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Trauma and Alcohol/Substance Use: The Role of Self-regulation Flexibility

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A Dissertation Submitted to The Graduate School at the University of Missouri-St. Louis
in partial fulfillment of the requirements for the degree
Doctor of Philosophy in Psychology with an emphasis in Clinical-Community
Psychology

August 2022

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Abstract

Despite a high comorbidity rate between trauma/PTSD and problematic alcohol/substance use, there is only a small body of work investigating moderators and mediators in this relationship. Few studies have examined the role of self-regulation, composed of coping and emotion regulation, in the context of PTSD and problematic substance use. Prior work has generally measured self-regulation categorically, with strategies labeled as maladaptive or adaptive, and therefore failing to account for the adaptiveness of the strategy in particular contexts. The present study is the only one to date to examine self-regulation flexibility in the relationship between posttraumatic symptoms (PTSS) and problematic alcohol/substance use. The study also examines the role of various trauma characteristics, including total trauma exposure and trauma type, in the context of PTSS, problematic alcohol/substance use, and self-regulation flexibility. Further, differences in individuals endorsing polysubstance use and monosubstance use with respect to PTSS and self-regulation flexibility is explored. The study involved 359 trauma-exposed participants who completed several self-report measures on trauma exposure, trauma characteristics, PTSS, self-regulation flexibility, and problematic alcohol/substance use. PTSS was related to problematic alcohol and substance use, with greater exposure to trauma and presence of childhood trauma relating to greater PTSS. Results also found that individuals engaging in polysubstance use, compared to monosubstance use, experienced a greater number of traumas and PTSS. Higher trauma exposure and presence of childhood trauma were related to lower levels of coping flexibility, although PTSS was not related to coping flexibility. PTSS was unexpectedly related to greater emotion regulation flexibility. Although findings did not support a

mediation role of self-regulation flexibility in the relationship between PTSS and problematic alcohol/substance use, the study supports continued development of the self-regulation flexibility construct as well as future studies assessing for a meditational role with different methodology.

Trauma and alcohol/substance use: The role of self-regulation flexibility

Trauma, as defined by the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), is exposure to “actual or threatened death, serious injury, or sexual violence” (American Psychiatric Association, 2013). In the United States, up to ninety percent of individuals are exposed to at least one traumatic event in their lifetime, and less than ten percent of individuals go on to develop post-traumatic stress disorder (PTSD; Kessler et al., 2005; Kilpatrick et al., 2013). DSM-5 includes four symptom clusters for PTSD, including intrusion, avoidance, negative changes in cognitions or moods, and changes in arousal or reactivity (American Psychiatric Association, 2013). Although a substantial minority of individuals meets criteria for PTSD following trauma exposure, research has established that trauma exposure itself, including a single exposure, may lead to considerable psychological and physical distress (D’Andrea et al., 2011). In essence, trauma exposure is a critical risk factor for mental and physical health conditions, including alcohol/substance use disorders (SUDs).

Trauma and Substance Use

Individuals who report trauma exposure are at an increased risk for problematic use of alcohol and substances (e.g. marijuana, stimulants, narcotics), which can lead to SUDs (Mills et al., 2006). Specifically, trauma-exposure itself, regardless of PTSD diagnosis, appears to be a risk factor for substance use problems, and it can also worsen the course of SUDs (Clark et al., 1997; Norman et al., 2007). For example, in one study, childhood trauma exposure itself was associated with reduced medication treatment retention in opioid-dependent individuals, highlighting the adverse effects of trauma exposure on opioid use outcomes, irrespective of a PTSD diagnosis (Kumar et al., 2016).

Among the SUDs, alcohol use disorder (AUD) is the most common in the general population, with lifetime estimates of about 29% (Grant et al., 2015). The use of more than one substance at the same time occurs at a high rate, with the majority of individuals with a SUD engaging in polysubstance use (Connor et al., 2014; Earleywine & Newcomb, 1997; Leri et al., 2004; Martin et al., 1996; Subbaraman & Kerr, 2015; Timko et al., 2018). In addition to including patterns of using substances at the same time (i.e., concurrent, or simultaneous use), polysubstance use is also characterized by use of multiple substances on separate occasions (i.e., sequential use). In one study it was found that approximately 27% of individuals meeting criteria for one SUD have at least one additional SUD (Bhalla et al., 2017).

