sheedy and Whitter, 2009; Ashford et al., 2019; Dekkers et al., 2020). The

Betty Ford Institute Consensus Group (2007) went further by categorising recovery by duration into "early recovery" (<1 year), "sustained recovery" (1–5 years) and "stable recovery" (>5 years), with the implication that recovery is more robust as the individual progresses through these stages. A number of evidence-based components of the recovery process have been identified. A review by Humphreys and Lembke (2014) indicates the importance of peer and social processes, with the authors showing evidence for peer-based interventions, mutual aid and recovery housing. Another approach to recovery-focussed interventions can be drawn from the mental health field (Leamy et al., 2011; Best, 2019) and is based on the acronym CHIME (Connections, Hope, Identity, Meaning, Empowerment), in which human connection (normally from a peer or peer group) generates a sense of hope that recovery is achievable and—in turn—motivates a virtuous circle of meaningful activities, an emerging sense of empowerment and a positive identity.

The emergence of recovery science has also prompted an interest in metrics, one of which is the concept of "recovery capital." Granfield and Cloud (2001) first used this term in 2001 in discussing the concept of natural recovery and subsequently defined recovery capital as "the sum total of one's resources that can be brought to bear on the initiation and maintenance of substance misuse cessation" (Cloud and Granfield, 2008, p. 1972). The notion that this term could be quantified was first mooted by Best and Laudet (2010), who suggested that there were three domains for recovery capital—personal, social and community capital—but that these were dynamically related and included positive as well as negative elements. Groshkova et al. (2012) published the psychometric properties of the Assessment of Recovery Capital (ARC), an instrument designed to measure both strengths and barriers (across ten domains of personal and social recovery capital) and to measure progress in the recovery journey, and demonstrated that this was a robust and reliable tool. More recently, the ARC tool has been embedded in the REC-CAP (Recovery Capital) tool, an online instrument that not only assesses recovery capital but that is embedded in a care planning model that encourages clinicians and peer mentors to plan and support the ongoing accrual of positive recovery capital (Cano et al., 2017). Cano and colleagues also demonstrated the critical role that engagement in meaningful activities can play in the building of strengths and the resulting increases in wellbeing. In her review of the existing literature on recovery capital, Hennessy (2017) concluded that "as a framework for describing the various resources and supports that can be accumulated or exhausted to support recovery, RC [Recovery Capital] provides a broad overview of the multiple, interrelated factors in the recovery process and could be used as a tool to untangle variegated recovery pathways" (2017, p. 358).

To further complement the existing measures and tools, the current paper builds on innovative work described by Best et al. (2020) on the use of the Strengths And Barriers Recovery Scale. The SABRS scale is based on the Life in Recovery (LiR) survey method, first reported by Laudet (2013) in the United States, which assesses experiences in five life domains (work, finances, legal status, family and social relations, and citizenship), recording respondents' perceptions both retrospectively for their time in active addiction and currently when they are in recovery. The original LiR survey has been used in a number of other countries (e.g., United Kingdom, Best et al., 2015a; Canada, McQuaid et al., 2017; Australia, Elms et al., 2018), and most recently as part of a European study of recovery pathways (REC-PATH, Best et al., 2018). In the REC-PATH study (Recovery Pathways and social responses in the United Kingdom, the Netherlands, and Belgium), the Life in Recovery survey was used as a recruitment and screening tool for studying recovery from problem drug use (Martinelli et al., 2020a). The survey was also deployed by the Recovered Users Network (RUN) across a number of other European countries to assess recovery experiences and wellbeing. Using the latter dataset, the SABRS scale was created by dividing relevant items into strengths and deficits questions and generating change measures by subtracting the active addiction scores from recovery measures (e.g., change in involvement in family activities) (Best et al., 2020). All items that had a positive valence (such as "I exercise regularly") were categorised as Recovery Strengths and all items that had a negative valence (such as "I have been to prison") were categorised as Recovery Barriers. There were no neutral items. As each item was simply endorsed or not, this allowed a simple tally of Recovery Strengths and Recovery Barriers at two time points—"In active addiction" and "In recovery." A proxy measure of change could then be calculated by subtracting each "In active addiction" composite score from each "In recovery score," generating overall change scores for Recovery Strengths and Recovery Barriers.

Although there is a clear relationship between social connectedness and wellbeing in the general population (Christakis and Fowler, 2009; Holt-Lunstad et al., 2011; Jetten et al., 2012), there is limited research on this association in addiction and recovery populations. Available research shows that the extent to which the individual exhibits a sense of group belonging with peers in therapeutic communities (referred to as social identification) is predictive of positive outcomes (Dingle et al., 2014; Beckwith et al., 2015). Similar findings have been reported for mutual aid group participation (Kelly, 2019; Martinelli et al., 2020b; Barrett and Murphy, 2021). In their study of mental health recovery among people labelled as not criminally responsible, Aga et al. (2021) found that connectedness is central to the recovery experience, including a sense of belonging that is linked to active engagement in social groups and society at large. Taking care of children has been identified as a major barrier to seeking treatment for women (because of concerns of involvement of social services and the perceived threat of child removal), as well as an important factor promoting treatment retention and recovery in mother-child programs (Neale et al., 2018; Andersson et al., 2020; Schamp et al., 2020), where reunification with children or retaining custody of children can be a strong motivation to strive for recovery.

To assess the role of human connection in addiction recovery, we have combined the data from the RUN dataset with the screening data from the REC-PATH study discussed above to examine the associations between recovery capital measured

using the SABRS tool and a number of indicators of social support. The research questions to be addressed in this paper are:

RQ1: To what extent do recovery strengths and barriers change in recovery and is this a function of recovery duration?

RQ2: Do people in recovery who are in a relationship differ in recovery strengths and barriers from people who are not, and is this associated with the extent of change in both recovery strengths and recovery barriers in the period between active addiction and recovery?

RQ3: Do people in recovery who live with their dependent children differ in recovery strengths and recovery barriers from people who do not live with children, and is this associated with the extent of change in both recovery strengths and recovery barriers in the period between active addiction and recovery?

RQ4: Do people in recovery with strong social support networks differ in recovery strengths and recovery barriers from people with weaker support networks, and is this associated with the extent of change in both recovery strengths and recovery barriers in the period between active addiction and recovery?

RQ5: What types of social networks and supports are closely related to positive recovery capital?

RQ6: What social factors are linked with growth in recovery strengths?

MATERIALS AND METHODS

Design and Procedure

The paper is based on a convenience sample initially recruited during the REC-PATH study, an EU-funded multi-country and multi-method study on recovery pathways and experiences among persons with a history of illicit drug addiction. Between January and June 2018, the Life In Recovery (LiR) survey was used as a recruitment and screening instrument) in the United Kingdom, the Netherlands, and Flanders (Dutch-speaking part of Belgium) (n = 776). It was also distributed through the international Recovered Users Network (RUN), after it was translated into a number of other European languages (Bosnian/Croatian/Serbian/Montenegrin, Swedish, Polish, Portuguese, and Spanish, besides English and Dutch). RUN is a civil society organisation that promotes recovery among individuals, agencies and organisations, primarily but not exclusively in Eastern Europe. Five hundred and thirty seven individuals were recruited through the RUN network, primarily in Serbia (n = 123), Poland (n = 79), Bosnia (n = 72), and Spain (n = 60). The total sample for this study consisted of 1,313 participants.

The survey was available online on the REC-PATH project website[1], as well as through hard copies. Study participation was promoted in various ways through recovery groups and organisations, drug services, social media, websites, TV shows and other partner agencies. Snowball sampling was used to reach out to a more diverse group of potential participants. We used the online platform Qualtrics for data collection. Participants could choose which language they wanted to complete the form in, upon accessing the project website. Online information and consent preceded initiation of the survey. For participants to complete the form, each item of each section required an endorsement or they would not be able to pass onto the next question. Consequently, only completed questionnaires were available on the online platform. Hard copies of the survey were made available for those who did not have access to or were not comfortable completing the online survey. Only completed hard copies were entered into the database. Thus, no missing data had to be managed in the analysis. Data are based on self-reported survey completion and no financial incentive was provided for study participation. More information on the procedure for the REC-PATH (Best et al., 2018; Martinelli et al., 2020a) and RUN data collection (Best et al., 2020) can be found elsewhere.

Instrument

As outlined in the original SABRS paper (Best et al., 2020), the 44 items in the Life in Recovery survey were reduced to 32 items, consisting of 15 strengths items and 17 deficit items (with all items either endorsed or not), creating a scale of 0–15 for strengths and 0–17 for deficits (see **Table 1**). The retrospective approach of the Life in Recovery method looks at these strengths and deficits both during active addiction and in recovery, meaning that there are four scores derived from the scale:

1. Recovery Strengths in Active Addiction.
2. Recovery Deficits in Active Addiction.

TABLE 1 | Final set of included items (n = 32) in the Strengths And Barriers Recovery Scale (SABRS).

Recovery Strength items	Recovery Barrier items
– Exercise regularly	– Have untreated emotional or mental health problems
– Have a GP	– Make regular visits to the emergency room
– Have regular dental checks	– Regular use of health services
– Have good nutrition	– Smoke
– Take care of your health	– Have your drivers' licence revoked
– Maintain a driving licence	– Drive under the influence of alcohol or drugs
– Maintain a bank account	– Damage property
– Able to pay your bills	– Been arrested
– Maintain stable housing	– Been charged with a criminal offence
– Remain in steady employment	– Been to prison
– Further your education or training	– Have bad debts
– Start your own business	– Were unable to pay the bills
– Participate in family life	– Regularly missed school or work
– Plan for the future	– Dropped out of school or college
– Volunteer	– Fired or suspended from work
	– Lose custody of children
	– Experience family violence

[1] https://www.rec-path.co.uk/

3. Recovery Strengths in Recovery.
4. Recovery Deficits in Recovery.

The four domain scores allow a change analysis to be conducted, where the growth in strengths can be calculated as the total of Recovery Strengths in Recovery minus the total of Recovery Strengths in Active Addiction. Similarly, the change in Recovery Deficits is calculated as the total of Recovery Deficits in Recovery minus the total Recovery Deficits in Active Addiction.

Data-Analysis

The current analysis consists of three components. First, we provide a socio-demographic description of the people completing the survey, and the social networks and supports associated with people in recovery. The sample was divided into three groups: those in early (<1 year), sustained (1–5 years) and stable recovery (>5 years) (Betty Ford Institute Consensus Group, 2007). Second, analyses of variance assess differences associated with changes in recovery strengths and barriers (RQ 1–5). Third, we performed a multi-variate analysis to assess predictors of overall growth in recovery strengths to address research question 6. Given the importance of recovery strengths as a prognostic factor, a linear regression model (**Table 6**) delved further into other variables from the LiR that may be associated with growth in recovery strengths. "Growth in recovery strengths" was calculated as the difference between recovery strengths and addiction strengths. Variables were declared "statistically significant," if its $p < 0.05$ (i.e., working at 5% significance level). A linear regression model describes in detail all factors associated with growth (increase) in recovery strengths. The variables included in the regression analysis were demographic factors (age, gender, education); country of residence (grouped into the Netherlands and Belgium, Balkans, United Kingdom, Spain and Portugal, and Poland); relationship factors (parenting status, relationship status); addiction career events (age of first and last use of illicit drugs, length of recovery, duration of drug using career); recovery mediators (housing, criminal justice involvement, injecting, education and employment) and types of treatment received (12-step, outpatient, peer support and combinations of interventions).

RESULTS

Sample Characteristics

A total of 1,313 participants (combined over the two studies) completed the Life in Recovery survey—consisting of 854 men (65.0%), 453 women (34.5%), and 6 individuals (0.5%) who identified as another gender. The mean age of the sample was 40.3 years (±10.49), with a range of 18–74 years. The REC-PATH sample was drawn from the Netherlands (n = 231, 17.6%), Belgium (n = 181, 13.8%), and the United Kingdom (n = 364, 27.8%). The RUN international sample came from Serbia (n = 123, 9.4%), Poland (n = 79, 6.0%), Bosnia and Herzegovina (n = 72, 5.5%), Spain (n = 60, 4.6%), Croatia (n = 53, 4.0%), Sweden (n = 44, 3.4%), Montenegro (n = 15, 1.1%), Portugal (n = 6, 0.5%) and also included 85 persons (6.5%) from other European countries.

In terms of relationship status, the largest group were single and never married (n = 537, 40.9%) while 300 people (22.8%) were married, 213 (16.2%) co-habiting, 198 (15.0%) divorced or separated, 17 (1.3%) widowed and 48 (3.7%) in other relationship situations. For the purpose of the current analysis, these categories were summarised into 40.9% single, 39.8% married or co-habiting, 16.4% widowed, divorced or separated and 3.0% in another category.

Participants were asked three further questions about their level and type of social contact, with 70 respondents (5.3%) reporting that they had nobody to discuss important things with, 58 (4.4%) reporting that they had one person to discuss important things with, 131 (10.0%) two people, 142 (10.8%) three people and 912 (69.5%) reporting that they had four or more people they could discuss important things with.

The second aspect of social networks that was assessed asked how many of the people the respondent spent time with were users of illicit drugs. The largest group reported that none of the people in their network used illicit drugs (n = 779, 59.3%), with 369 (28.1%) reporting that it was less than half, 60 (4.6%) that it was about half, 49 (3.7%) that it was more than half and 56 (4.3%) that it was all of the people they spent time with. The final measure of social connection was an item assessing the proportion of the social network that included people in recovery. For 191 individuals (14.5%), this was "all" of the social network, for 439 participants (33.4%) it was more than half, for 165 (12.6%) it was around half, for 292 (22.2%) it was less than half and for 226 (17.2%) none of the people they spent time with were in recovery.

Table 2 provides the basic summary scores for strengths and barriers both at the time of active addiction and at the time of completing the survey when in recovery.

Recovery Strengths and Barriers in Active Addiction and in Recovery

Overall, participants reported a mean "increase" of 5.81 strengths (±3.11) and a mean "reduction" of 6.02 barriers (±3.87) between their period in active addiction and recovery. There was an inverse correlation of −0.55 ($p < 0.001$) between changes in strengths and changes in barriers. In other words, the greater the growth in recovery strengths, the greater the reductions in recovery barriers. However, the picture is not consistent across the whole sample and as anticipated, the greater the duration (stability) of recovery the more strengths have accrued (see **Table 3**).

TABLE 2 | Number of strengths and barriers while in addiction and recovery (n = 1,313).

	Strengths (addiction)	Strengths (recovery)	Barriers (addiction)	Barriers (recovery)
Mean	4.71	10.53	8.59	2.58
SD	2.91	3.25	3.30	2.31
Minimum	0	0	0	0
Maximum	15	15	17	17

TABLE 3 | Mean number of strengths and barriers while in recovery and growth of strengths and reduction of barriers, by recovery stage (n = 1,313).

	Early recovery	Sustained recovery	Stable recovery	*F*, significance
Strengths	8.59	10.46	11.69	102.39, $p < 0.001$
Barriers	3.07	2.58	2.33	11.19, $p < 0.001$
Change in strengths	3.33	5.66	7.37	109.84, $p < 0.001$
Changes in barriers	−4.74	−6.13	−6.64	24.50, $p < 0.001$

Post hoc testing with Scheffe tests revealed that, for strengths, there were significant differences between each pairwise comparison, but for barriers, there were only significant differences between the early recovery group and the sustained and stable groups. No significant differences were observed between the sustained and stable groups in terms of their barriers to recovery. *Post hoc* tests revealed that all sub-group comparisons were significantly different for strengths change, but for changes in barriers, the significant differences were found between the early and stable group and between the early and sustained group, but not between the stable and sustained groups.

Relationship and Parenting Status and Recovery Strengths and Barriers

A further analysis assessed the association between relationship status and strengths and barriers, both in active addiction and in recovery, with the results shown in **Table 4**.

We found a clear association between being in a stable relationship (married or cohabiting) and both higher levels of recovery strengths and lower numbers of residual barriers in recovery. In addition, compared with persons who were not in a stable relationship, these individuals show greater change in strengths and deficits on the journey from addiction to recovery.

From the overall sample, 452 participants (35.6%) reported that they had dependent children living with them (with a mean of 1.73 dependent children living with participants who did have dependent children). Differences by parenting status are shown in **Table 5**.

Participants living with dependent children reported significantly more strengths in recovery than those without dependent children and also showed greater growth in strengths and larger reductions in barriers from active addiction to recovery. However, a significant difference in the number of barriers while in recovery was not found between the two groups.

This analysis was repeated separately for men and women. While 276 men (32.3%) lived with dependent children, relatively more women (n = 195; 43.0%) were in this situation, a statistically significant difference ($chi^2 = 15.77$, $p < 0.001$). For men, the same overall pattern applied with men living with dependent children reporting more strengths in recovery (11.1 vs. 9.8; $t = 5.20$, $p < 0.001$) and showed a greater increase in strengths from addiction to recovery (6.2 vs. 5.1; $t = 3.64$, $p < 0.001$), and a greater reduction in recovery barriers from active addiction to recovery (−6.7 vs. −6.0; 5 = 2.53, $p < 0.05$). No significant difference in the number of barriers in recovery was experienced by men, while a significant difference was found among women with a greater increase in strengths for women with dependent children than for those without (7.0 vs. 6.3; $t = 2.00$, $p < 0.05$).