According to the DSM-5, SUDs are characterized by two or more of the following: a pattern of craving, drinking/using more or for longer than intended, increased tolerance, withdrawal symptoms, significant time spent obtaining substances, and continued use despite the resulting functional impairments and/or desires to cut down (American Psychiatric Association, 2013). There is a considerable burden of SUDs on the individual, their relationships, and the community at large. SUDs are associated with a greater risk for many negative outcomes, including homelessness, legal problems, divorce, trauma exposure, other mental and medical health conditions, and death (Collins et al., 2007; Darke et al., 2009; Grinman et al., 2010; Mokdad et al., 2004; Opsal et al., 2013; Slade et al., 2008; Wells, 2009) Individuals with SUDs engaging in polysubstance use compared to monosubstance use face even more negative consequences, including greater risks for legal problems and homelessness (Brière et al., 2011; Collins et al., 1998; Hassan & Le Foll, 2019; Hedden et al., 2010). Of note, even in the absence of a

SUD, polysubstance compared to monosubstance use is associated with greater physical and mental health concerns, including increased violent and risky behaviors, and mortality risk (Gilmore et al., 2018; Lorvick et al., 2018; Pennings et al., 2002). Thus, in addition to furthering research on SUDs, it is also important to study differences among individuals with mono- and polysubstance use.

Prior research has demonstrated that individuals report different motives for substance use. Within the alcohol use literature, four motives have been established, including mood enhancement, coping (i.e. tension reduction), social, and conformity (Cooper, 1994). Other motives have been associated with other substances, including pain within the context of opioid use, and enhancement of perceptual and cognitive experiences for marijuana use (Jones et al., 2014; Simons et al., 1998). Differential outcomes have been found in frequency, quantity, and negative consequences based on the motive for use, highlighting the complexity of the development of SUDs. Of note, the coping motive of substance use has had the greatest associations with problematic substance use (Asberg & Renk, 2012; Bonn-Miller et al., 2007; Galen et al., 2001; Ullman et al., 2013).

Despite research demonstrating the various substances serving the common purpose of coping with symptoms in the context of PTSD, there is considerable evidence that suggests that different substances appear to have unique associations with PTSD. A study conducted by Dworkin et al. (2018) investigated cluster-level differences in PTSD presentation in a treatment-seeking PTSD sample with current SUDs. Specifically, they found that among individuals with AUD and PTSD, those who also had problematic use of opioids, cocaine, or cannabis had more severe hyperarousal symptoms than those

without; those who also had problematic use of sedatives, hypnotics, or anxiolytics reported more severe numbing symptoms than those without; and those who also misused opioids reported more severe intrusion symptoms (Dworkin et al., 2018). Further, individuals with AUD and/or AUD and other SUDs reported more severe avoidance symptoms compared to those with other SUDs (Dworkin et al., 2018).

Another study found that individuals with PTSD using marijuana and alcohol report greater hyperarousal and mood-related negative cognition symptoms compared to alcohol-only users (Kearns et al., 2019). These results demonstrate the additive negative nature of polysubstance use in the context of trauma. There is also evidence for an interplay between PTSD and SUD symptoms, such that symptoms and severity are compounded. For example, withdrawal from alcohol and opioid misuse are also related to hyperarousal symptoms, such that the withdrawal may mimic PTSD hyperarousal symptoms (Fareed et al., 2013; Parlato et al., 2010; Patel et al., 2017; Saladin et al., 1995). Thus, these symptom are further exaggerated in individuals with PTSD who experience withdrawal, and may encourage substance users to continue use to reduce hyperarousal symptoms in the short-term. This is heightened in the case of multiple SUDs and PTSD.

There is a large body of epidemiological, clinical, and biological research demonstrating the high comorbidity between trauma/PTSD and SUDs. About 46% of individuals with lifetime PTSD were found to have a SUD in a large epidemiological study (Pietrzak et al., 2011). Further, in another PTSD sample, 20% of the participants reported using alcohol or substances to relieve their PTSS (Leeies et al., 2010). On the other hand, individuals with an SUD compared to those without one are 6.5 times more

likely to also have PTSD (Mills et al., 2006). In contrast with individuals who have either PTSD or SUD, those with comorbid PTSD and SUD are associated with worse physical health, occupational functioning, prognosis, and treatment outcomes (Dutton et al., 2014; Hassan et al., 2017; McCauley et al., 2012; Mericle et al., 2012; Mills et al., 2005; Seal et al., 2012). Further, individuals with multiple SUDs compared to a single SUD also show less improvement in PTSS during integrated treatment (Jeffirs et al., 2019). Given the massive toll of problematic substance use coupled with a prior history of trauma, it is important to advance research on underlying mechanisms that may be contributing to and maintaining the compounded burden of both conditions. Such work can help guide treatment targets to help ameliorate symptoms associated with the conditions, with one such avenue being self-regulation, a major focus of this study.

Trauma Characteristics, PTSD, and SUDs

Childhood Trauma

Individuals with a childhood trauma history appear to have a longer and more severe course of PTSD compared to those without, and also evidence greater rates of problematic substance use (Bremner et al., 1993; Cross et al., 2015; Farrugia et al., 2011; Khoury et al., 2010; Lawson et al., 2013). Individuals with polysubstance use, compared to those with monosubstance use, have been associated with greater rates of childhood trauma (Martinotti et al., 2009). Furthermore, a dose-response relationship has been found between early trauma and some substances. In the case of opioid misuse, for example, greater number of childhood traumas is associated with greater risk of prescription and injection drug misuse (Quinn et al., 2016). Individuals with childhood trauma histories and problematic substance use, compared to either alone, have more

severe negative outcomes, including in illness course and treatment outcomes (Brady & Back, 2012). In a study done by the Centers for Disease Control and Prevention and Kaiser Permanente (Adverse Childhood Experiences study), a graded relationship was found between adverse childhood experiences and multiple outcomes, including adulthood health risk behaviors—such as problematic substance use—and medical disorders (e.g. heart, liver, and lung diseases; Felitti et al., 1998).

Lifetime Trauma Exposure and Number of Traumatic Event Types

Research has demonstrated a dose-response relationship between the number of traumas experienced and worse mental and medical health outcomes, including more severe PTSD (Adams et al., 2016; Agorastos et al., 2014; Turner & Lloyd, 1995). Further, individuals who both drink alcohol and use other substances, as opposed to either alone, appear to have more complex trauma histories and greater PTSD severity (Kearns et al., 2019; Mills et al., 2006; Ruglass et al., 2016; Salgado et al., 2007; Ullman et al., 2013). In addition to number of total traumas, the number of traumatic event types also appears to have significant relationships with greater PTSS (Briere et al., 2008; Cloitre et al., 2009; Kolassa et al., 2010; O'Donnell et al., 2017; Putnam et al., 2013; Schauer et al., n.d.). The findings are consistent in SUD literature, with evidence for an additive effect of number of types of trauma, especially in childhood, on problematic substance use (Khoury et al., 2010). Generally, individuals who engage in problematic use of substances, especially those with SUDs, have experienced multiple traumas.

Type of Trauma

Extant research has demonstrated that certain trauma types are associated with greater PTSS and likelihood of PTSD development. In particular, sexual and physical

traumas, especially occurring in childhood, are related to increased PTSS and problematic substance use (Briere et al., 2008). Interpersonal traumas also appear to be related to more severe PTSS as well as greater rates of PTSD (Ford et al., 2006; Green et al., 2000; Kelly et al., 2009), as are combat traumas (Guina et al., 2018; Pietrzak et al., 2011). In particular, a recent meta-analysis found a strong relationship between sexual trauma and PTSD (Dworkin et al., 2021). In the context of problematic substance use, studies have also found that interpersonal traumas, especially child sexual trauma, is associated with a greater use of substances to cope (Ouimette & Brown, 2003; Ullman et al., 2013). Within military samples, there is evidence that combat trauma is related to increased alcohol use post-deployment compared to use pre-deployment (Hoge et al., 2004), with up to 25% of individuals reporting problematic alcohol use post-deployment (Wilk et al., 2010). Further, compared to civilian populations, military populations have a higher prevalence of problematic alcohol use, which may indicate that there is a greater risk for comorbid AUD and PTSD in military populations (Carter et al., 2011)

PTSD and SUD Comorbidity: Theoretical Models

Three major theoretical models have been proposed to explain the high comorbidity rate between PTSD and SUDs.

Negative Reinforcement Models/Self Medication Hypothesis

Negative reinforcement models of substance use broadly assert that individuals use substances to get rid of aversive stimuli, including negative affect, and over time individuals are reinforced to use substances when the aversive stimulus is experienced (Baker et al., 2004; Koob & Le Moal, 2008). The self-medication hypothesis, a negative reinforcement model, is the conceptual model with the greatest evidence base for the

relationship between PTSD and SUDs (Dabbs et al., 2014; Khantzian, 1985; Khantzian, 1997). This model proposes that substance use is a means to self-medicate the negative symptoms of PTSD (e.g. the noradrenergic overstimulation in PTSD that is associated with hypervigilance), with a general assumption that PTSD precedes and causes the problematic substance use. Community studies as well as those with veterans show that PTSD often precedes problematic substance use, including OUD (Kessler, 2000).