Current Social Networks and Support and Changes in Recovery Strengths and Barriers

All three measures of current social networks and social support are strongly related to the four SABRS domain scores as shown in **Figures 1–3**.

Having more people to talk to about important things was strongly associated with greater strengths in recovery ($F = 66.87$, $p < 0.001$), fewer barriers to recovery ($F = 36.36$), more growth in strengths from active addiction to recovery ($F = 43.44$, $p < 0.001$) and greater reductions in barriers to recovery ($F = 62.17$, $p < 0.001$). **Figure 2** shows a similar relationship for the number of current users the participant is in contact with while in recovery.

Where respondents have fewer of the current social network members that are active drug users, there was a strong association with greater strengths in recovery ($F = 38.91$, $p < 0.001$), fewer barriers to recovery ($F = 15.47$, $p < 0.001$), more growth in strengths from active addiction to recovery ($F = 22.54$, $p < 0.001$) and greater reductions in barriers to recovery ($F = 19.30$, $p < 0.001$). **Figure 3** shows similar associations for the number of contacts with people in recovery while in recovery.

Having fewer members of the current social network who are active drug users was strongly associated with greater strengths in recovery ($F = 35.96$, $p < 0.001$), fewer barriers to recovery ($F = 9.99$, $p < 0.001$), more growth in strengths from active addiction to recovery ($F = 19.05$, $p < 0.001$) and greater reductions in barriers to recovery ($F = 24.43$, $p < 0.001$). However, this only seems to be a linear effect up to the point of having a majority of your friends in recovery. For people who have all of their friends in recovery, the benefits are not as strong.

Factors Associated With Growth in Strengths

Based on the linear regression analysis, variables that were positively associated with increased "growth" in recovery strengths were shorter duration of substance misuse (in years) and more time in recovery; the baseline level of strengths (higher) and deficits (lower); being female; being married; higher levels of education and either part-time or full-time work; or being in education or volunteering; living in the United Kingdom, the Netherlands, or Belgium; and having participated in residential rehabilitation, peer-based mutual aid, out-patient treatment and peer support groups (see **Table 6**). In contrast, variables that were negatively associated with "growth" (i.e., lower growth rates of recovery strengths from addiction to recovery) were longer duration of substance misuse in years;

TABLE 4 | Mean number of strengths and barriers while in recovery and changes in strengths and barriers from addiction to recovery, by relationship status (n = 1,313).

	Single	Married or cohabiting	Separated, divorced or widowed	Other	*F*, significance
Strengths in recovery	9.8	11.5	10.6	10.7	31.37, $p < 0.001$
Barriers in recovery	2.8	2.3	2.8	2.4	3.66, $p < 0.05$
Change in strengths	5.0	6.9	5.4	5.4	20.00, $p < 0.001$
Changes in barriers	−5.7	−6.4	−5.8	−6.4	3.64, $p < 0.05$

TABLE 5 | Mean number of strengths and barriers while in recovery and changes in strengths and barriers from addiction to recovery, by parenting status (n = 1,313).

	No dependent children (mean, SD)	With dependent children	*T*, significance
Strengths in recovery	10.2 (3.32)	11.1 (3.05)	5.03, $p < 0.001$
Barriers in recovery	2.62 (2.06)	2.51 (2.40)	0.84, 0.40
Change in strengths	5.43 (4.00)	6.51 (4.23)	4.61, $p < 0.001$
Change in barriers	−5.79 (3.85)	−6.42 (3.88)	2.84, $p < 0.01$

TABLE 6 | Linear regression model of growth in recovery strengths.

Prognostic variables	Coefficient	Standard error	P > [t]
Age first using a substance	0	0.001	0.799
Age last using a substance	0.002	0.001	0.139
Duration of substance use (years)	−0.001	0.001	0.043
Length of recovery (years)	0.058	0.01	<0.0001
Age	0.001	0.001	0.281
Addiction strengths	0.231	0.025	<0.0001
Addiction deficits	0.275	0.023	<0.0001
Recovery deficits	−0.398	0.031	<0.0001
Male	−0.691	0.143	<0.0001
Secondary education	0.926	0.474	0.051
Higher education	1.218	0.479	0.011
Primary education	0.514	0.492	0.296
Single	−0.044	0.264	0.868
Co-habitation	0.424	0.29	0.145
Married	0.651	0.284	0.022
Divorced	−0.077	0.302	0.798
Living with dependent child	0.192	0.151	0.205
Acute housing need (in last 30 days)	−1.239	0.369	0.001
Has been evicted (in last 30 days)	−0.698	0.457	0.127
Injected (in last 30 days)	−0.846	0.6	0.159
Offended (in last 30 days)	−0.437	0.339	0.197
Criminal justice involvement (in last 30 days)	−0.804	0.294	0.006
Full-time employment (in last 30 days)	1.097	0.149	<0.0001
Part time employment (in last 30 days)	0.49	0.172	0.005
Undertook education (in last 30 days)	0.87	0.162	<0.0001
Volunteered (in last 30 days)	0.422	0.146	0.004
Residence: United Kingdom	0.643	0.253	0.011
Residence: Balkans	−0.967	0.271	<0.0001
Residence: The Netherlands and Belgium	0.554	0.25	0.027
Residence: Spain and Portugal	0.454	0.395	0.25
Residence: Poland	−0.753	0.346	0.03
Received 12-Step help/treatment	0.616	0.373	0.099
Received out-patient (OP) help/treatment	−0.312	0.285	0.273
Received OP and Residential Rehab (RR) help/treatment	0.035	0.215	0.871
Received OP and RR help/treatment	0.063	0.22	0.775
Received RR, OP, 12-step and peer support	0.653	0.237	0.006
Constant	5.942	0.594	0

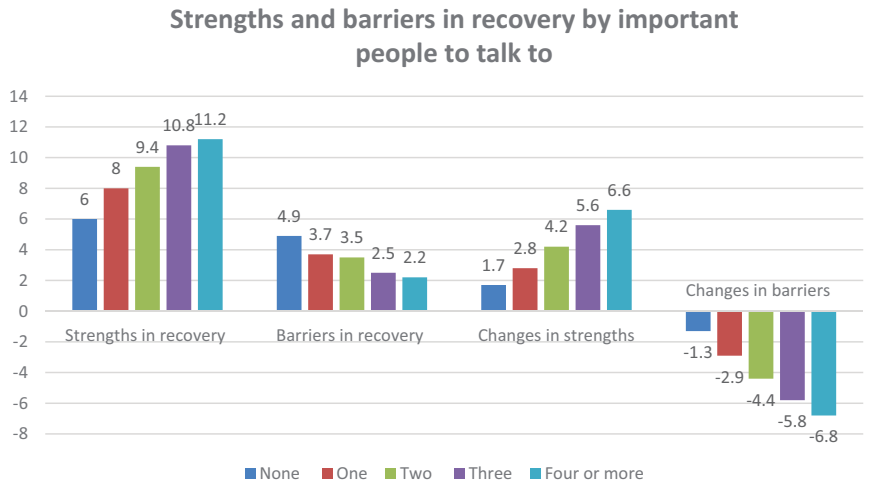

FIGURE 1 | Strengths and barriers in recovery by important people to talk to.

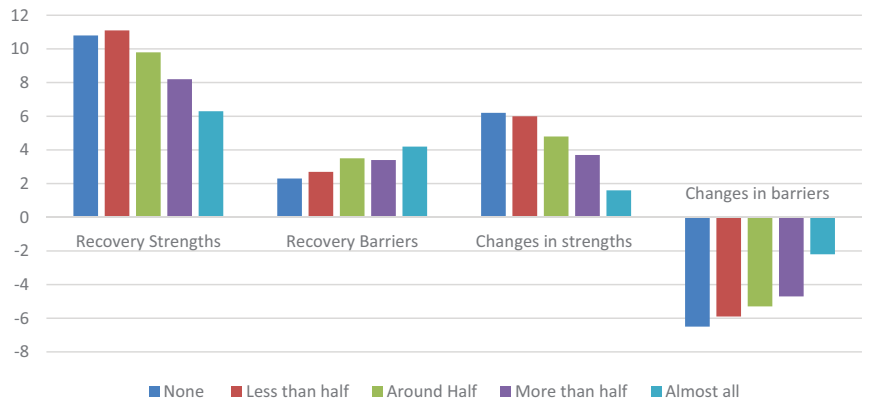

FIGURE 2 | Recovery strengths and barriers by number of illicit drug users in social network.

more deficits in recovery; acute housing needs; involvement in the criminal justice system and, living in the Balkan countries or Poland.

DISCUSSION

Few studies have explored the association between social and family relationships and recovery strengths and barriers. The data presented in this paper use the SABRS measure (Best et al., 2020) to demonstrate clear changes in recovery strengths and barriers from active addiction to recovery as an indicator of positive and negative recovery capital (Best and Laudet, 2010). The key findings from this large European sample show that being in two different kinds of close relationships (having an intimate partner and having children) is associated with greater positive changes in recovery strengths and greater reductions in barriers to recovery. Similarly, larger social networks of people in recovery and more people to confide in (indicators of social capital) are associated with more positive growth in recovery strengths and reductions in barriers to recovery.

These findings are consistent with a previous publication on the SABRS scale (Best et al., 2020) indicating—on a much larger sample—that the transition from addiction to recovery is associated both with an increase in recovery strengths and a reduction in recovery deficits. However, and one of the key purposes of measuring recovery capital is that, these transitions are not consistent across the entire sample in predictable ways. While the previous paper primarily focussed on gender effects, the current paper shows clear associations with key social and family factors, consistent with existing evidence about the importance of social support and group belonging in other substance using populations (Jetten et al., 2012; Best et al., 2015b).

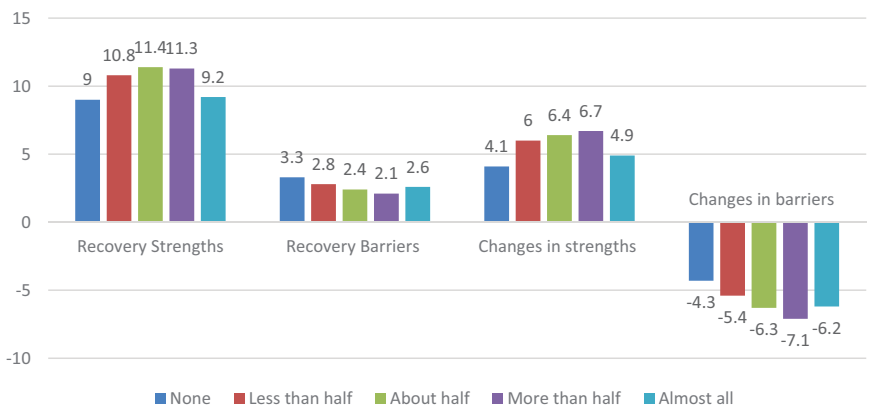

FIGURE 3 | Recovery strengths and barriers by proportion of social network in recovery.

There seems to be a beneficial effect for family connections both in terms of relationship status and living with dependent children, suggesting the potential benefits of specifically family connections but also more generally of positive and pro-social relationships for the development and emergence of recovery capital consistent with a "social cure" model (Jetten et al., 2012) and with the application of this model to addiction recovery populations (Dingle et al., 2014; Beckwith et al., 2015). The effects of both relationships and family fit with a model of "informal social control" (Sampson and Laub, 2003), in which positive relationships to family bind people into prosocial lifestyles and support efforts at rehabilitation and reintegration. However, as the study applied a cross-sectional design, causal inference is not warranted. Alternatively, an inverse causal relation may exist, i.e., people with more recovery strengths may be more able to build and maintain social relationships.

Nonetheless, these findings are consistent with work done in the area of desistance from offending by Sampson and Laub (2003) around the importance of "informal social control," and the multi-variate analysis suggests benefits of marriage on recovery strengths while in recovery. What this model suggests is that family supports create both a pressure on former offenders to conform, but also reduce the opportunities for engaging with former using and offending friendship groups. Yet, LeBel et al. (2008) have cautioned against placing too much emphasis on marriage or parenting as the "causes" of desistance or recovery, suggesting that these key events can be markers of changes that have taken place rather than causes of subsequent change. In the context of recovery capital, it is important to recognise the limitation about whether parenting or relationships have started since the onset of recovery and so we can make no assumptions about causal ordering of this association.

Where we found stronger evidence, and evidence that is consistent with existing empirical and conceptual work (Best et al., 2008, Best et al., 2015b, Longabaugh et al., 2010), is around the importance of moving away from social networks involved in substance use and offending and into networks supportive of recovery. "Social cure" (Jetten et al., 2012), in which stronger social support (as measured in the question about the number of social network members one can talk to about important things) is clearly associated with more strengths and less barriers in recovery and greater increases in strengths while in recovery and greater reductions in recovery barriers. However, who is in your social network also matters as shown in our analyses. The higher the proportion of people in recovery in one's social network and the lower the proportion of drug users in the network, the greater the total number of current strengths and the smaller the number of current barriers, which is consistent with the notion of "recovery contagion" (Best, 2019). We observed one interesting exception to this trend, as it appears that it is not beneficial to have a social network consisting exclusively of people in recovery, which is consistent with the "social cure" concept of the beneficial effects of belonging to multiple groups (Jetten et al., 2012).

The multi-variate analysis indicated positive associations for meaningful activities—with all of employment, education and volunteering associated with greater strengths in recovery. This is entirely consistent with previous quantitative (Best et al., 2011; Cano et al., 2017) and qualitative studies (De Maeyer et al., 2011; Pickering et al., 2020), showing the added value of meaningful activities. It further contributes to the evidence presented by the CHIME model of mental health recovery (Leamy et al., 2011; Best, 2019; Aga et al., 2021), indicating that positive social Connections generate Hope that in turn creates the conditions for Identity change that results from engaging in Meaningful activities which in turn enhances Empowerment.

There are some limitations to this study that merit mention. The sample is entirely self-selected—neither their recovery status nor their previous using experiences were examined or validated in any way. This also means that we cannot comment on the representativeness of the sample. As with all recovery studies, we have limited knowledge of the population and so commenting

on the representativeness of the sample achieved is difficult, although it is worth noting that the size of the sample (in excess of 1,000) and the relatively balanced gender breakdown may suggest reasonable coverage. Nationality effects (as reported in the regression model) need to be treated with great caution as the recruitment strategy among the RUN members was much more limited (no fulltime researcher involved) than in the REC-PATH countries. Finally, the SABRS scale remains relatively untested and the accuracy of recollection of historical barriers and strengths and the potential for self-presentational bias in the current reporting of strengths and barriers cannot be validated or tested. We would suggest that future studies that use the Life in Recovery method consider reliability testing by repeated administration of the scale to at least examine test-retest consistency. Further, future research could administer the "in active addiction" component to those currently using substances to generate norms that could in principle validate the scores at a group level. Similarly, prospective designs could be used in future studies to assess both reliability and validity of both the LiR method and the resulting SABRS scores.

Nonetheless, the paper presents evidence on associations that are not reliant on sample representativeness and which suggests the importance of both familial and friendship effects in shaping recovery barriers and strengths. The SABRS scale is easy to administer and quick to complete and provides a measure of change that is not present in instruments that examine only current or past behaviours and do not offer the contrast offered by the LiR survey. Considerably more research is required to test the effects reported here prospectively, but what this paper indicates is both a "social cure" and further support for the importance of network transitions and domestic stability in building the recovery capital that is required to sustain recovery and wellbeing over time.

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 Ghent University, Ethics Committee of the Faculty of Psychology and Educational Sciences, Belgium; the Sheffield Hallam University Ethics Committee, United Kingdom; and METC Erasmus MC, Netherlands. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DB, AS, and LB undertook the data analysis and drafted a first version of the manuscript. MN and TM oversaw the data collection process and reviewed the draft versions. GN, DM, and WV wrote the introduction and discussion section and revised draft versions of the manuscript. All authors contributed to the conceptualisation, the drafting and reviewing of the manuscript, and revised draft version of this manuscript.

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Changes in Social, Romantic, and General Life Satisfaction Over the Course of a Substance Use Disorder

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Background: The pandemic has highlighted the importance of social connection for health and well-being. Satisfaction across domains of life is associated with substance use outcomes, such as risk of relapse and mortality. Previous work has delineated the relationship between substance use and social connections, yet there is a lack of research exploring the relationship between substance use and satisfaction with domains of life over time.

Methods: We retrospectively assessed satisfaction with social life, romantic life, and general life across five phases of substance use among 339 adults, of whom 289 identify as formerly having a problem with substance use, and a comparison group of 50 who report no history of problematic drug use. We compared those whose primary drug of choice was alcohol, marijuana, methamphetamine, non-prescription opioids, and prescription opioids.

Results: Those who used prescription opioids reported a larger drop in satisfaction in social life, romantic life, and general life during the course of substance use than those who used other drugs. However, we report no significant differences in *current* satisfaction, social well-being, or quality of life between people in recovery and people with no history of problematic substance use.

Conclusions: These findings—alongside neuropsychological work on the opioid system and sociality—paint a picture that those who formerly used prescription opioids may experience lower satisfaction across life domains during the course of their substance use than those who used other substances. However, people in prolonged recovery—regardless of their drug of choice—all show similar levels of satisfaction compared to people with no history of problematic substance use.