(Bremner et al., 1996; Hall & Weier, 2017; Robins et al., 2010; Seal et al., 2012). More severe PTSD is also associated with a greater risk of problematic substance use.

High Risk and Susceptibility Hypotheses

Another set of causal theories concerning the relationship between SUDs and PTSD proposes that problematic substance use precedes and increases the vulnerability for PTSD (Brown & Wolfe, 1994; Chilcoat & Breslau, 1998). Compared to the Self-Medication Hypothesis, however, these theories evidence more conflicting research and are therefore less supported (Chilcoat & Breslau, 1998; Haller & Chassin, 2014). The High Risk Hypothesis suggests that the dangerous lifestyle and environment associated with SUDs increases an individual's exposure to illegal and traumatic events and, therefore, the likelihood of PTSD (Chilcoat & Breslau, 1998). To illustrate, witnessing or experiencing an opioid overdose is a trauma in itself. The Susceptibility Hypothesis, on the other hand, proposes that the increased anxiety and arousal that often accompany chronic substance misuse, in addition to poor coping skills, may increase biologic vulnerability to developing PTSD subsequent to trauma exposure (Brown & Wolfe, 1994). In the opioid literature, for example, it has been found that prolonged opioid use may result in down-regulation of endogenous opioids, which in turn can disrupt natural

stress responses; the result is a compromised homeostatic response to traumatic events, increasing the risk of developing PTSD (Kreek, 2002). Evidence also suggests that withdrawal from opioids results in dysregulation of the stress response and hyperarousal, which further increases the susceptibility to PTSD (Danovitch, 2016).

Shared Vulnerability/Common Factors Hypothesis

The Shared Vulnerability Hypothesis, sometimes referred to as the Common Factors Hypothesis, is the third major conceptual model to help explain the strong relationship between SUDs and PTSD. Unlike the previous two models, this one is non-causal. Instead, this model posits that there are common pathways contributing to both problematic substance use and PTSD. For example, there is evidence that there are overlapping genetic substrates between PTSD and SUDs, with early temperamental factors indicative of specific genes underlying both conditions (Wolf et al., 2010). Furthermore, epigenetics and the interactions between the early environment and unfolding brain plasticity may also lead to vulnerability for both conditions, as early stress can influence biological set points in long-lasting ways (Gold et al., 1982; Henry et al., 1994). Additionally, psychological traits such as resilience, distress tolerance, impulsivity, and negative emotionality may be common to both disorders, and have been found to mediate the relationship between PTSD and SUDs (Lanius et al., 2011; Miller et al., 2006). Such traits may be indicative of poor coping skills that may cause, maintain, and exacerbate both conditions. Finally, in addition to early environmental factors, continued negative features such as lack of social support, trauma exposure, and the availability of substances may be common experiences that increase the risk for developing both conditions (Reddy et al., 2013).

Critiques of Current Theories

Despite evidence for the three major conceptual models in explaining the comorbidity between SUD and PTSD, many limitations exist. Specifically, not everyone with PTSD uses opioids or other substances to cope with the distressing symptoms. Further, despite self-medication models proposing that use of substances is a means to self-medicate negative symptoms, the substances themselves can cause additional suffering and/or not actually reduce symptom severity (Gil-Rivas et al., 2009; Reddy et al., 2014). Thus, effective self-medication may not even result. Major critiques of the High Risk and Susceptibility Hypotheses include evidence from longitudinal studies that PTSD onset often precedes opioid misuse, leading to mixed results for this model. Lastly, given that the Shared Vulnerability/Common Factors Hypothesis is non-causal in nature, it does not adequately account for and integrate data pointing to the transactional nature of PTSD and SUDs, but rather simply identifies common correlates of both disorders.

A more integrated, systemic framework may better conceptualize the comorbidity between PTSD and SUD. Such a framework could support the existence of multiple pathways to the comorbidity rather than one causal pathway. It can also illustrate the transactional nature of the conditions, whereby PTSD severity predicts SUD exacerbation, and vice versa. One preliminary study lends support to this integrated framework capturing previous theoretical models, but other researchers have not adopted this and continue to test previous theories, namely self-medication, ignoring the evidence indicating the presence of multiple pathways towards the comorbidity (Dell'Osso et al., 2014). An integrated framework can not only merge previous theories, but can also include factors such as trauma type, motive(s) for substance use, and demographics in

addition to other known risk and maintaining factors for PTSD and SUD, biological or otherwise. As discussed next, self-regulation flexibility may be an important component to consider for such a model, as inflexible self-regulation may be an important risk and maintaining factor for both disorders, yet serve as a practical treatment target in addressing comorbid PTSD and SUD. Overall, such a comprehensive model may give clinicians hints on which risk and maintaining factors may be the most promising treatment targets for each unique case.

Self-Regulation

One common pathway that may contribute to the development of SUD and PTSD is self-regulation. Self-regulation encompasses coping and emotion regulation, which broadly involve an individual's responses to stress and efforts to manage emotions in various situations, respectively. Self-regulation may be integral to theories explaining the PTSD and SUD comorbidity. For example, ineffective self-regulation may be associated with greater PTSD hyperarousal symptoms and SUD severity, in line with the self-medication hypothesis. On the other hand, having ineffective self-regulation may be a common vulnerability for developing both disorders, falling under the shared vulnerability theory. Thus, self-regulation may fit well in a more integrated model as proposed above.

Coping

The conceptualization of coping has evolved from a more dispositional view, described as a personality trait and "style," to a more situational view, where it was defined as an individual's response (behavioral and cognitive) to handle stress that exceeds the individual's resources (Carver & Scheier, 1994; Donoghue, 2004; Folkman

& Lazarus, 1980; Lazarus & Folkman, 1984). In other words, the latter view defined coping as a set of strategies as opposed to a style (Monzani et al., 2015). The earlier, dispositional view of coping oversimplified the process, as people approach different situations with divergent coping strategies; thus, the situational view recognizes that coping is a transactional process between the person and environment in a particular context (Folkman & Lazarus, 1980; Lazarus & Folkman, 1984). The situational view of coping also shows more potential for identifying treatment targets, rather than concluding that coping cannot change because it is inherently dispositional. Importantly, in both views, theorists have acknowledged that coping may or may not be directed at emotions. It is also worth noting that although the dispositional and contextual views are often competing, some authors have proposed a more integrated view of personality factors, including coping, whereby both situational and contextual/process perspectives are part of a congruent personality system (Mischel & Shoda, 1999).

Research has examined the relationships between coping, PTSD, and SUD. As previously mentioned, handling stress and distress is a strong motive for substance use. Studies have demonstrated that individuals with OUD are less likely to use adaptive coping strategies such as problem-focused and adaptive emotion-focused coping compared to controls, and are more likely to use maladaptive strategies such as avoidance and disengagement coping (Adan et al., 2017; Coriale et al., 2012; Hruska et al., 2011; Hyman et al., 2009; Marquez-Arrico et al., 2015; Pence et al., 2008; Bavojudan et al., 2011). Trauma-exposed individuals who go on to develop PTSD also show avoidance-related coping, including denial and wishful thinking (Dörffel, Rabe, & Karl, 2008; Pietrzak, Goldstein, Southwick, & Grant, 2011; Tsay, Halstead, & McCrone, 2001). Such

avoidance coping, as well as emotional discharge (venting), common patterns found in both PTSD and SUD samples, may help explain the high comorbidity between PTSD and SUD (Grosso et al., 2014; Hruska et al., 2011; Lee et al., 2017; Penk et al., 1988; Read et al., 2014; Staiger et al., 2009; Tyler Boden et al., 2014). Importantly, this underlying commonality appears true among studies that conceptualized coping as dispositional as well as situational.

A major critique to both the dispositional and situational views of coping is the fallacy of uniform efficacy, which maintains that coping strategies and styles are not necessarily adaptive and maladaptive (Bonanno & Burton, 2013). Instead, as discussed next, a more flexible use of strategies has been associated with well-being. Given a body of contradictory findings on which strategies are adaptive rather than maladaptive, especially in the context of PTSD, consideration of coping flexibility is particularly critical (Park et al., 2015).