Keywords: social connection, life satisfaction, social satisfaction, quality of life, opioid, substance use, recovery, prescription opioid

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INTRODUCTION

The widespread impacts of the COVID-19 pandemic on social relationships have highlighted their importance for our psychological and physical well-being (1, 2). Humans are hyper-social beings (3), and our success as a species is strongly linked to our capacity for flexible cooperation (4).

As individuals, our health, longevity, and happiness all appear to be linked to the maintenance of strong social bonds (5, 6). Higher degrees of social connection are associated with lower risks of inflammation and physiological dysfunction (6). However, in recent years, there has been a downward trend in the number of close personal relationships people maintain (7, 8).

This decline in personal relationships is concerning given that high quality friendships are positively correlated with overall life satisfaction (9), which is in turn associated with lower risk of mortality (10). Those who feel more lonely or isolated have lower life satisfaction as a result of feeling a need to belong, relative to those who are less isolated (11). Social capital (trust in relationships, belonging to a group, and socializing) is highly correlated with overall life satisfaction across dozens of countries (12).

Additionally, recent work has shown that community-level social capital is negatively correlated with per capita fatal drug overdoses (13). During the pandemic, adults in the United States who report higher levels of social isolation had (a) lower life satisfaction across domains, and (b) were more likely to use substances to cope with life stressors (14). Other studies have documented a significant increase in both the initiation and maintenance of substance use during the pandemic, including a large spike in opioid overdose deaths (15–17), that has coincided with markedly increased feelings of isolation brought on by social distancing measures designed to reduce the spread of COVID-19 (1, 2, 18). This evidence points to the idea that isolation and satisfaction (e.g., social, romantic, and general) are associated with substance use behaviors.

Substance use is a well-documented coping mechanism for social distress. The Diagnostic and Statistical Manual of Mental Disorders (19) explicitly outlines social impairment as part of the diagnostic criteria for substance use disorders. Risk factors for relapse often include social components, such as a lack of social support from friends or family, or poor quality of social relationships (20). Interventions aim to target the decline of social relationships that often accompanies substance use disorders by providing new social connections within a recovery community (21), by focusing on repairing damaged relationships within the individual's community (22), or by encouraging social involvement to combat the powerful reinforcing properties of drug use (23). Peer-run treatment modalities for substance use disorders routinely focus on human connection through shared experiences of addiction, including peer support groups like Alcoholics Anonymous. A recent Cochrane review reported that Alcoholics Anonymous and other 12-step facilitation programs are as effective as other established treatments, such as cognitive behavioral therapy (CBT), and even outperform CBT in prolonged abstinence (24).

In addition to diagnostic criteria and treatment regimens, neural correlates illuminate the relationship between social relationships and substance use disorders—specifically opioid use disorder. The brain opioid theory of social attachment (BOTSA) outlines the critical role of the endogenous opioid system in social attachment (25). The endogenous opioid system plays a key role in the reward associated with social ties across the life span of humans and non-human primates, including (a) maternal/infant bonds, (b) non-kin relationships, and (c) romantic relationships. For more details, please see the 2011 paper by Machin and Dunbar. It is important to note that humans consume pharmacologically similar drugs in different social contexts: prescription and non-prescription opioids are not consumed in the same way, by the same people, nor in the same places. There is evidence that those who use solely heroin (rather than prescription opioids) are more socioeconomically disadvantaged, older, and more disconnected from social institutions, while those who use solely prescription opioids (rather than heroin) are more likely to be economically stable, connected to social institutions, and less likely to have a history of criminal justice involvement (26). Those who use prescription opioids are also at risk for developing a later heroin use disorder, particularly those who initiate pharmaceutical opioid misuse at a younger age and use it exclusively to get high, rather than those who are introduced to it via the medical system (27). Additionally, among those who are prescribed opioids by a physician, those who have a college degree are 2.5 times more likely to develop an opioid use disorder than those who do not (28). We hypothesized that those who used opioids would show differential satisfaction with their social, romantic, and/or general lives throughout the course of substance use because of the unique pharmacological association between opioids and interpersonal connections as described by BOTSA. However, we separately evaluated those who used prescription and non-prescription opioids because of the differences in sociodemographic characteristics and experiences of stigma between these groups. These differences may be associated with divergent outcomes (e.g., life satisfaction, social wellbeing). As high-risk opioid use remains a prominent issue, further exploration of the relationship between substance use (particularly opioid use) and satisfaction with interpersonal connections is warranted.

While the link between substance use and social isolation has been established, there is a lack of evidence exploring the relationship between substance use and a person's satisfaction with their social, romantic, and general life over the course of time. There is also a dearth of information regarding how prescription opioid use may differ from non-prescription opioid use in terms of social, romantic, and general life satisfaction. In the present study, we aim to retrospectively assess changes in satisfaction in a person's social, romantic, and general life circumstances among those with a history of problematic substance use, and assess whether any differences persist during recovery. We also contemporaneously measure social well-being and quality of life. We sought to address three main questions: (1) Is satisfaction in life domains *pre-drug use* different for people who used different substances? (2) Is satisfaction in life domains predicted by an interaction between a person's former drug of choice and time (i.e., *during different stages throughout the course of substance use)*? (3) Is satisfaction in life domains, social well-being, and quality of life *in recovery* different for people who used different substances and people with no history of problem drug use?

METHOD

Sample Selection

The current study employed a retrospective survey design to assess those with a history of problem substance use alongside a comparison sample of participants with no history of problem substance use. The present study used a convenience sample; the sampling universe consisted of adults who reside in the United States and who have an account with Prolific Academic Ltd., an online data collection platform (Prolifiic.co) that has good transparency, functionality, and a relatively high minimum hourly payment for participants (29). Prolific allows researchers to select participants using a two-part survey in which participants complete a screening survey and are subsequently invited to complete the full study. All participants completed the full study between June 6th, 2021 and August 14th, 2021. We used the Drug Abuse Screening Test (DAST-10; a validated clinical measure) to identify participants with a history of at least a low level of problems related to drug use—defined as scoring a three or above on the scale (30, 31). Previous literature has found that a cutoff score of three or higher is associated with a DSM-3R diagnosis of substance abuse or substance dependence (32). A literature review of effective behavioral health screening tools within primary care settings supported the use of the DAST-10 with a cutoff score of three or higher for a substance use disorder, with a discussion of using two as a lower cutoff score for primary care applications (33). We posted a screening survey on Prolific to identify individuals who met our inclusion criteria: individuals screened into the full study if they had (a) a history of problems associated with drug use (i.e., scored a 3 or above on the DAST-10), (b) currently do not engage in problematic substance use (i.e., are not using any substances, or use occasionally/casually with no problems), and (c) were adults currently residing in the United States who have Prolific accounts. Individuals were asked to identify their primary drug of choice in the screening survey. We were interested in comparing those who had a history of problematic use of prescription opioids, non-prescription opioids, methamphetamine, marijuana, and alcohol to one another. We asked about substances other than opioids because methamphetamine, marijuana, and alcohol are also widely used substances and provide controls for opioids among a population of people who use substances. We oversampled those who used opioids and methamphetamine to ensure that we had an adequate sample size to statistically compare between groups. We oversampled by selectively inviting those who indicated that their primary drug of choice was opioids or methamphetamine in the screener to complete the full survey until we had ∼50 participants in each category for drug of choice. Additionally, we collected responses from 50 individuals who reported *no* former or current problem with substance use to serve as a comparison group. The control participants did not complete the DAST-10 as they previously indicated that they had never experienced problematic substance use.

Measures

The full survey for all participants (including controls) who screened in included the following: Social Well-being Scale (34); Quality of Life 35-item measure (35); and demographic questions on age, ethnicity, socioeconomic status. People with a history of substance use also completed the 8-item Inventory of Drug Taking Situations (36) and substance use questions about their age of first intoxication (from any substance, not only drug of choice) and time in sobriety/recovery.

Lastly, there were several measures in which participants with a history of substance use were instructed to answer the same set of questions repeatedly, but each time focusing on a different period of their substance use history: (1) before the initiation of substance use, (2) in the initial stages, (3) in the height/midst of substance use, (4) in the initial stages of reducing or quitting substance use, and (5) in recovery from substance use (either abstinence or non-problematic use). Questions were binned into these 5 blocks, each one representing a phase of substance use. Assessment of satisfaction across life domains were single-item Likert-style questions. Participants were asked the following questions in each block: (a) how satisfied are/were you with your social life, (b) how satisfied were/are you with your romantic life, (c) how satisfied were/are you with your overall life, and (d) were social relationships more/less/similarly desirable compared to [the previous stage]. Control participants were asked these same four questions, but only for the contemporaneous or current time (e.g., how satisfied are you with your social/romantic/general life?). All study measures were approved by the local Institutional Review Board. All statistical analyses were completed using R version 1.1.4.

Analytic Procedures

Demographic Differences

We utilized chi-square tests to determine if there were significant differences between groups in demographic characteristics (e.g., education) and measures of drug use (e.g., substance use severity score).

Satisfaction Prior to Substance Use

We used ANOVA to predict pre-drug use satisfaction separately for each domain: social, romantic, and general life satisfaction based on the participant's reported primary substance of choice. For each of the three models, we included participant age, DAST score (i.e., substance use severity), and age of first intoxication as covariates, and the reference group was people who reported alcohol as their primary substance of choice. We did not assess reliability metrics for any of the satisfaction measures as they were single-item measures that retrospectively assessed satisfaction across the 5-stages of substance use.

Satisfaction During the Course of Substance Use

For our primary analyses, we used ANOVA to predict satisfaction across the three domains (social, romantic, and general life) based on the interaction between *time* (the 5 stages of substance use assessed in the current study—before initiation, initial stages, height of problematic use, initial cessation, and recovery/current time) and substance of choice, with alcohol as the reference group. In addition, we performed a secondary analysis examining these same variables as change scores relative to satisfaction prior to drug use in a two-step approach: first without removing

the variance linked to drug use severity and age, and then a second time after removing the variance associated with drug use severity and age. These secondary analyses using change scores and residual change scores are included in the **Appendix**.

Current Satisfaction and Well-Being (Post-problem Use)

We used ANOVA to predict current satisfaction across the three life domains by drug of choice with the comparison group (i.e., participants with no history of drug use) as the reference. Covariates in the model were current age, age of first intoxication, and DAST.

In addition to questions about current satisfaction with life domains, participants completed the Social Well-being Scale and the Quality of Life Scale. We created two models for each scale: in the first model we used ANOVA to predict separately (a) social well-being and (b) quality of life by drug of choice, including the comparison group (no history of drug use) as the reference and age as a covariate. For the second model, we only included individuals with a history of substance use problems, and used ANOVA to predict current social well-being by the interaction between drug of choice (with alcohol as the reference group), and time in sobriety (< 1 year as the reference group), including age and drug use severity as covariates.

RESULTS

Demographic Characteristics

Our sample consists of 339 adults (178 males). Among the 339 participants, 50 were comparison participants, and 289 participants reported a history of problems with substance use. See **Table 1** for demographic characteristics of the current sample, and see **Table 2** for the characteristics of drug use among the sample.

DAST-10

Participants completed the DAST-10 measure as a retrospective evaluation of problems they had *ever* experienced due to their substance use (i.e., not a current measure of severity of problems associated with substance use). Higher DAST-10 scores were observed among those whose drug of choice was prescription opioids ($N = 48$, B = 0.87, $t = 2.82$, $p < 0.01$), non-prescription opioids ($N = 48$, B = 1.28, $t = 4.17$, $p < 0.001$), or methamphetamine ($N = 32$, B = 1.26, $t = 3.54$, $p < 0.001$) relative to those whose drug of choice was alcohol ($N = 103$).

Pre-drug Use

Social Life Satisfaction

Prior to the initiation of substance use, those who used marijuana reported lower satisfaction in their social lives relative to those who used alcohol (B = −0.69, $t = -2.41$, $p < 0.05$). Higher age is also associated with higher pre-use social satisfaction (B = 0.02, $t = 2.08$, $p < 0.05$). There was no significant association between severity of substance use and social life satisfaction prior to substance use.

Romantic Life Satisfaction

Prior to the initiation of substance use, those who used prescription opioids reported higher satisfaction in their romantic lives relative to those who used alcohol (B = 0.88, $t = 2.64$, $p < 0.01$). There was no significant association with either age or severity of substance use.

General Life Satisfaction

Prior to the initiation of substance use, those who used prescription opioids reported higher satisfaction in their social lives relative to those who used alcohol (B = 0.76, $t = 2.61$, $p < 0.01$). Higher age was also associated with higher pre-use general life satisfaction (B = 0.02, $t = 2.53$, $p < 0.05$).

During the Course of Substance Use

Social Life Satisfaction

The ANOVA evaluating the relationship between drug of choice and the time from pre-substance use to initial stages of use on feelings of social life satisfaction revealed a significant main effect of time and drug of choice; satisfaction tended to be higher in the initial use phase than before the initiation of use (B = 0.49, $t = 2.03$, $p < 0.05$), and those who used marijuana reported lower satisfaction than those who used alcohol (B = −0.64, $t = -2.27$, $p < 0.05$). **Figure 1** depicts the significant interaction; those who used prescription opioids were the only participants who reported a *decrease* in social life satisfaction from pre-substance use levels to the initial stages of use (B = −1.21, $t = -2.86$, $p < 0.005$).

The association between drug of choice and time is depicted in **Figure 2**. The three time-points *during* use (initial use, height of use, and initial cessation) revealed a main effect of time: relative to the initial phases of substance use, people report lower feelings of social satisfaction both during the height of problematic use (B = −0.70, $t = -3.03$, $p < 0.01$) and during the initial stages of quitting/reducing use (B = −0.69, $t = -2.99$, $p < 0.01$). We also observed a main effect of drug of choice: relative to alcohol, people report lower feelings of social satisfaction if their primary drug of choice was either marijuana (B = −0.57, $t = -2.11$, $p < 0.05$) or prescription opioids (B = −0.72, $t = -2.51$, $p < 0.05$). There was no significant interaction between drug of choice and time.

Romantic Life Satisfaction

The ANOVA evaluating the association between drug of choice and the time from pre-substance use to initial stages of use on feelings of romantic life satisfaction is depicted in **Figure 3**. It revealed a significant main effect of drug of choice; romantic life satisfaction is higher among those who used prescription opioids relative to those who used alcohol (B = 0.79, $t = 2.40$, $p < 0.05$). There was no significant interaction between time and drug of choice. Again, the only group that shows a decline in romantic satisfaction pre-substance use to the initial stages is the group of those with a history of prescription opioid use.

The ANOVA evaluating the association between drug of choice and time for the three time-points *during* use (initial use, height of use, and initial cessation) revealed a main effect of time: relative to the initial phases of substance use, people report

TABLE 1 | Demographic characteristics of the full sample including control participants ($N = 339$) by substance of choice.

Basic descriptive statistics	Control $N = 50$	Alcohol $N = 103$	Marijuana $N = 58$	Methamphetamine $N = 32$	Prescription opioids $N = 48$	Non-prescription opioids $N = 48$	*P*-value
Age							0.081
Median (IQR)	36 (29–46)	33 (29–39)	30 (25–42)	39 (33–47)	36 (30–42)	32 (28–41)	
Missing	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	1 (2%)	
Income							0.062
<$10,000	3 (6%)	6 (6%)	5 (9%)	3 (9%)	2 (4%)	5 (10%)	
$10,000–$29,999	8 (16%)	23 (22%)	7 (12%)	8 (25%)	8 (17%)	9 (19%)	
$30,000–$49,999	6 (12%)	30 (29%)	18 (31%)	10 (31%)	10 (21%)	9 (19%)	
$50,000–$79,999	18 (36%)	17 (17%)	14 (24%)	6 (19%)	15 (31%)	14 (29%)	
$80,000–$99,999	6 (12%)	12 (12%)	6 (10%)	2 (6%)	4 (8%)	4 (8%)	
$100,000 or more	9 (18%)	15 (15%)	7 (12%)	3 (9%)	8 (17%)	6 (12%)	
Missing	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	1 (2%)	
Race							**0.045**
American Indian or Alaska Native	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Asian	8 (16%)	8 (8%)	6 (10%)	1 (3%)	1 (2%)	0 (0%)	
Black or African American	8 (16%)	10 (10%)	5 (9%)	1 (3%)	1 (2%)	3 (6%)	
Hispanic	1 (2%)	8 (8%)	2 (3%)	2 (6%)	0 (0%)	0 (0%)	
Multiethnic	5 (10%)	8 (8%)	5 (9%)	3 (9%)	5 (10%)	6 (12%)	
White	28 (56%)	68 (66%)	39 (67%)	25 (78%)	40 (83%)	38 (79%)	
Missing	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	1 (2%)	
Education							**<0.0001**
Less than high school	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2%)	1 (2%)	
High school graduate	5 (10%)	14 (14%)	7 (12%)	7 (22%)	6 (12%)	8 (17%)	
Some college but no degree	8 (16%)	24 (23%)	9 (16%)	15 (47%)	18 (38%)	14 (29%)	
Associate degree	4 (8%)	4 (4%)	7 (12%)	7 (22%)	5 (10%)	7 (15%)	
Bachelor's degree	19 (38%)	41 (40%)	28 (48%)	2 (6%)	11 (23%)	14 (29%)	
Master's degree	7 (14%)	19 (18%)	6 (10%)	0 (0%)	5 (10%)	3 (6%)	
Doctoral degree	0 (0%)	0 (0%)	0 (0%)	1 (3%)	1 (2%)	0 (0%)	
Professional degree	7 (14%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Missing	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	1 (2%)	
Employment							**0.041**
Employed	29 (58%)	57 (55%)	36 (62%)	10 (31%)	21 (44%)	24 (50%)	
Self-Employed	4 (8%)	10 (10%)	6 (10%)	9 (28%)	12 (25%)	10 (21%)	
Not working (disabled)	0 (0%)	6 (6%)	2 (3%)	6 (19%)	3 (6%)	3 (6%)	
Unemployed	13 (26%)	26 (25%)	11 (19%)	6 (19%)	11 (23%)	10 (21%)	
Retired	3 (6%)	2 (2%)	1 (2%)	1 (3%)	0 (0%)	0 (0%)	
Missing	1 (2%)	2 (2%)	2 (3%)	0 (0%)	1 (2%)	1 (2%)	

The far-right column is the p-value associated with chi-squared analyses to detect differences between participants for each demographic characteristic.
The bold values indicate a significant difference on that demographic characteristic between groups with different primary drugs of choice.

lower feelings of romantic life satisfaction during the height of problematic use ($B = -0.58$, $t = -2.26$, $p < 0.05$). This finding is depicted in **Figure 4**. We observed no main effect of drug of choice. However, there was a significant interaction between drug of choice and time: those who used non-prescription opioids reported lower romantic life satisfaction during the initial cessation period than those who used alcohol ($B = -0.96$, $t = -2.10$, $p < 0.05$).