Emerging research indicates that rather than focusing on specific strategies and styles and characterizing them as adaptive or maladaptive, examining an individual's ability to be flexible with coping strategies is more reflective of psychological functioning (Bonanno & Burton, 2013; Cheng et al., 2014). Initial work on coping flexibility was based on Cheng's (2001) goodness-of-fit approach, which involves selecting strategies based on an individual's appraisal of the controllability of the situation. Building on this model, Kato's dual-process theory of coping flexibility involves the processes of evaluating and stopping the use of an ineffective strategy (i.e., evaluation coping), and then employing a new strategy until an adaptive outcome results (i.e., adaptive coping; Kato, 2012, 2015). In the dual-process model, a transactional

model, coping is conceptualized as a dynamic and ongoing process based on the effectiveness of a strategy (Kato, 2012, 2015). Studies have demonstrated that inflexible coping in trauma-exposed individuals predicts worse outcomes, such that coping flexibility serves as a protective factor for PTSD following trauma (Galatzer-Levy et al., 2012; Park et al., 2015; Pinciotti et al., 2017). Further, in a study examining individuals dependent on alcohol, low coping flexibility was concluded to deter recovery from alcohol dependence (Borzyszkowska & Basińska, 2018). Coping repertoire, the degree to which individuals can use a variety of coping skills, has been found to be related to less negative alcohol outcomes (Roos, 2015). Another study examining adolescents, however, did not find support for differences in coping flexibility among users and non-users of marijuana (Kruczek, 2017).

One line of research on regulatory processes proposes that coping with distress may use up an individual's resources, coined ego-depletion, making him/her more vulnerable to "failed" self-regulation in other domains, such as inability to resist cravings for substances, etc. (Baumeister et al., 1999; Muraven & Baumeister, 2000; Vohs & Baumeister, 2018). This may be especially true in the case of PTSD, with symptoms such as emotional numbness and avoidance resulting in ego-depletion, and therefore setting up the individual to make more risky decisions that compromise self-control (e.g. substance use; Baumeister, 2003; Baumeister et al., 1998; Baumeister & Heatherton, 1996; Baumeister & Vohs, 2007; Muraven, 2012; Vohs & Baumeister, 2018). For example, one study found that ego-depletion mediated the relationship between negative affect and greater risk taking (Bruyneel et al., 2009). Interestingly, research has demonstrated that coping flexibility may still be beneficial for ego-depleted individuals, as a balance of

different coping strategies and alternating between them can lead to more effective energy expenditure and an overall conservation of energy (Aldwin, Skinner, Zimmer-Gembeck, & Taylor, 2011). In one study examining individuals with posttraumatic stress symptoms following trauma, it was found that flexible use of coping strategies reduced ego depletion, which in turn enabled individuals to delay gratification and curb risky drinking (Boyras et al., 2018). In other words, flexible coping prevented a drain on resources needed for self-control, which in this case was delayed gratification; consequently, alcohol outcomes were better. No research has been done on coping flexibility and other substances in the context of trauma and PTSD. Thus, future research is warranted to establish whether flexible coping serves as a protective factor against both problematic alcohol and substance use in the presence of posttraumatic symptoms.

Emotion Regulation

The second arm of self-regulation is emotion regulation. Emotion regulation involves the monitoring, assessing, modulating, and controlling of emotions (Gross, 1998; Naragon-Gainey et al., 2017). There are overlaps between coping and emotion regulation, but the latter involves unique processes such as expression-management and increasing positive emotions that are not fully relevant in the context of stress. Adaptable emotion regulation can certainly underlie effective coping under stress, and effective coping can consequently contribute to positive emotional functioning and regulation.

The field of emotion regulation has many parallels with that of coping. Similar to coping, the literature has emphasized both a dispositional perspective of emotion regulation, as well as a more context-based framework to address the complexity of this construct (Naragon-Gainey et al., 2017). Whereas the coping field largely still

conceptualizes both of these views as competing, the emotion regulation field has had a more recent focus on integrating both perspectives, as emotion regulation strategies and styles/abilities may work in a transactional fashion (Tull & Aldao, 2015).

Another parallel with the coping literature is that extant research has established certain maladaptive emotion regulation strategies and styles, sometimes referred to as “emotion dysregulation,” and demonstrated that these are more associated with psychopathology compared to adaptive strategies (Aldao & Nolen-Hoeksema, 2010). Although understanding maladaptive emotion regulation is important for this reason, understanding what is adaptive is equally important in conceptualization of disorders as well as identification of potential treatment approaches. Focusing only on dispositional emotional regulation would lead to the erroneous conclusion that an adaptive style of emotion regulation is always helpful and not predictive of psychopathology, and that maladaptive styles are ineffective across all situations; however, taking on a more contextual perspective elucidates that adaptive strategies may be useful only in certain contexts, such that reliance on such a strategy in across situations may not be “adaptive” after all (Aldao & Nolen-Hoeksema, 2012b). Emphasis on considering context, therefore, may illuminate what is decidedly adaptive. Moreover, certain strategies that have been labeled “maladaptive,” including rumination, have evidence for positive outcomes as well, including contributing to posttraumatic growth, or the experience of positive change following trauma (Heiy, 2010; Tedeschi & Calhoun, 1996). As emotions are critically involved in everyday decisions, true adaptive emotion regulation by nature, then, may serve to guide the most optimal use of strategies based on context (Katz et al., 2017; Tamir, 2009).