General Life Satisfaction

Figure 5 depicts the interaction between drug of choice and the time from pre-substance use to initial stages of use on feelings of general life satisfaction. This analysis revealed a significant main effect of time; participants report higher satisfaction overall before the initiation of drug use ($B = 3.73$, $t = 23.76$, $p < 0.001$). Additionally, there was a main effect of drug, such that those who used prescription opioids reported higher satisfaction in general than those who used alcohol ($B = 0.73$, $t = 2.63$, $p < 0.01$). There was also a significant interaction; those who used prescription opioids reported *lower* general life satisfaction than those who use alcohol in the initial stages of use ($B = -1.27$, $t = -3.23$, $p < 0.01$).

The ANOVA evaluating the association between drug of choice and time for the three time-points *during* use (initial use, height of use, and initial cessation) revealed a main effect

TABLE 2 | Substance use history and characteristics of the subsample of participants with a history of problematic substance use ($N = 289$).

Basic descriptive statistics	Alcohol $N = 103$	Marijuana $N = 58$	Methamphetamine $N = 32$	Prescription opioids $N = 48$	Non-prescription opioids $N = 48$	*P*-value
Substance use severity	6 (4–7)	5 (4–7)	7 (6–8)	7 (5–8)	7 (5–9)	**<0.0001**
Time in Sobriety						0.096
< 1year	33 (32%)	18 (31%)	7 (22%)	6 (12%)	11 (23%)	
1–5 Years	51 (50%)	28 (48%)	13 (41%)	25 (52%)	22 (46%)	
6+ years	19 (18%)	12 (21%)	12 (38%)	17 (35%)	15 (31%)	
Missing	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Age of First Intoxication	18 (16–19)	16 (14–18)	15 (14–16)	16 (14–18)	16 (14–18)	**0.010**

The far-right column is the p-value associated with chi-squared analyses to detect differences between participants for each substance use characteristic. The bold values indicate a significant difference on that substance use characteristic between groups with different primary drugs of choice.

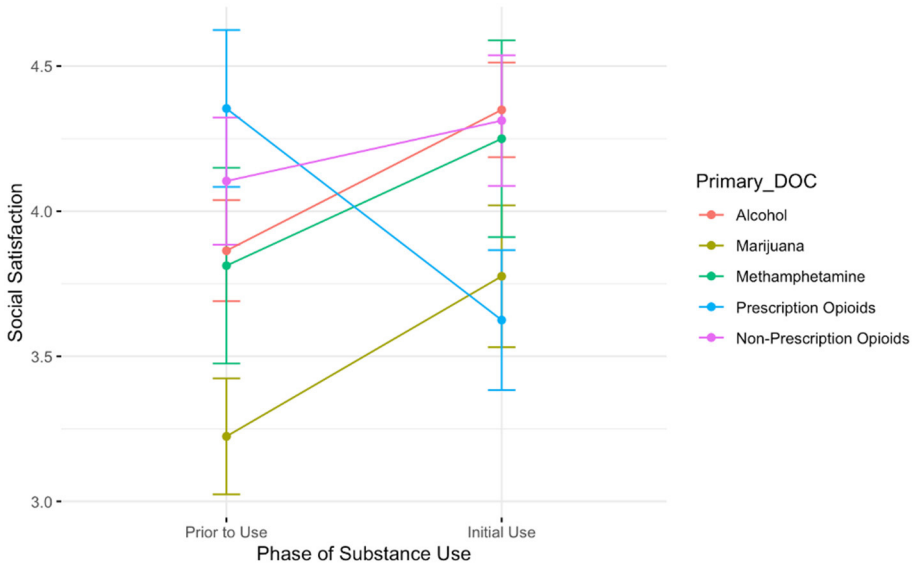

FIGURE 1 | A plot showing the average social satisfaction scores for participants prior to the onset of substance use and during the initial stages of use. Lines are colored by participant primary substance of choice. The only group showing a decrease in social satisfaction is those who report using prescription opioids.

of time; **Figure 6** depicts the results. Relative to the initial phases of substance use, people report lower feelings of general life satisfaction both during the height of problematic use ($B = -0.92$, $t = -4.32$, $p < 0.001$) and during the initial stages of quitting/reducing use ($B = -0.73$, $t = -3.41$, $p < 0.001$). We also observed a main effect of drug of choice: relative to those who used alcohol, those who used prescription opioids reported lower life satisfaction ($B = -0.54$, $t = -2.02$, $p < 0.05$). There was a significant interaction between drug of choice and time: those who used marijuana reported higher general life satisfaction during the height of their problematic use period than those who used alcohol ($B = 0.77$, $t = 2.16$, $p < 0.05$).

Current Satisfaction and Well-Being (Post-problem Use)

Social Life Satisfaction

We used ANOVA to predict current social life satisfaction by drug of choice (participants with no history of drug use as the reference group) with age, drug use severity, and age of first intoxication as covariates in the model. We observed no significant main effects or interactions in the model; no differences in current social life satisfaction were observed among those who used any drug of choice relative to the comparison group.

Romantic Life Satisfaction

We used ANOVA to predict current romantic life satisfaction by drug of choice (participants with no history of drug use as the reference group) with age, drug use severity, and age of first intoxication as covariates in the model. We observed no significant main effects or interactions in the model; however, age was a significant covariate such that for each additional year of age, participants scored 0.03 lower on current romantic life satisfaction ($B = 0.03$, $t = -2.66$, $p < 0.01$).

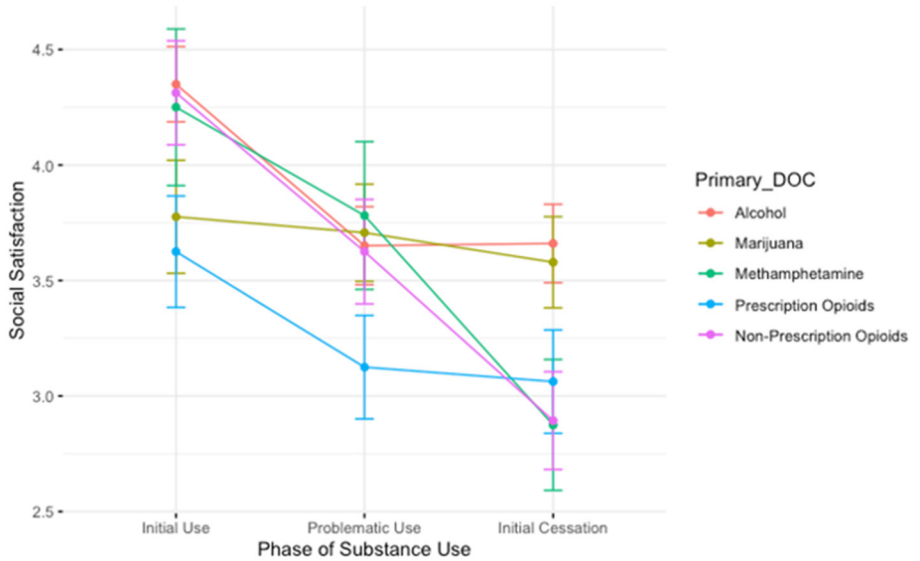

FIGURE 2 | A plot showing the average social satisfaction scores for participants during the initial stages of use, the height of problematic use, and during the initial stages of cessation. Lines are colored by participant primary substance of choice. The groups showing the steepest decrease in social satisfaction between the height of use and period of initial cessation are those who reported using methamphetamine and non-prescription opioids, while those who used prescription opioids reported lower satisfaction than those in other groups during the height of problematic use.

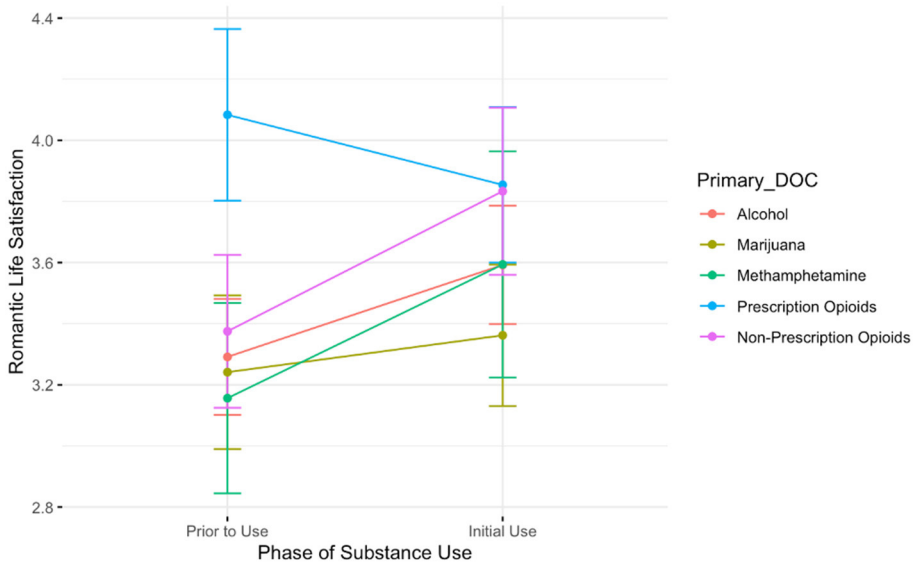

FIGURE 3 | A plot showing the average romantic life satisfaction scores for participants prior to the onset of substance use and during the initial stages of use. Lines are colored by participant primary substance of choice. The only group showing a decrease in romantic life satisfaction between these two timepoints is those who reported using prescription opioids.

General Life Satisfaction

We used ANOVA to predict current general life satisfaction by drug of choice (participants with no history of drug use as the reference group) with age, drug use severity, and age of first intoxication as covariates in the model. We observed no significant main effects or interactions in the model.

Social Well-Being

We used the validated Social Well-being Scale (range = 7–105) to assess *current* feelings of social well-being; the scale had high internal reliability (Cronbach's alpha = 0.89, CI [0.87, 0.90]). We observed no significant differences between the comparison group of those with no history of problematic drug use and any other drug use class. We observed no significant interaction

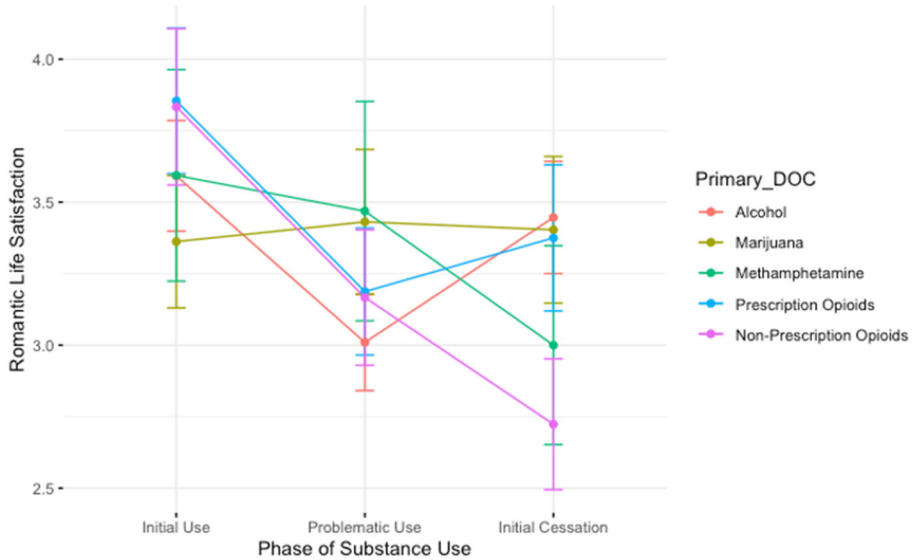

FIGURE 4 | A plot showing the average romantic satisfaction scores for participants during the initial stages of use, the height of problematic use, and during the initial stages of cessation. Lines are colored by participant primary substance of choice. Those who use non-prescription opioids report lower satisfaction than those in other groups during the initial period of cessation. We also generally see a "V"-shaped pattern among those who used alcohol and prescription opioids, where romantic satisfaction is lowest in the height of problematic use. However, for those who used methamphetamine and non-prescription opioids, romantic satisfaction continues to decrease from the height of problematic use to the initial cessation period.

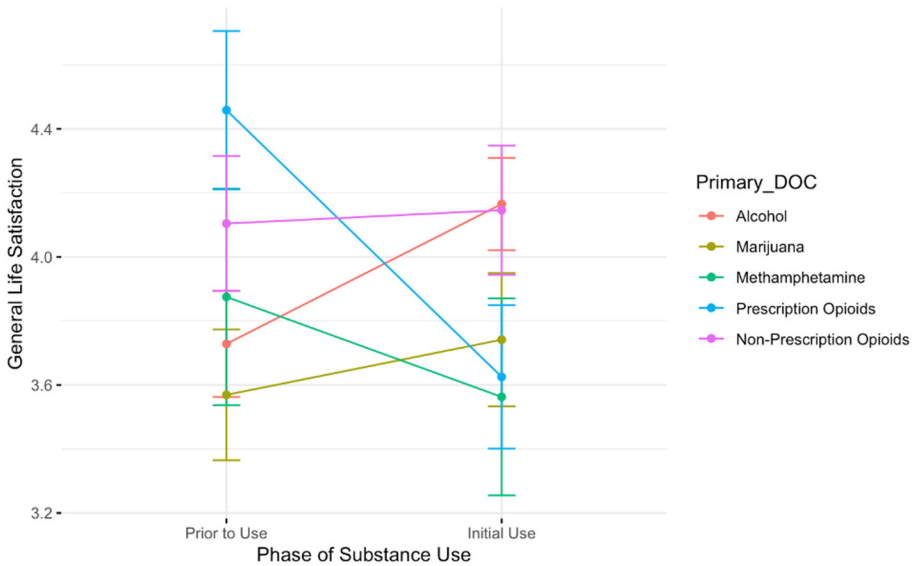

FIGURE 5 | A plot showing the average general life satisfaction scores for participants prior to the onset of substance use and during the initial stages of use. Lines are colored by participant primary substance of choice. The group showing the steepest decrease in general life satisfaction between these two timepoints is those who reported using prescription opioids.

between drug of choice and time in sobriety, nor any effect of age or drug use severity on current social well-being.

Quality of Life

The Quality of Life measure (range = 7–245) had high internal reliability (Cronbach's alpha = 0.94, CI [0.94, 0.95]). We observed no significant differences between the comparison group of those with no history of problematic drug use and any other drug use class. However, there is an effect of age, such that for each year older, participants reported a 0.37 higher point quality of life ($B = 0.37$, $t = 2.00$, $p < 0.05$). Among those who do have a history of problematic substance use, we observed a significant main

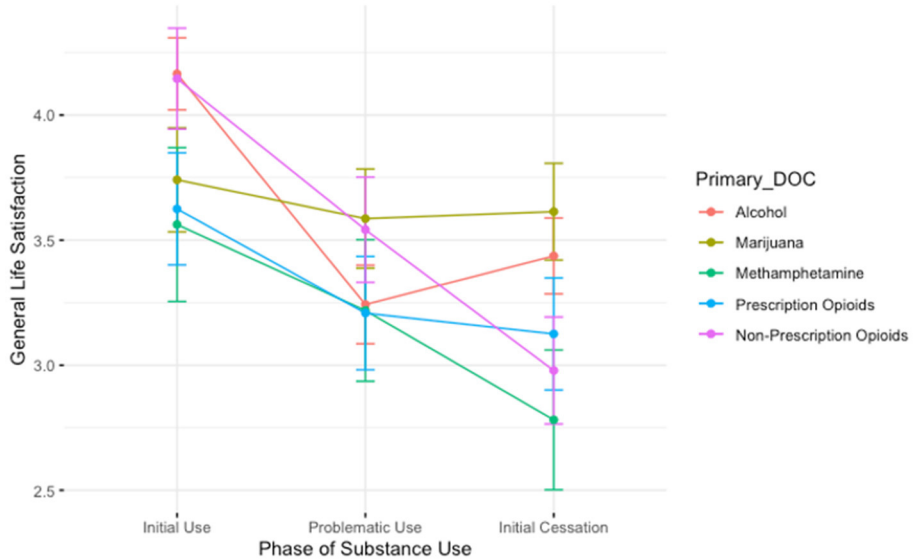

FIGURE 6 | A plot showing the average general life satisfaction scores for participants during the initial stages of use, the height of problematic use, and during the initial stages of cessation. Lines are colored by participant primary substance of choice. Those who used marijuana report higher general life satisfaction than those who used alcohol during the height of problematic use.

effect of time in sobriety such that those in the 1–5-year recovery mark report a Quality of Life score that is 15.85 points higher than those with < 1 year of recovery time, which is depicted in **Figure 7**. There is also an effect of drug use severity; for each additional point endorsed on the DAST-10 measure, participants reported a 2.32 lower quality of life score ($B = -2.32$, $t = -2.11$, $p < 0.05$). We report no significant main effect of drug of choice, and no effect of age. See **Figure 7**.

DISCUSSION

The changes in social, romantic, and general life satisfaction across phases of substance use vary by a person's primary drug of choice. The first portion of this paper assessed differences in groups prior to the initiation of substance use. When reflecting on the time before they had ever tried a substance, those who used marijuana report lower social life satisfaction, and those who used prescription opioids report both higher romantic and general life satisfaction.

In the second portion of the paper, we assessed differences that arise during the course of active substance use. Interestingly, the highest reported social, romantic, and general life satisfaction for those who used prescription opioids is *before the initiation of any substance use* at all, whereas the highest reported social, romantic, and general life satisfaction for those who used alcohol, marijuana, methamphetamine, and non-prescription opioids occurs *during the initial stages of substance use*. It may be the case that those who used prescription opioids feel low satisfaction with social, romantic, and/or general life during the course of substance use, and thus report higher levels of pre-substance use satisfaction, because in hindsight that may be the time in which they felt the most satisfied. One possible reason is that a higher proportion of those initiating prescription opioid use may have begun their use due to physical pain: they may think of their time prior to the onset of a medical issue as more satisfactory than the time when they initiated misuse of the prescription—which may have occurred in the context of pain. Thus, there was no "honeymoon" period where the drug effect was highly pleasurable in the initial stages of use. Another plausible explanation for the differences in satisfaction between those who used prescription vs. non-prescription opioids is that those who used prescription opioids tended to report higher levels of socioeconomic well-being relative to their counterparts who used non-prescription opioids. It could be the case that change from pre-substance use to the initial stages of use produced a larger decline in social, romantic, and general life satisfaction among those who used prescription opioids because their lives pre-substance use may have been more socially and economically enriched. Their starting point may have yielded a "farther fall" with more negative consequences experienced as a result of substance use, such as a loss of familial or social ties, or economic loss. Future work should address these issues in a larger sample, and collect data cross-sectionally and prospectively to determine if there are pre-existing differences in feelings of social or romantic connections in the beginning of substance use among those who use different substances that may put people at higher risk of developing a substance use disorder.

Perhaps unsurprisingly, participants across all substance groups report a decline in social, romantic, and general life satisfaction as substance use moves from the initial stages, to the height of problematic use, and into the initial stages of cessation. For social life, those who used prescription opioids and marijuana reported lower satisfaction throughout

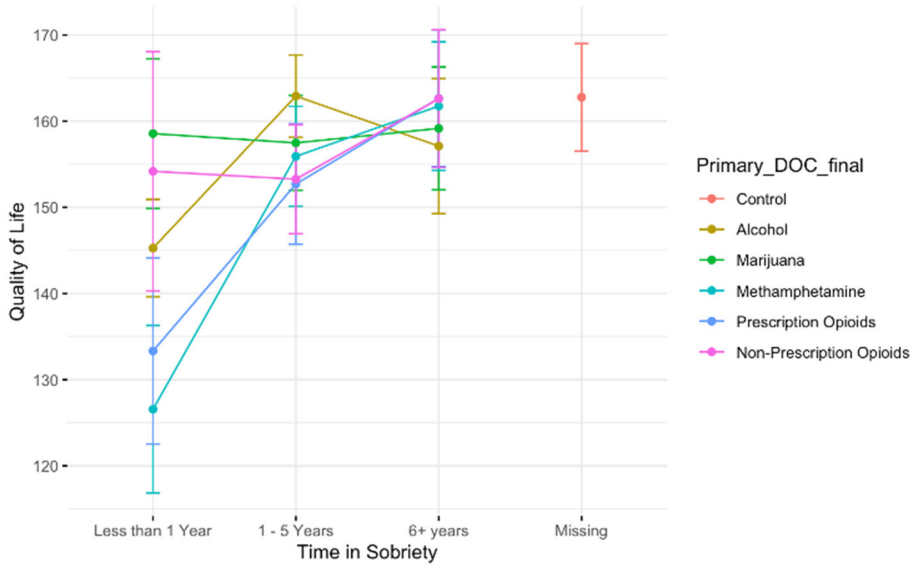

FIGURE 7 | A plot showing the trend that the longer time a person spends in recovery/sobriety, the higher their reported Quality of Life. There is no difference between Quality of Life among the control participants and any of those who have been in sobriety/recovery for six or more years. The highest increases in quality of life from early to later recovery are among those who used methamphetamine or prescription opioids.

the course of substance use than their counterparts who used alcohol. The lowest reported social satisfaction was among those who used prescription opioids during the height of their problematic use. For romantic life satisfaction, those who used non-prescription opioids reported the lowest scores, specifically during the period of initial cessation. Interestingly, those who used non-prescription opioids and methamphetamine were the only groups to report a decrease in romantic life satisfaction from the height of problematic use to the initial period of cessation. This is in line with prior work on the role of methamphetamine in romantic and sexual encounters; and is paradoxically also in line with work suggesting that those who use non-prescription opioids report little interest in romantic partners in the midst of their use. It may be that those who used opioids report lower romantic life satisfaction during the initial period of cessation as romantic encounters begin to become appealing once more, but they do not yet have a partner. For general life satisfaction, once again those who used prescription opioids report lower satisfaction than their peers. Compared with feelings of satisfaction before the initiation of substance use, those who used prescription opioids also reported a larger decrease in satisfaction in their social life and general life compared with those who used alcohol, and a larger decrease in their romantic life satisfaction than those who used marijuana or methamphetamine (see **Appendix** for detailed results on change scores).

In the third and final section of the paper, we addressed differences in current feelings of satisfaction between people with different drugs of choice alongside those who have no history of problematic substance use, and we see a new pattern emerge. There were no significant differences between the comparison group and the participants with a history of problematic substance use in any of the three domains: social, romantic, or general life. Beyond the current single-item measures of life satisfaction, we also asked participants to complete two full scale measures on social well-being and quality of life. Again, we saw that participants with a history of substance use report similar levels of social well-being and quality of life compared with those with no history of substance use. We then separately assessed only those with a history of drug use, including covariates such as age of first intoxication and time in recovery. Those in the 1–5-year period of recovery reported a higher quality of life than those with fewer than 1 year in recovery. Yet, scores among those with over 6 years in recovery match the control group. In short, quality of life is higher among those who are in recovery for longer. Altogether, participants with and without a history of problematic substance use look similar in terms of current social life satisfaction, romantic life satisfaction, social well-being, and quality of life. These findings suggest a hopeful message: although satisfaction across domains of life is low during problem use, it returns to normal with sustained remission. These findings are also important from a clinical and policy perspective. From a clinical perspective, life satisfaction predicts who will remain in recovery: for instance, those who report higher satisfaction in their own lives are more likely to remain in recovery at a 2-year follow-up, even when controlling for motivation and commitment to abstinence (37). Additionally, for medical providers, understanding how substance use impacts general well-being can potentially enhance patient-provider interactions and lead to improvements in substance use disorder/overall well-being screening measures within a healthcare setting. From a policy perspective, policymakers can aim to support and implement programs that are demonstrated to increase quality of life among those who use substances—which is associated with a

decreased risk of relapse. For example, policymakers can increase the availability and accessibility of methadone maintenance programs, which have been shown to increase quality of life among those who are in recovery from opioid use (38).

While we aimed to assess differences between those with different primary drugs of choice, we had a specific interest in looking at changes over time in satisfaction among those who used opioids. There is a strong biopsychosocial rationale as to why opioid use could produce divergent social satisfaction changes relative to other drugs. In human romantic relationships, endorphins (a class of endogenous opioid) increase with sexual behavior (39). Behaviorally, opioid use disorder negatively impacts relationships across the board with detrimental outcomes for familial, social, and romantic ties. This disruption is somewhat more complex for romantic partners: individuals who engage in chronic opioid use —males in particular—tend to lose sexual interest in their partners, with impairments in both psychological and physiological arousal (40). Given the centrality of the endogenous opioid system in the experience of social connection (see BOTSA), it has been proposed that problem use of opioids may be more closely linked to social disconnection than problem use of other substances (13). The directionality of the relationship between social isolation and opioid use remains unclear. However, we posit that the relationship is likely bidirectional, such that pre-existing feelings of social exclusion or isolation put a person at higher risk of developing problem opioid use, and that chronic problem opioid use exacerbates the lived experience of social isolation and blunts feelings of reward associated with social connection [see (13)].

We did not, however, have specific hypotheses about differences between those who used prescription and non-prescription opioids in terms of satisfaction or social well-being. Prior work has demonstrated differences in demographic characteristics between those who use prescription opioids relative to non-prescription, and has even reported that those with lower incomes hold fewer stigmatizing attitudes toward people with an opioid use disorder (41). Thus, people who initiate prescription opioid use may belong to social circles where their peers or family members are more likely to socially exclude or stigmatize them for their substance use. Additionally, people who report prescription opioid use may feel shame about misusing a prescribed medication intended for therapeutic purposes (42), which is unlikely to be a factor with other substances observed. Another variable that may explain differences between the groups is the legality of a person's drug of choice: alcohol is legal throughout the United States, marijuana is legal in several states (although the sample is of people who *formerly* used marijuana and it may not have been legal at the time of their use), and prescription opioid use is sometimes initiated under the legal supervision of a healthcare professional. However, methamphetamine and non-prescription opioids are both illicit substances in the United States. People who reported methamphetamine or non-prescription opioids as their drug of choice may have different experiences than those who are using more licit and less stigmatized substances. Future work should aim to address the differences between satisfaction in life, including the social domain, among those who use prescription and non-prescription opioids, as well as among those who interact with the criminal justice system during the course of their substance use.

This study is not without limitations. First, our data is retrospective data, and in addition to forgetting, people often interpret their past according to narratives (such as redemption narratives) which may affect the feelings they ascribe to their past selves over time (43). Secondly, this sample is comprised of adults in the United States, and future work should address how these patterns may differ in adolescent and young adult populations both in the United States and abroad. Adolescent opioid use differs from adult opioid use in several ways: (1) developmentally, adolescents show increased reward sensitivity to opioids relative to adults' reward sensitivity (44), and (2) the onset of adolescent opioid use has been linked to structural factors, such as parental opioid use and medical treatment for injuries [such as through sports; (45, 46)]. Thus, exploring satisfaction in life domains related to adolescent substance use, particularly with opioid use, is a worthwhile preventative public health endeavor. Third, using substance of choice as a variable does not allow us to make inferences about the unique effects of polysubstance use, which many individuals in our sample likely engaged in throughout the course of their substance use. Specifically, the majority of people who use opioids use a combination of substances, and may use both prescription and non-prescription opioids—preference for one over the other does not equate to exclusive use of the preferred substance (47, 48). Fourth, we do not have a large enough sample size to make statistical comparisons between the two subgroups of our sample in recovery with a history of problematic drug use: those who are abstinent, and those who engage in casual drug use. Finally, as our sample was predominantly white, we are unable to comment on the potential role of race or ethnicity. Prior work using the framework of minority stress theory has reported that men who identify as a racial and sexual minority are more likely to engage in substance use behaviors as a form of avoidant coping for social stress and discrimination (49).

There are also several strengths to the current study. The present study is the first to our knowledge to chart the time-course of satisfaction with social life, romantic life, and general life satisfaction among people with a history of problematic substance use—broken down by primary drug of choice. In order to effectively treat those with substance use disorders, we must understand in which life domains people are suffering. This work paints a picture that those who formerly used prescription opioids experience larger declines across several domains of life satisfaction throughout the course of their substance use: social life, romantic life, and general life. Secondly, this decline in satisfaction among those who used prescription opioids is between the time before substance use initiation to the time when they had just initiated substance use, whereas those who used other substances reported increases in life satisfaction domains from pre-substance use to initial phases, and declines following that. Feeling connected and satisfied in life domains is important for overall well-being and longevity, and is particularly important for those suffering from prescription

opioid use disorders across the span of their substance use and into recovery.

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 University of Southern California Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

NC created the project idea in collaboration with JM and NC completed the outline of the manuscript, and the analyses. PM contributed to the literature review and writing the introduction. VV also contributed to the literature review and writing the introduction. JM was the supervising author, consulting on data analyses, presentation, and authorship. 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/fpsyt.2021.734352/full#supplementary-material

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Attachment Styles, Personality Organization, and Substance Use as Predictors of Emotion Regulation Strategies "Suppression" and "Reappraisal" in Young Adults

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Background: As evidenced by current literature, there is a crucial link between emotion regulation, attachment, personality patterns, and substance abuse. However, knowledge regarding the exact interactions of these specific parameters in terms of substance abuse development is still sparse. Therefore, this study is aimed to shed light on how two specific emotion regulation strategies ("Reappraisal" and "Suppression") might be influenced by the relationship between attachment, structural deficits in personality organization, and addictive behaviors.

Method: A total sample of 299 non-clinical young adults (Age: M = 22; SD = 3.81; 74.2% females) filled in the Emotion Regulation Questionnaire (ERQ) together with the Adult Attachment Scale (AAS), the Personality Organization Inventory (IPO-16), and the Alcohol, Smoking and Substance Involvement Screening (ASSIST) by means of an online survey.

Results: As suggested by hierarchical regression analysis, attachment specifically predicted differences in Emotion Regulation (ER), whereby the AAS subscales "Close" ness ($\beta = -0.38$, $p < 0.01$) and "Depend" ence ($\beta = -0.18$, $p < 0.01$) were negatively associated with increased use of maladaptive strategies of expressional suppression of emotion, and "Depend" ($\beta = 0.26$, $p < 0.01$) was positively associated with increased use of adaptive strategies of cognitive reappraisal.

Discussion: In line with our assumptions, we observed a more secure attachment system to be predictive for an increased use of adequate emotion regulation strategies. The findings support the suggestion that a focus on underlying attachment-related processes in a psychotherapeutic setting might be a promising way to promote adaptive self-regulation of emotions.

Keywords: attachment, personality organization, substance use, emotion regulation, young adults

INTRODUCTION

Emotions are an indispensable component of living, as "they can direct attention to key features of the environment, optimize sensory intake, tune decision making, ready behavioral responses, facilitate social interactions, and enhance episodic memory" [(1), p. 3].

To live a functioning and fulfilling emotional life, one has to regulate their emotions. The process of Emotion Regulation (ER) is understood as a bundle of strategies and processes that change appearance, intensity, durability, and expression of emotion (2). Some of these strategies can be seen as adaptive, and some of them can be seen as maladaptive. The use of predominantly maladaptive strategies and the lack of adaptive strategies can be seen as risk factors for psychopathology (3). Furthermore, adaptive ER shows negative correlations with Neuroticism and anxious-depressive symptoms, whereas for maladaptive strategies, it works the other way around, and the selection of emotion regulation strategies shows in part a mediating role in the relationship between adolescents' Neuroticism and increased mood pathology (4).

In line with Gross and John (5) and in order to narrow down the relatively broad ER concept, mainly two specific ER strategies are addressed in this study. (1) *Cognitive reappraisal* ("Reappraisal") describes antecedent-focused strategies of cognitively changing the appraisal of situations and therefore changing their emotional impact; (2) *Expressive suppression* ("Suppression") means the response modulation of inhibiting the (mimic, verbal, or gestural) expression of one's emotion (6). What is more, "Reappraisal" is seen as an adaptive strategy, which leads to increased subjective well-being, and both affective and social functioning (5). "Suppression" of emotional expression on the other hand has more negative implications for affective and social functioning, as well as for subjective wellbeing (5, 6) and is less effective at modifying affect (7).

The basis for successful ER is connected to various variables, among which Object relations are to mention. Object relations mean the "internalization of significant relations between self and others as the fundamental building blocks of the mind" [(8), p. 41]. These internal representations of relationships influence various parts of our behavior in adulthood, among other things one's way to attach to others or to organize one's personality (8, 9).