Work on emotion regulation in the context of PTSD has revealed that trauma may impair an individual's ability to down-regulate negative emotions and enhance positive emotions, and emotion dysregulation explains much of the variance in PTSD symptoms (Shepherd & Wild, 2014; Xiong et al., 2013). A similar pattern has been implicated in the context of SUDs, whereby misuse is associated with difficulties regulating both positive and negative emotions (Blanchard et al., 2019; Dingle et al., 2018; Garland et al., 2017; Lutz et al., 2018; Weiss et al., 2018; Wong et al., 2013). Some work has also found that emotion regulation difficulties are significantly associated with coping motives for substance use, previously mentioned as the most problematic motive for use. In one study, nonacceptance of emotional responses was found to be a unique predictor for motive among opioid users (Gold, Stathopoulou, & Otto, 2019).

As with coping, this categorical view of emotion regulation strategies as being adaptive or maladaptive is susceptible to the fallacy of uniform efficacy, with evidence showing that even strategies considered "maladaptive" such as rumination are not always definitively maladaptive.

Focusing on flexible emotion regulation may have more utility than taking on a categorical perspective, especially because individuals may be utilizing more than one strategy at a time, some of which may have been categorized as adaptive and others as maladaptive. Indeed, flexible emotion regulation is associated with better psychological health (Aldao et al., 2015; Bonanno & Burton, 2013; Southward et al., 2018). One facet of emotion regulation flexibility involves expressive flexibility, or the ability for an individual to appropriately modulate (e.g., enhance, suppress) their positive and negative emotions given the situation (Burton & Bonanno, 2016). Importantly, these abilities are

significantly related to social and clinical outcomes following stressful events (Bonanno et al., 2004; Gupta & Bonanno, 2011; Westphal et al., 2010).

Interestingly, research has demonstrated that women use emotion regulation strategies more often and more flexibly than men, suggesting that emotion regulation processes differ among men and women (Goubet & Chrysikou, 2019). This may also indicate that different treatment approaches for emotion dysregulation may be needed for men and women. Within PTSD research, it has been found that the ability to flexibly choose emotion regulation strategies based on the situation may buffer against developing PTSD symptoms following trauma exposure (Levy-Gigi et al., 2016). In one study that included individuals with anxiety, depression, and alcohol problems, results from a moderation revealed that adaptive strategies were negatively correlated with psychopathological symptoms only when there were high levels of maladaptive strategies (Aldao & Nolen-Hoeksema, 2012a). The authors did not find a relationship between adaptive strategies and psychopathology longitudinally. In other words, adaptive strategies may be compensatory when there are several maladaptive strategies at play, but their predictive power of psychopathology by themselves is limited. Furthermore, work involving emotion transfer suggests that when an individual uses just one means to regulate emotions and attain a goal, such as substance use, the emotional aftermath of the goal (tension reduction or enhancement of mood) will transfer, or be associated with, just that one means (Fishbach et al., 2004; Köpetz et al., 2013). On the other hand, if an individual uses a variety of means to achieve a goal, there will be lower emotional transfer to each means. As such, positive reinforcement of only one means, such as substance use, may be prohibited; this may therefore prevent problematic outcomes

associated with an overreliance on substance use. Together, extant work illustrates the need to examine emotion regulation strategies more comprehensively and flexibly, rather than focusing on certain strategies. To date, only a few studies investigated whether flexibility in emotion regulation is related to better substance use outcomes, and the results of one study were counter to predictions, such that a larger repertoire for regulating emotions was generally associated with more severe illicit substance use (Yi, 2015). Another study found generally non-significant findings in the relationship between various facets of emotion regulation flexibility and alcohol-related consequences (Jenzer, n.d.). The current study attempts to add to this work by investigating the relationships between emotion regulation flexibility and problematic substance/alcohol use in the context of trauma.