Early positive interactions of a child with its caregiver allow a person to reasonably relate to one's environment and regulate one's affect on this secure basis, whereas early negative or traumatizing childhood experiences can lead to an impairment regarding the development of healthy internalized object relations. In turn, this results in decreased personality organization and a predominance of insecure attachment styles, which predict decreased emotion functioning in adult life (10). In correspondence to this, maltreated children search less for support of their mother while expressing emotions, report to be less likely to share their emotions with their mother, and have fewer coping strategies for anger at their disposal, which indicates that the experience of physical or psychological abuse may influence the emotional development (11). In general, experiences of abandonment or violence, especially at a young age, make it more difficult for individuals (also in adulthood) to "get through life with an affectively positive framework" [(12), p.3]. Correspondingly, Desatnik et al. (13) state that different variables of internal representations of relationships (IRR) formed in early childhood account for almost 50% of variation in ER. Furthermore, there is substantial evidence that successful ER is increased in individuals experiencing support from their close social environment (14). This shows that the actual attachment behavior in adulthood might change the use of different ER strategies, and therefore the developmental perspective of ER as an attachment-related variable is of high interest. A securely attached individual is more likely to have a functional social support system at their disposal than an insecure attached one. In line with this, insecure attachment was observed to be connected to more maladaptive ER strategies and impairment of neural structures and neural functioning (15). Considering the two strategies of ER ("Suppression" and "Reappraisal") illuminated in this study, literature suggests that highly secure attached people tend to show a greater use of the adaptive strategy of "Reappraisal," whereas insecure attached (fearful or avoidant) individuals reported greater use of the maladaptive strategy of expressional "Suppression" (16).

What is more, ER was found to be influenced by the level of personality organization, whereby a higher amount of personality disorganization was found to be linked to diminished ER capabilities (13). In line with social baseline theory (17), identity and coherence of self (ICS) could be linked to higher functioning ER; in detail, ICS predicted reduced activation in brain regions responsible for the intrinsic strategy of expressional "Suppression" indicating less effort and more efficacy during ER (13). Furthermore, there is evidence suggesting that ER strategies mediate the relationship between Big Five personality traits and psychotic experiences in a non-clinical sample (18). Additionally, the Big-5 personality factors "Extraversion" and "Openness" predict more "Reappraisal" use and all Big-5 personality factors predict less use of "Suppression," except for "Neuroticism," which leads to higher rates in the use of "Suppression" (19). Regarding structural deficits in "Personality Organization," there is a noticeable connection to "Reappraisal" and "Suppression." For example, individuals with high schizotypal traits show hindered "Reappraisal" and biased "Suppression" (20), while negative correlations were found for borderline symptomatology and "Reappraisal," and positive correlations were found for borderline symptomatology and "Suppression" (21).

By expanding the study of addiction as a kind of attachment disorder to ER research, impaired ER can be seen as a crucial factor underlying the increased vulnerability to substance abuse (15). Thereby, from a developmental perspective, impoverished ER can be discussed as both the origin and the result of substance abuse [e.g., (22, 23)]. Correspondingly, higher rates of substance abuse as well as increased psychopathology were observed to be related to maladaptive or less effective styles of ER (24, 25). Therefore, various authors [e.g., (25)] argue that drugs are used to either increase positive emotions or alleviate negative emotional states, including anxiety, sadness, and depression, which again increases the likelihood of taking drugs by means of a positive feedback mechanism. Whereas, in the beginning, using drugs is

perceived as an adaptive strategy to regulate one's emotions, in the long run, it can lead to addiction because of its reinforcing characteristics (26). Furthermore, a deficient attachment system and the isolation that comes along with it effectuate that people with insecure or fearful attachment patterns are not able to resort to intact inner representations of the self and others, which leads in turn to external use of substances to cope with difficult situations or disruptions in close relationships (27–30). Accordingly, on a neurochemical level, an overlap can be found between social attachment and drug addiction, in particular in the mesolimbic dopamine pathway (31). Correspondingly, poly-drug users show impairments regarding the reactivity within the white matter and reduced cortical thickness, which in turn is linked to more insecure attachment as well as to more negative affectivity (32, 33). Therefore, an attachment-specific side effect of substance abuse is the reduced exploration of one's inner world as a suppressing strategy. In correspondence to this, substance use might be understood as a substitute for lacking coping strategies regarding the handling of strong emotions (34, 35).

Research Aims

Based on the established connection between increased addictive behaviors and attachment and personality dysfunctioning, we intend in this study to investigate the role of those parameters for the selection of ER strategies more in detail. It is hypothesized that higher attachment and personality pathology as well as substance use might lead to a higher difficulty to regulate negative and positive emotions.

METHODS

Participants and Procedure

The participants were recruited by means of the University of Graz mail distribution system. After informing the participants of the anonymity of the study and declaring consent, each participant was asked to fill in the questionnaires *via* the online-survey platform LimeSurvey©. Participants were included if they filled in all questionnaires and were aged between 18 and 35 years. A total of 21 people were excluded because they did not meet the age criteria. In total, 299 people were included in the study. The study was carried out in accordance with the Declaration of Helsinki. Ethical approval was granted by the Ethics Committee of the University of Graz, Austria. The recruitment of participants was carried out between September 2020 and January 2021.

Psychometric Instruments

Emotion Regulation

The *Emotions Regulation Questionnaire* (5) is a self-report questionnaire capturing two specific Emotion Regulation strategies in terms of dealing with positive and negative emotions. The emotion regulation strategy "Reappraisal" describes an antecedent-focused behavior, whereby a person is cognitively changing upcoming situations to switch the emotional impact they might have. "Suppression" is a response-focused strategy, suppression behavior, or emotional expression following an experience (5, 36). The German version of the ERQ (36) is composed of 10 items (6 items for reappraisal and 4 items for suppression) and is rated on a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Cronbach's alpha was $\alpha = 0.85$ for "Reappraisal" and $\alpha = 0.73$ for "Suppression."

Personality Organization

The 16-Item *Inventory of Personality Organization* [IPO-16; German version by (37)] is a self-report measurement of deficits within personality structure. The questionnaire is theoretically grounded in Otto Kernberg's model of personality organization (38). The IPO-16 is composed of three subscales: (1) "Identity Diffusion," which measures the integrity of the representations of oneself and others; (2) dominance of primitive defense mechanisms such as denial, splitting, projection, and dissociation ("Primitive Defense"); and (3) the capacity to differentiate between internal and external stimuli and to maintain the social shared reality ("Reality Testing") (10). A total score of structural deficits can be generated with this instrument. The items are rated on a 5-point Likert scale ranging from 1 ("never") to 5 ("always"). Internal consistencies for the subscales were acceptable ranging from Cronbach's $\alpha = 0.6$ to $\alpha = 0.73$. The total score showed acceptable internal consistency with a Cronbach's $\alpha = 0.74$.

Adult Attachment

The *Adult Attachment Scale* [AAS; (39)] is a self-report questionnaire based on the assumption that early attachment experiences form relatively stable inner attachment working models that influence individual needs and behavior in later relationships (9, 10). The AAS consists of three subscales measuring anxiety about being rejected or unloved ("Anxiety"), comfort with closeness ("Close"), and comfort with depending on others ("Depend"). The German version of the AAS (40) is composed of 15 items (five items per subscale) and is rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Cronbach's α for "Anxiety" was $\alpha = 0.77$, that for "Close" was $\alpha = 0.84$, and that for "Depend" was $\alpha = 0.77$.

Substance Use

The *Alcohol, Smoking and Substance Involvement Screening Test* [ASSIST, (41)] is a standardized interview that is used to assess psychoactive substance use and related problems. This questionnaire measures lifetime use and substance-related symptoms of 10 substance groups, including tobacco, alcohol, cannabis, cocaine, amphetamines, inhalants, sedatives, hallucinogens, opioids, and "other drugs." A global score was generated from the subscales ("frequency of drug use," "craving to use drugs," "(health, social, legal or financial) problems," "failed expectations," "expressed concerns by relatives and friends," "failed attempt to cut down," and "drug injection"). Cronbach's α for the subscales ranged between $\alpha = 0.67$ and $\alpha = 0.75$. The total score showed an excellent internal consistency with Cronbach's $\alpha = 0.9$.

Data Analysis

SPSS 27.0 was used for data management, descriptive statistic, bivariate correlations, and multiple hierarchical regression. In

a first step, age and gender were included in the regression as control variables. The total score of the ASSIST was induced as a second step into the multiple hierarchical regression as a control variable. Finally, the global score of Personality Organization and the three scales "Depend," "Close," and "Anxiety" of the adult attachment scale were incorporated in a third step.

RESULTS

Demographics and Sample Characteristics

The investigated sample consisted of 299 young adults (222 females, 74.2%). The participants ranged in age from 18 to 35 years (M = 22; SD = 3.81). A total of 51 (17.1%) participants reported a university degree as their highest educational level, 244 (81.6%) participants reported a high school degree, 3 (1%) participants declared a completed apprenticeship as their highest educational level, and one (0.3%) participant absolved compulsory education. Concerning the current relationship status, 156 (52.2%) reported to be single, 134 (44.8%) were in a relationship, 3 (1%) were married, 1 (0.3%) person was divorced, and five (1.7%) participants preferred not to share information about their relationship status. In terms of the question, which kind of substance was ever consummated, 227 (75.9%) participants reported to have consummated tobacco, 292 (97.7%) alcohol, 198 (66.2%) cannabis, 45 (15.1%) cocaine, 57 (19.1%) amphetamines, 23 (7.7%) inhalants, 47 (15.7%) sedatives, 53 (17.7%) hallucinogens, 19 (6.4%) opioids, and 28 (9.4%) "other drugs." Since ASSIST is a standardized tool for estimating the severity of drug abuse and the resulting need for therapeutic intervention, the following groups were formed based on the results: (1) No intervention is needed; (2) Short-term intervention is advised; (3) Intensive treatment is advised. Participants were predominantly in the "no intervention is needed" group (tobacco: 56.9%; alcohol: 68.9%; cocaine: 93.6%; cannabis: 69.9%; amphetamines: 93.6%; inhalants: 99%; sedatives: 93.3%; hallucinogens: 94%; and opioids: 97%).

Correlations

As normal distribution was not given for any of the examined variables, Pearson and Spearman correlations were both calculated. The changes in the correlations were negligible, and changes in correlation appearance/disappearance only were observed for correlations not concerning the dependent variables "Suppression" and "Reappraisal." As shown in **Table 1**, bivariate correlations between the examined variables suggested that the ER strategy "Suppression" was significantly positively related to structural deficits in "Personality Organization" ($r = 0.16$; $p < 0.01$), anxiety about being rejected or unloved ("Anxiety"; $r = 0.15$; $p < 0.05$), and "Gender" ($r = 0.19$; $p < 0.01$), and significantly negatively related to comfort with closeness ("Close"; $r = -0.46$; $p < 0.01$) and comfort with depending on others ("Depend"; $r = -0.36$; $p < 0.01$). Furthermore, the ER strategy "Reappraisal" showed a significant positive correlation with "Depend" ($r = 0.24$; $p < 0.01$) and "Age" ($r = 0.12$; $p < 0.05$), and a significant negative correlation with structural deficits in "Personality Organization" ($r = -0.15$; $p < 0.01$) and "Anxiety" ($r = -0.20$; $p < 0.01$). In addition, structural deficits in "Personality Organization" showed an association to all three scales measuring adult attachment ("Anxiety," $r = 0.59$; "Close," $r = -0.36$; "Depend," $r = -0.50$; all $p < 0.01$), as well as to "Substance Use" ($r = 0.36$; $p < 0.01$) and "Age" ($r = -0.14$; $p < 0.05$). "Substance Use" was moreover related to the attachment dimension "Depend" ($r = -0.15$; $p < 0.01$). Within the attachment scales, "Anxiety" showed a relation to "Gender" ($r = -0.18$; $p < 0.01$) and "Age" ($r = -0.14$; $p < 0.05$). "Depend" was associated with "Gender" ($r = 0.13$; $p < 0.05$) and "Age" ($r = 0.13$; $p < 0.05$). All attachment scales were correlated with each other (for all $p < 0.01$). Additionally, Bonferroni correction was conducted in order to control for α inflation. Hereby, the originally significant correlations between "Personality Organization" and "Reappraisal," "Suppression" and "Anxiety," "Depend" and "Substance Use," "Gender" and "Depend," as well as all statistically relevant correlations with "Age," disappeared.

Multiple Hierarchical Regression

Suppression

The ASSIST was inserted into the stepwise regression, even though no correlations with ER could be found, because the ASSIST correlated with the IPO and some scales of the AAS.

Although some correlations had to be classified as non-significant after performing a Bonferroni correction, the originally selected predictor variables were adhered to. This decision is based on the fact that the Bonferroni procedure can be considered very conservative. In addition, most corrections were observed regarding the "Age" variable, which was still considered of interest mainly due to the explorative nature of the study.

However, ANOVA of the models, created through stepwise regression including, firstly, age and gender, secondly, the total score of the ASSIST, and thirdly, the global score of the IPO and the three scales of the AAS, showed that all three models predicted reliably the dependent variable "Suppression" [$F_{1(2.296)} = 6.58$; $F_{2(3.295)} = 4.88$; $F_{3(7.291)} = 16.05$; all $p < 0.01$]. The model summary, however, showed that model 3 explained 26.1% of the variance in "Suppression" and therefore accounted for the most variance. Furthermore, inserting the ASSIST did not show any significant change in *F*.

Regarding the coefficients of model 3, "Gender" and the scales "Close" and "Depend" showed significant results (all $p < 0.01$). "Close" showed the greatest effect on "suppression" ($\beta = -0.38$), followed by "Gender" ($\beta = 0.23$) and "Depend" ($\beta = -0.18$). **Table 2** displays the results of the stepwise regression.

Reappraisal

ANOVA of the models, created through stepwise regression including, firstly, age and gender, secondly the total score of the ASSIST, and thirdly, the global score of the IPO and the three scales of the AAS, showed that models two and three significantly predicted the dependent variable "Reappraisal" [$F_{2(3.295)} = 2.70$, $p < 0.05$; $F_{3(7.291)} = 4.10$; $p < 0.01$]. The model summary showed that model three explained 6.8% of the variance in "Reappraisal" and therefore accounted for the most variance. Furthermore, checking the coefficients of models two and three, only age had an impact in model two ($\beta = 0.13$; $p < 0.05$), but lost its significant

TABLE 1 | Correlations among examined variables: Emotion regulation, personality organization, attachment styles, substance use, age, and gender.

Variable	1	2	3	4	5	6	7	8	9
1. Suppression	-								
2. Reappraisal	0.03	-							
3. PO	0.16**	−0.15**[a]	-						
4. Close	−0.46**	0.04	−0.36**	-					
5. Depend	−0.36**	0.24**	−0.50**	0.58**	-				
6. Anxiety	0.15*[a]	−0.20**	0.59**	−0.28**	−0.53**	-			
7. SU	0.07	−0.09	0.36**	−0.11	−0.15**[a]	0.08	-		
8. Gender	0.19**	0.05	−0.10	0.05	0.13*[a]	−0.18**	0.07	-	
9. Age	0.69	0.12*[a]	−0.14*[a]	0.04	0.13*[a]	−0.14*[a]	0.10	0.11	-
M or n	3.38	4.44	2.07	2.79	3.26	2.06	24.52	222	22
SD or %	5.07	7.28	0.57	4.26	3.80	3.92	31.54	74.2	3.81

*N = 299; Gender was coded as 0 = female and 1 = male; *p < 0.05, and **p < 0.01; [a]non-significant after Bonferroni correction.*
PO, structural deficits in "Personality Organization"; SU, "Substance Use."

TABLE 2 | Multiple hierarchical regression model for ER strategy "Suppression."

	Variable	*B*	*β*	*p*	Adjusted R^2	St. error of estimate
Step 1				**0.00**	0.036	1.24
	Gender	0.57	0.2	**0.00**		
	Age	−0.03	−0.09	0.12		
Step 2				**0.00**	0.038	1.24
	Gender	0.55	0.19	**0.00**		
	Age	−0.03	−0.1	0.09		
	SU	0.00	0.07	0.23		
Step 3				**0.00**	0.261	1.09
	Gender	0.67	0.23	**0.00**		
	Age	−0.02	−0.07	0.20		
	SU	0.00	0.02	0.78		
	PO	−0.13	−0.06	0.40		
	Close	−0.57	−0.38	**0.00**		
	Depend	−0.30	−0.18	**0.01**		
	Anxiety	0.01	0.01	0.93		

N = 299; gender was coded as 0 = female and 1 = male; PO, structural deficits in "Personality Organization"; SU, "Substance Use"; Dependent Variable, ERQ "Suppression"; ER, "Emotion Regulation." Bold values mean significant predictor.

effect ($\beta = 0.09$; $p > 0.05$) as the IPO and AAS scales were inserted. Regarding the coefficients of model three, the variable "Depend" ($\beta = 0.26$) showed a significant result ($p < 0.01$). "Close" ($\beta = -0.14$) was found to be significant by tendency but will not be further interpreted. **Table 3** displays the results of the stepwise regression.

DISCUSSION

In this study, it was intended to investigate the influence of adult attachment patterns, personality organization, and substance use regarding the two ER strategies "Suppression" and "Reappraisal." As revealed by stepwise regression analysis, we observed that for both strategies, adult attachment seems to have the most predictive value out of the examined variables. People who show more comfort with closeness and with depending on others tend to inhibit less often the (mimic, verbal, or gestural) expression of their feelings than people who show less secure attachment patterns in both the "Suppression" and the "Reappraisal" domains. Furthermore, we found "Gender" to play a crucial role in the selection of one specific ER strategy. Here, women tend to make a greater use of inhibiting the expression of their feelings ("Suppression"). In line with this finding, women show higher scores in the personality dimension Agreeableness (42, 43). Furthermore, it can be assumed in the light of gender role theories on affect that women use more self-focused, internalized activities in response to negative affect (44), resulting in the use of less expressive strategies. Gender, comfort with closeness, and comfort with depending on others accounted for over 26% of variance in "Suppression" of

TABLE 3 | Multiple hierarchical regression model for ER strategy "Reappraisal."

	Variable	*B*	*β*	*p*	Adjusted R^2	St. error of estimate
Step 1				0.10	0.009	1.21
	Gender	0.10	0.04	0.53		
	Age	0.04	0.11	**0.05**		
Step 2				**0.05**	0.017	1.20
	Gender	0.12	0.04	0.46		
	Age	0.04	0.13	**0.03**		
	SU	−0.00	−0.11	0.06		
Step 3				**0.00**	0.068	1.18
	Gender	0.01	0.00	0.96		
	Age	0.03	0.09	0.13		
	SU	−0.00	−0.08	0.21		
	PO	0.05	0.03	0.75		
	Close	−0.19	−0.14	0.05		
	Depend	0.41	0.26	**0.00**		
	Anxiety	−0.15	−0.10	0.19		

N = 299; Gender was coded as 0 = female and 1 = male; PO, structural deficits in "Personality Organization"; SU, "Substance Use"; Dependent Variable, ERQ "Reappraisal"; ER, "Emotion Regulation." Bold values mean significant predictor.

emotional expression. In comparison, findings concerning the ER strategy of "Reappraisal" show eminently less contribution. Only ∼7% of variance in "Reappraisal" could be explained through the examined variables. The findings suggest that the capacity to depend on others comes along with higher use of strategies, which cognitively change the appraisal of situations and therefore their emotional impact.

Moreover, in this study, no significant results were found for ER with neither attachment "Anxiety" nor deficits in "Personality Organization." In the case of "Reappraisal," research supports the assumption that active adaptive strategy use shows weaker relationships with psychopathology than the use of maladaptive strategies (45). As attachment "Anxiety" and deficits in "Personality Organization" pose both characteristics of psychopathological behavior, this might cause the absence of significant results and furthermore explains the small variance in emotional "Reappraisal" caused by the examined variables. Another explanation could be that the score for structural deficits in "Personality Organization" and all three scales of the Adult Attachment Scale showed to be intercorrelated. Therefore, controlling for attachment, the absent significance of "Personality Organization" for "Suppression" as well as "Reappraisal" supports the assumption that attachment could play a more pronounced role in these specific emotion regulation strategies than personality organization. In this context, it could be hypothesized that attachment behavior measured by the AAS—similar to "Reappraisal" and "Suppression"—is linked to higher levels of mental processing than "Personality Organization" measured by the IPO, as the latter concept is focused on more severe levels of psychopathology (37, 46). Therefore, adult attachment could be more connected to higher brain functions such as ER. Finally, no connection whatsoever could be found between Substance Use and ER. This result could be due to the nature of the sample. Participants reported predominantly very little use of substances. Even for tobacco and alcohol, except for a small percentage, participants reported a rather mild use, where no therapeutic intervention was indicated.

Limitations of the Study

Even though this study was carefully planned and conducted, it has some limitations, which must be taken into consideration for drawing a conclusion from the results. The substantially higher percentage of participating women must be mentioned as well as the comparatively high educational level of the participants. These demographics confine the representativity of the results. A higher educational level is attended with a reduced risk of substance abuse [e.g., (47)] or psychopathology [e.g., (48)]. It could also be theorized that the educational level influences the selection of emotion regulation strategies. Therefore, a more balanced sample regarding the educational level would have been advantageous. Furthermore, some of the correlations showed changes after applying a Bonferroni correction and have to be interpreted cautiously. Also, conducting research online has advantages, like an easier way to approach participants, a good manageability of data, and a greater sense of anonymity, but it also holds some possible disadvantages. For example, the environment in which the study is conducted is not controlled. Therefore, participants might be less attentive while filling in the questionnaires or they might get easily distracted. Also, the absence of an investigator-in-charge might evoke participants to fill in the questionnaires less thoroughly. Furthermore, two very specific emotion regulation strategies have been taken into account. A broader approach might have produced deeper insight into the broad field of emotion regulation. Finally, there is research supporting the hypothesis that emotion beliefs change emotion regulation (49). Whether one perceives emotions as good or bad, and controllable or uncontrollable might dictate the

choice of emotion regulation strategies and it would have been interesting to examine emotion beliefs as well.

CONCLUSION

Despite its limitations, this study contributes to a better understanding of how attachment, personality organization, and substance use might be connected to emotion regulation. The results suggest that attachment behavior particularly helps to explain the different selection of strategies in emotion regulation.

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 University of Graz. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PB, XV, and H-FU conceptualized the study. PB and XV collected the data. PB analyzed and interpreted the data. PB and H-FU drafted the manuscript. JF and H-FU critically reviewed it. All authors gave their final approval of the manuscript.

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Attachment and Therapeutic Alliance in Substance Use Disorders: Initial Findings for Treatment in the Therapeutic Community

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Background: There is convincing evidence that individuals suffering from Substance Use Disorder (SUD) often present insecure attachment patterns. In contrast, a strong therapeutic alliance in treatment of SUD has been found to lead to a more positive treatment outcome. However, insecure attachment has been observed to be linked with weaker therapeutic alliance strength. The primary aim of this explorative study was to gain initial insights regarding the influence of attachment and personality characteristics on therapeutic alliance and therapy motivation in SUD patients undergoing treatment at a therapeutic community. Furthermore, SUD patients were compared to healthy controls regarding attachment, personality and mood pathology.

Methods: A total sample of 68 participants, 34 inpatients in SUD treatment and 34 age-gender and education adjusted controls, were investigated. Both groups filled in the Adult Attachment Scale (AAS), the Inventory of Personality Organization (IPO-16), and the Brief Symptom Inventory (BSI-18) questionnaires. Additionally, SUD patients filled in the Working Alliance Inventory (WAI-SR) and the adapted German version of the University of Rhode Island Change Assessment scale (FEVER).

Results: In line with our assumptions, SUD patients exhibited a decreased amount of attachment security (AAS) which was related to higher personality (IPO-16) and mood pathology (BSI-18). Furthermore, correlational analysis revealed the WAI-SR dimension Bond being positively associated with more secure attachment. A strong task alliance was linked to the Action stage of change (FEVER) and decreased mood but not personality pathology.

Conclusion: Our findings confirm the putative negative effect of attachment and personality pathology on therapy motivation and therapeutic alliance in addiction therapy as well as more specifically in therapeutic community treatment. Future research in enhanced samples might focus more on the long-term effects of the interaction of attachment, personality and therapeutic alliance variables.

Keywords: substance use disorder, therapeutic alliance, working alliance dimensions, therapeutic community, attachment

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INTRODUCTION

In 2019, nearly 26,000 people in Austria suffering from Substance Use Disorder (SUD) were in long-term outpatient or inpatient drug-specific treatment. Additionally, there is a highly problematic rate of dropouts around 54% in inpatient drug treatment (1). In contrast, drug treatment retention in terms of the length of stay has been shown to be one of the most important predictors of favorable follow-up treatment outcomes (2, 3). Therefore, keeping patients in treatment is one of the main objectives in SUD therapy and correspondingly, the philosophy of drug-free therapeutic communities is to establish sustainable relationships by building on self-help and mutual-aid between patients. Hereby, the community acts as the central attachment figure, as most of the therapy takes place in group dynamic processes between the clients. Therapists mostly just monitor group dynamics and are mainly responsible for single-therapy sessions (4).

Across various psychotherapeutic approaches, therapeutic alliance is one of the most widely studied process variables in psychotherapy research, mainly because of its obvious link to a positive or negative therapy outcome (5, 6). The concept of therapeutic alliance originates from traditional psychoanalysis and was conceptualized as being closely related to the mechanisms of transference (7). However, early approaches considered therapeutic alliance more as a bonding concept, while Bordin (8) later conceptualized it as a working relationship between client and therapist, emphasizing its cooperative nature (6). Following Bordin's model of alliance as *working alliance)*, it is composed of the three dimensions bond, goals, and tasks, i.e., an affective relationship component, the jointly determined therapy goals, and the process-related tasks of therapist and client (8).

Numerous empirical studies emphasize the substantial relationship between therapeutic alliance and positive treatment outcomes, independent of potential confounders such as cultural background, therapist profile, type of treatment or research design (9–11). This is consistent with the findings from therapy outcome research focusing on SUD treatments (12, 13). Nevertheless, recent studies suggest the relationship between therapeutic alliance and positive outcomes to be lower in SUD patients, by reporting weak correlations of around $r = 0.14$ (9, 14). What is more, various client characteristics have been observed to play an important role for the relationship between therapeutic alliance and the course of SUD treatment. Based on an enhanced literature review, Meier et al. (13, 15) argue that neither SUD patients' demographic nor diagnostic pre-treatment characteristics predicted good therapeutic alliance. However, they found a significant number of studies showing modest relationships for positive previous treatment experience, motivation and treatment readiness, coping strategies, social support and secure attachment.

Attachment pathology has received an increased interest as a potential vulnerability factor in the context of SUD, as insecure attachment patterns can be frequently observed in SUD patients (16–18). In correspondence to this, SUD has been regarded as a certain kind of attachment disorder (19), see also (20) for an enhanced review). Experiences with insufficient attachment figures (in most cases the parents) cause severe emotional disturbances within the child and lead to the formation of deficient internal working models in relation to the self and other people later in life (16, 21–23). Correspondingly, substance use can be described as a kind of "self-medication" in order to regulate affects by means of chemical substances (23, 24). Therefore, from the perspective of attachment theory, therapeutic communities try to break this bond to a harmful substance use or activity and aims to replace it by a bond to the community, with the therapeutic community acting as an attachment figure (19, 25, 26).

Despite of conflicting results [e.g., (26)] attachment organization might have a huge impact regarding an increased alliance, as securely attached individuals were observed to exhibit stronger alliance values than insecurely attached ones (27–30). Correspondingly, Gidhagen et al. (14) reported attachment styles as to be a significant moderator variable between higher working alliance and positive therapy outcome in a sample of SUD patients. Furthermore, there is significant evidence for the substantial connection of attachment organization and personality structure (31). In general, SUDs are often seen as co-occurring with a dysfunctional personality structure as 34–73% of SUD patients were diagnosed for comorbid personality disorder, despite the fact that there is only a prevalence rate of about 10% for the presence of personality disorder in the general population (32–34). What is more, borderline personality organization seems to be associated in particular with the development of SUD (35, 36). In terms of therapy outcome, the occurrence of personality disorders has been shown to be linked to negative treatment outcome like early treatment dropout (12, 37). On the other hand, a strong alliance turned out to be a substantial positive predictor of treatment success (38). However, as personality disorders often cause problematic interpersonal relationships, they can impede the formation of an alliance (39, 40).

Therapy motivation has been reported as a highly important variable as no or low therapy motivation is one of the major challenging problems in the treatment of SUD, throughout the entire therapeutic process. This applies to different phases of therapy as well as to maintaining therapy goals and avoiding relapse. Frequently, treatment is only sought when the physical condition becomes so severely damaged that external help is inevitable, or social pressure becomes too strong. In many cases, inconsistency between actual behavior and a supposedly high verbally communicated therapy motivation can be observed. Once acute problems have subsided, therapy is often terminated prematurely (41).

The transtheoretical model of DiClemente and Prochaska (42) assumes five stages of change in human behavior, each describing the motivational state of the person, as well as the motivation for change (43). As to positive outcomes, low treatment readiness leads to e.g., short-term retention and SUD clients in the pre-contemplation stage are more likely to drop out of therapy prematurely, while clients in the action stage are more likely to actively engage in self-change (43–45). Most importantly, growing evidence has been supporting the idea of readiness for change and certain stages to predict alliance strength (13, 45–47).

Ilgen et al. (48) found a positive and strong alliance to be especially important for patients with low therapy motivation, highlighting the potentially beneficial relation between higher stages of change and working alliance. Finally, the putative link regarding SUD and mood pathology has already been extensively investigated in the past and there is evidence that a positive therapeutic alliance might be especially important in keeping SUD clients with additional psychiatric comorbidity in treatment [e.g., (13, 49, 50)].

Research Aims

Primarily, this study aims to explore the potential link between different attachment dimensions and therapeutic alliance/therapy motivation in SUD patients undergoing treatment within the surroundings of the therapeutic community. Furthermore, it is intended to compare SUD patients to healthy controls in terms of several parameters of attachment and personality pathology to further examine the assumption of substance misuse as a dysfunctional way of emotion regulation. In line with the primary hypothesis of this study, this investigation might further elucidate the specific challenges regarding the treatment of addiction disorders.

METHOD

Participants and Procedure

A total sample of 68 male (86.8%) and female (13.2%) participants between 20 and 61 years of age ($M = 33.3$, $SD = 9.7$), consisting of one clinical ($n = 34$) and one non-clinical control group ($n = 34$), was investigated. Samples were adjusted in terms of Age, Gender and Education status. All participants of the clinical group were diagnosed for SUD according to the International Classification of Diseases version 10 (ICD 10) (51), by a licensed psychiatrist. These patients were undergoing inpatient therapy in the drug-free environment of an Austrian TC, hosted by the Grüner Kreis society, at the time of the study. In terms of the consumed psychoactive substances the following percentages could be observed: 29.1% Opioids (ICD-Code: F11), 19.0% Alcohol (F10), 19.0% Cannabinoids (F12), 13.9% Sedatives or hypnotics (F13), 11.4% Cocaine (F14) and 7.6% Other stimulants (F15). 76.5% of patients reported poly drug use. Comorbidities with other diagnosis were distributed as follows: 21.4% Affective disorders (F3.x), 16.7% Neurotic, stress-related and somatoform disorders (F4.x), 7.1% Personality and behavioral disorders (F6.x), 7.1% Schizophrenia, schizotypal and delusional disorders (F2.x) and 2.4% Behavioral and emotional disorders with onset usually occurring in childhood and adolescence (F5.x). The sample for the control group was taken from the normal population by means of an internet survey, distributed through social networks. Hereby, the inclusion criterion was an Age range from 18 to 65 years. Exclusion criteria were a diagnosis of SUD and/or any kind of diagnosed mental disorder, either at the time of the study or in the past. Nicotine dependence was not considered in this study. The study protocol was approved by the ethics committee of the University of Graz, Austria. Data of the clinical sample were acquired in a one-time group testing in the therapeutic community in July 2020. Data of the non-clinical sample were collected *via* the online-survey platform LimeSurvey© in November 2020. Written informed consent was given by all participants before answering the questions.

Psychometric Instruments

Mood Pathology

The short version of the *Brief Symptom Inventory* [*BSI-18*; (52); German version: (53)] assesses psychological distress within the past seven days. The inventory includes three subscales: (1) Somatization, (2) Depressiveness and (3) Anxiety. It consists of 18 items in total, which are rated on a 5-point Likert scale ranging from *not at all* (0) to *very much* (4). By summing up all the three scale scores, a Global Severity Index (*GSI*) can be generated that provides information about the overall severity of general psychiatric symptoms. Cronbach's α in this study ranged from 0.75 to 0.84. for the subscales. The total GSI score showed a Cronbach's α of 0.91.

Attachment Styles

The German Version of the *Adult Attachment Scale* [*AAS*; (54, 55)] is a self-descriptive measure of attachment-related attitudes consisting of 15 items answered on a 5-point Likert scale, ranging from *strongly disagree* (1) to *strongly agree* (5). The questionnaire is based on Bowlby's attachment theory (56) and consists of three subscales: (1) Anxiety about being rejected or unloved ("Anxiety"), (2) Comfort with closeness and intimacy ("Closeness") and (3) Comfort in depending on others ("Dependence"). Cronbach's α for the scales ranged from 0.76 to 0.86.

Personality Organization

The Inventory of Personality Organization—Short Version [*IPO-16*; (57)] is a self-report instrument to assess personality organization according to Otto Kernberg's model (58). The IPO-16 is composed of 16 items, which are rated on a 5-point Likert scale ranging from *never true* (1) to *always true* (5). The total score is a global measure representing the extent of structural deficit and can serve as an indicator of the presence of a personality disorder. In this study we observed good internal consistency for the scale with a Cronbach's α of 0.88.

Readiness to Change

The "*Fragebogen zur Erfassung der Veränderungsbereitschaft*" questionnaire [*FEVER*; (59)] is the German version of the University of Rhode Island Change Assessment Scale [*URICA*; (60)] based on the transtheoretical model of change by DiClemente and Prochaska (42). The FEVER is a self-descriptive procedure to measure readiness to change and to assess therapy motivation in complex problem behaviors. Instead of pointing a person into one single stage, the FEVER provides scores for each of the three temporal-motivational dimensions corresponding to the stages of change: Precontemplation, Contemplation, and Action. The 24 items can be answered on a 5-point Likert scale from *not true at all* (1) to *very true* (5). Cronbach's α for the three scales ranged from 0.80 to 0.84.

Therapeutic Alliance

The German client version of the Working Alliance Inventory—short revised [*WAI-SR*; (61)] is based on the frequently used Working Alliance Inventory (*WAI*) by Horvath and Greenberg (62). The WAI is theoretically based on Bordin's (8) conception of the therapeutic alliance and therefore measures the three working alliance dimensions of Bond, Tasks and Goals. The 12 items of the WAI-SR are rated using a 5-point Likert scale ranging from *rarely* (1) to *always* (5). Participants were asked to rate the relationship to their reference therapist. Internal consistency was acceptable to good with Cronbach's α ranging from 0.77 to 0.87.

Data Analysis

SPSS 26 was used for statistical analyses. For group comparisons, one-way or multivariate analyses of variance and χ^2 tests were conducted. To investigate the relationship between behavioral measures and the three dimensions of working alliance in the clinical group, Pearson's correlation coefficients were calculated. As the requirement of normal distribution for the use of parametric statistical methods was violated for some variables, equivalent non-parametric procedures were conducted in these cases. Furthermore, in cases where linearity assumption was not given, non-parametric Spearman rank-correlation was also calculated. However, these proceedings did not lead to any deviating result. In order to control for α-inflation, the level of significance was set to $p < 0.01$ in ANOVAs, and Pearson's and Spearman's correlations, while p-values < 0.05 were marked as tendencies, but where not further interpreted. Where it was feasible, effect sizes were included.

RESULTS

Demographics and Sample Characteristics

Socio-demographic variables of both groups as well as resulting group differences are presented in **Table 1**.

Group Differences in Behavioral Measures

As shown in **Table 2**, group comparisons between the clinical and the control group showed that the clinical SUD sample reported significantly higher values on all behavioral dimensions than non-clinical controls did. In correspondence to this, SUD patients exhibited more severe deficits in personality organization, higher mood pathology and less secure attachment attitudes ($F = 8.99$–68.02; $\eta^2 = 0.12$–0.50; all $p < 0.01$).

Correlations Between Behavioral Measures and Working Alliance Dimensions in SUD Patients

As demonstrated in **Table 3**, we observed the "Bond" dimension of working alliance to be strongly positively associated with the attachment dimension "Dependence" ($r = 0.61$; $p < 0.001$). Furthermore, the "Tasks" dimension was negatively related to BSI subscale "Anxiety" ($r = -0.44$; $p < 0.01$) and the overall BSI total score "GSI" ($r = -0.44$; $p < 0.01$), as well as "Action" stage of change ($r = 0.45$; $p < 0.01$). No significant relations were found between the "Goals" dimension and any of the examined variables ($p > 0.01$) apart from intercorrelating working alliance dimensions ($p < 0.01$). Also, no significant relations were found between the IPO "Structural deficit" total score and working alliance ($p > 0.01$). The attachment dimension "Dependence" and "Structural deficit" correlated negatively ($r = -0.47$, $p < 0.01$), while "Anxiety" about being rejected or unloved and "Structural deficit" correlated positively ($r = 0.59$; $p < 0.001$). Finally, we observed a positive association between the "Precontemplation" stage and "Structural deficit" ($r = 0.47$; $p < 0.01$). Overall, all significant correlations were moderate to strong. No significant correlations were observed regarding age and sex (all $p > 0.05$).

DISCUSSION

In this study it was primarily aimed to explore the putative link between attachment and personality characteristics and task alliance, namely the three dimensions of working alliance "Bond," "Tasks," and "Goals," in SUD patients undergoing treatment within the surroundings of a therapeutic community. In line with our assumptions, attachment security showed a strong positive correlation with the "Bond" dimension. Accordingly, the "Bond" dimension in particular refers to the personal bonding experience between therapist and client. This experience is built on more affective aspects of the therapeutic relationship like confidence, acceptance or mutual trust (7). Moreover, this finding is confirmed by previous research [e.g., (27, 28)].

Furthermore, in order to shed further light on the question why substance use disorders are assumed to be notoriously difficult to treat (1), we investigated possible differences regarding attachment and personality between healthy controls and patients diagnosed with SUD. In correspondence to this, we found SUD patients to differ significantly from an age-gender and education adjusted control group by exhibiting diminished attachment security, as well as higher amounts of personality and mood pathology. These findings are highly consistent with the literature [e.g., (16, 17, 34, 35, 49, 63)].

In addition, resonating with previous studies, we found an increased personality structural deficit to be related to more insecure attachment [e.g., (31)]. More in general, these findings further underline the well-established assumption of substance misuse as a dysfunctional way of emotion regulation (63, 64). Taken together, these results seem to suggest that one of the difficulties in the treatment of SUD might be related to addiction specific problems regarding attachment security. However, further research needs to be done, comparing different patient populations (e.g. SUD patients vs. mood disorder patients) to further investigate this assumption.

Moreover, we explored correlation patterns of attachment and personality dysfunctioning, mood pathology, and therapy motivation readiness in SUD patients. As to mood pathology, clients who felt less anxious and demonstrated a less severe overall mood pathology rated the "Tasks" working alliance with their therapist to be moderately stronger. We only found clients in the "Action" stage of treatment readiness to exhibit a higher "Tasks" working alliance with their therapists. This relates to findings of Fitzpatrick and Irannejad (65) who found

TABLE 1 | Sociodemographic data with group differences.

	Clinical ($n = 34$)			Controls ($n = 34$)			*T*	*df*	*p*
	M	***SD***	***Range***	***M***	***SD***	***Range***			
Age	33.9	10.2	(20–61)	32.7	9.2	(20–56)	0.50	66	0.62
Days spent in facility	213.5	158.9	(8–745)	N/A		N/A			
	n	**%**			***n***	**%**	χ^2	***df***	***p***
Gender							0.13	1	0.72
Females	4	11.8			5	14.7			
Males	30	88.2			29	85.3			
Other	0				0				
Education							8.97	4	0.06
No completed education	10	29.4			3	8.8			
Apprenticeship	16	47.1			13	38.2			
Secondary school	2	5.9			7	20.6			
High School	4	11.8			5	14.7			
Bachelor/Master	2	5.9			6	17.6			
Other	0	0			0	0			
Nationality							7.66*	2	0.02
Austria	30	88.2			27	79.4			
Germany	0	0			7	20.6			
Other EU country	1	2.9			0	0			
Non-EU country	3	8.8			0	0			
Occupation							44.54**	5	<
Employed	6	17.6			27	79.4			0.001
Unemployed	22	64.7			1	2.9			
Housewife /- man	0	0			1	2.9			
Retired	5	14.7			0	0			
Student	0	0			5	14.7			
In apprenticeship	1	2.9			0	0			
Family status							18.59**	4	<
Single	21	61.7			8	23.5			0.001
Married	2	5.9			6	17.6			
In partnership	6	17.6			19	55.9			
Divorced	1	2.9			1	2.9			
Seperated	4	11.8			0	0			
Widowed	0	0			0	0			
Parenthood							0.30	1	0.58
No	24	70.6			26	76.5			
Yes	10	29.4			8	23.5			
Therapy phase				N/A		N/A			
Inclusion phase	6	17.6							
Motivation phase	3	8.8							
Aspirant phase	20	58.8							
supervisor phase	5	14.7							

*$p < 0.05$; **$p < 0.01$; N/A, Not Applicable.

higher stages of change in adolescents being strongly related to higher "Tasks" and "Goals" working alliance, highlighting their collaborative nature. More in general, our results support the idea of a potentially beneficial relation between higher stage of change and working alliance. Interestingly, mood disorder related symptoms like anxiety often affect motivation and clients in a higher stage of change have been observed to exhibit stronger working alliance and symptom improvement (46, 47). In contrast, we observed that clients in "Precontemplation" stage exhibited a more severely impaired personality structure and described themselves as feeling more anxious about being rejected or unloved. This aspect of insecure attachment was also related to an increased mood pathology. The findings suggest that less pathology in patients is associated with higher treatment

TABLE 2 | Group differences in behavioral measures.

		Clinical ($n = 34$)			Controls ($n = 34$)			ANOVA		
	α	*M*	*Mdn*	*SD*	*M*	*Mdn*	*SD*	*F (1, 66)*	η^2	*p*
Days spent in facilty		213.5	206.0	158.9			N/A			
Therapy phase			2.0							
Differences in attachment security: AAS										
Closeness	0.861	16.5	16.5	4.6	20.7	21.5	3.7	17.66**	0.21	<0.001
Dependence	0.798	16.8	17.0	4.1	20.6	21.0	3.2	18.44**	0.22	<0.001
Anxiety	0.763	11.8	12.0	3.8	8.7	8.0	3.2	13.32*	0.17	0.001
Differences in psychiatric symptom burden: BSI-18										
Somatization	0.837	3.4	1.0	4.4	1.1	0.0	1.5	8.99*	0.12	0.01
Depression	0.825	5.5	4.0	4.5	1.8	2.0	1.7	20.58**	0.24	<0.001
Anxiety	0.746	5.5	5.0	3.8	1.8	1.0	1.4	28.15**	0.30	<0.001
GSI	0.907	14.5	12.5	10.7	4.7	4.0	3.4	26.32**	0.29	<0.001
Differences in personality organization: IPO-16										
Structural Deficit	0.875	2.4	2.5	0.5	1.6	1.5	0.4	68.02**	0.51	<0.001
FEVER										
Precontemplation	0.836	1.9	1.7	0.7			N/A			
Contemplation	0.803	4.3	4.3	0.5		N/A				
Action	0.823	4.0	3.9	0.6						
WAI-SR										
Bond	0.847	3.2	3.3	1.0			N/A			
Tasks	0.772	3.3	3.3	0.7		N/A				
Goals	0.869	3.4	3.5	1.0						

*$p < 0.01$; **$p < 0.001$; α Cronbach alpha; N/A, Not Applicable; AAS, Adult Attachment Scale; BSI-18, Brief Symptom Inventory; GSI, Global Severity Index; IPO-16, Inventory of Personality Organization; FEVER, Fragebogen zur Erfassung der Veränderungsbereitschaft (URICA); WAI-SR, Working Alliance Inventory—short revised.

readiness. Consequently, they could have been more capable to engage in a strong working alliance. On the other hand, a weak working alliance would likely not have contributed to symptom improvement. Therefore, our results might reflect these connections. Against our expectations, personality pathology was not significantly correlated to working alliance dimensions. This finding is in contrast to previous results, where higher levels of impaired personality organization impeded working alliance formations in residential treatment of SUD (40).

Our study offers additional insights into the putative effect of attachment and personality pathology on working alliance and therapy motivation in SUD patients, by expanding these findings for the therapeutic community environment. In this study we focused on the examination of alliances between SUD clients, but further research is needed to investigate within-patient therapeutic alliance. This might contribute to more knowledge regarding the specific direction of the association between therapeutic alliance and symptomatic improvement, as previously pointed out by Gidhagen et al. (14). Does a stronger therapeutic alliance lead to symptomatic improvement or does the decrease of symptoms increase therapeutic alliance? Current studies mostly find therapeutic alliance to predict symptom improvement, but an interplay is also very likely, especially regarding common therapeutic alliance fluctuation and ruptures throughout treatment (7, 11, 66).

Limitations and Future Perspectives

Due to the exploratory nature of this study, its main limitation is the small number of participants. Moreover, since inconsistent therapeutic alliance developments have been observed, a longitudinal study approach applying therapeutic alliance oriented measures might probably deliver in-depth insights into its development over time, providing a trait-like characteristic instead of state-alliance (5, 7). Additionally, only self-report measures were used in this study. As to therapeutic alliance measures, previous research found client-rated therapeutic alliance to be most predictive for outcome variables like dropout [e.g., (67)]. However, in fact therapists' assessment of therapeutic alliance has sometimes been found to be a more precise predictor [e.g., (68)]. Therefore, it would be appealing for future research to investigate possible deviations in client and therapist perception of their therapeutic alliance. Likewise, this study did not investigate the impact of same-gender or different-gender therapist/patient pairings, which might have had an influence on therapeutic alliance. Hence, further studies should consider the patient-therapist gender match as a potential confounding variable. Another limitation of this study is that neither severity nor duration of the SUD diagnoses were assessed in our patient sample. It is also important to state that individuals suffering from SUD form a quite heterogenous group often presenting a variety of comorbid psychiatric disorders (50). This circumstance might also have affected our findings. A study with

TABLE 3 | Intercorrelations for behavioral measures within the SUD sample ($n = 34$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Days spent in facility	–	0.73**	0.08	0.06	−0.12	−0.24	−0.03	−0.14	−0.16	−0.12	−0.26	0.14	0.21	0.16	0.30	0.36^{+}
2. Therapy phase		–	0.23	0.24	−0.27	−0.14	−0.29	−0.21	−0.29	−0.18	−0.35	0.21	0.33	0.34	0.41^{+}	0.38^{+}
AAS																
3. Closeness			–	0.53*	−0.23	−0.09	−0.05	−0.28	−0.15	−0.39^{+}	−0.09	−0.21	−0.12	0.41^{+}	0.25	0.28
4. Dependence				–	−0.23	−0.36^{+}	−0.28	−0.19	−0.33	−0.47*	−0.29	0.11	0.16	0.61**	0.27	0.39^{+}
5. Anxiety					–	0.31	0.51*	0.28	0.44*	0.59**	0.47*	−0.08	0.01	−0.30	−0.23	−0.25
BSI-18																
6. Somatization						–	0.41^{+}	0.72**	0.84**	0.27	0.26	−0.24	−0.15	−0.17	−0.31	−0.05
7. Depression							–	0.55**	0.79**	0.39^{+}	0.24	−0.30	−0.38^{+}	−0.33	−0.42^{+}	−0.32
8. Anxiety								–	0.89**	0.33	0.02	−0.13	−0.15	−0.08	−0.44*	−0.01
9. GSI									–	0.40^{+}	0.21	−0.27	−0.28	−0.24	−0.47*	−0.16
IPO-16																
10. Structural Deficit										–	0.47*	0.11	−0.02	−0.33	−0.20	−0.29
FEVER																
11. Precontemplation											–	−0.46*	−0.47*	−0.33	−0.44^{+}	−0.31
12. Contemplation												–	0.81**	0.22	0.38^{+}	0.22
13. Action													–	0.33	0.45*	0.34^{+}
WAI-SR																
14. Bond														–	0.37^{+}	0.72*
15. Tasks															–	0.52*
16. Goals																–

$^{+}$ *$p < 0.05$; *$p < 0.01$; **$p < 0.001$; AAS, Adult Attachment Scale; BSI-18, Brief Symptom Inventory; GSI, Global Severity Index; IPO-16, Inventory of Personality Organization; FEVER, Fragebogen zur Erfassung der Veränderungsbereitschaft (URICA); WAI-SR, Working Alliance Inventory—short revised.*

larger samples would make it possible to differentiate between specific SUD diagnoses. Similarly, due to the small sample size of controls diagnosed with mood disorders, we were unable to include these participants as a separate group. Hence, to avoid a possible confounding variable in our control group we decided to exclude these participants. Nevertheless, comparisons of participants with mood disorders and patients suffering from SUD might be a particularly interesting research topic, as mood disorders pose a significant vulnerability to develop addictions (64).

Finally, literature suggests the associations between therapeutic alliance and attachment to be more complex with various intervariable connections [e.g., (14, 27)]. In order to gain an enhanced understanding of the relationship between working alliance dimensions and attachment, as well as personality, mood pathology and therapy motivation, future research might focus on more complex research designs in SUD samples. Also, it would be feasible to include therapy outcome as a dependent variable and to examine possible mediational relationships regarding attachment, personality organization and therapeutic alliance. In correspondence to this, other variables that have been observed to play a role in the attachment-alliance linkage—such as the type of experienced abuse—should be considered in future studies [e.g., (14)].

CONCLUSION

Still, some notable implications for treatment of SUD can be derived from our findings: They highlight once more the importance of therapeutic alliance as a beneficial relationship between client and therapist in SUD treatment. However, regarding the diminished attachment security often found in SUD patients, this might be an especially challenging task for practicians working with this patient population. In conclusion, our findings point toward the need to take the client's attachment style into account while establishing the therapeutic alliance and to carefully consider related pathologies and motivational aspects.

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 University of Graz. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LR, AF, and H-FU conceptualized the study. LR, AR, and PK collected the data. LR and JF analyzed and interpreted the data. LR and H-FU drafted the manuscript. JF, AR, PK, AF, and H-FU critically reviewed it. All authors gave their final approval of the manuscript.

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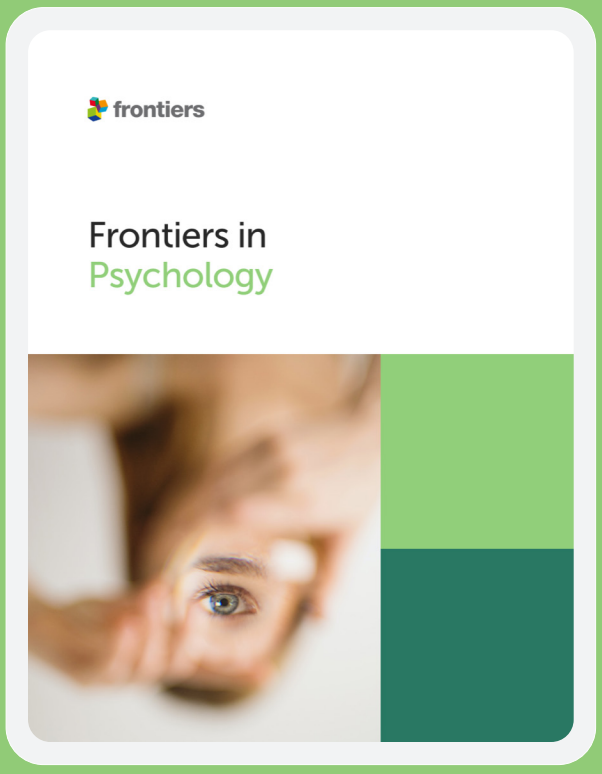

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