Trauma, Substance Use, and Self-Regulation Flexibility

Coping and emotion regulation, together making up self-regulation, appear to have many associations with the development and maintenance of both PTSD and SUD. Research has demonstrated that self-regulation flexibility influences the development and progression of PTSD, but more research is needed to demonstrate that a similar pattern is occurring in the context of SUD. This can help provide additional evidence of the transdiagnostic nature of self-regulation flexibility and its promise as a treatment target to address PTSS, problematic substance use, separately and together. It may be possible to prevent the development of comorbid PTSD and SUD if self-regulation flexibility is improved upon in the context of just one condition. Given that broader SUD and PTSD research demonstrates the efficacy, safety, preference for and acceptability of integrated treatments (including both psychosocial and pharmacological approaches for SUD),

addressing self-regulation flexibility is likely a useful addition to integrated treatments (Flanagan et al., 2016). Further, evidence indicates that psychological flexibility in general, including coping and emotion regulation flexibility, is a malleable factor that can be improved with treatment (Cheng et al., 2012; Kato, 2012). Initial work suggests a reduction of symptoms of disorders such as depression above and beyond cognitive-behavioral therapy, with reductions maintained at follow up; however, more work is needed to understand the efficacy of such treatments in the context of comorbid PTSD and SUD (Cheng et al., 2012). Despite different associations with PTSD clusters among different substances and demographics, the transdiagnostic nature of self-regulation flexibility allows it to be effective across several contexts.

Trauma Characteristics and Self-Regulation

Childhood Trauma

A history of childhood trauma may interfere with effective emotion regulation development (Choi & Oh, 2014; Hébert et al., 2018). In a sample of school-aged victims of child sexual abuse, cumulative childhood trauma was found to be related to greater emotional dysregulation (Hébert et al., 2018). Only one study to our knowledge has examined childhood trauma in the context of emotion regulation flexibility, which found a relationship between childhood trauma and reduced expressive flexibility (Pițur & Miu, 2020). In the coping literature, research has found that adverse childhood events also influence the coping strategies people use, which in turn increases the likelihood of experiencing physical and emotional stress. One study found that childhood trauma compared to adulthood trauma was related to lower coping ability later in life (Ogle et al., 2013). Further, one longitudinal study found that greater use of adaptive coping strategies

and lower use of maladaptive strategies following greater exposures to adverse childhood events, which in turn was related to negative mental and medical health outcomes; this suggests that childhood trauma may adversely affect the development of coping flexibility (Sheffler et al., 2019).

Lifetime Trauma Exposure and Number of Traumatic Event Types

As previously mentioned, there is a synergistic effect of childhood traumas in impairing appropriate emotion regulation development (Hébert et al., 2018). In one study, emotion regulation was found to mediate the relationship between cumulative childhood trauma and internalizing and externalizing problems, suggesting that it may be especially important in the development of PTSD and SUD in the presence of early trauma (Hébert et al., 2018). Some researchers have concluded that such findings suggest that mature emotion regulation may be a protective factor against psychopathology in the presence of childhood trauma (Hopfinger et al., 2016). Within the coping literature, greater trauma exposure has also found to be associated with greater use of maladaptive coping strategies (Bal et al., 2003; Christiansen et al., 2014; Vaughn-Coaxum et al., 2018). Higher trauma exposure has also been found to be related to greater PTSS severity when individuals have low coping flexibility (Park et al., 2015). Interestingly, regardless of the level of repeated exposure to trauma, high coping and emotion regulation flexibility have been found to be protective factors against PTSS (Bonanno et al., 2011; Levy-Gigi et al., 2016). To our knowledge, no work has been done on the relationship between coping and emotion regulation flexibility and number of traumatic event types experienced.

Type of Trauma

Interpersonal trauma, with childhood sexual abuse in particular, appears to be particularly problematic for development of emotion regulation and coping (Banyard et al., 2001; Cloitre et al., 2002; Dunn et al., 2018; Ford et al., 2006). In one study, 75% of children who experienced sexual abuse were found to experience another form of maltreatment, suggesting that sexual trauma is associated with greater trauma exposures and consequently worse outcomes compared to non-sexual traumas (Hébert et al., 2018). Child sexual trauma, compared to non-sexual trauma, is related to greater use of maladaptive coping behaviors, which has been found to mediate the relationship between trauma and PTSS (Bal et al., 2003). No work has examined the relationship between type of trauma experienced and self-regulation flexibility.

Present Study

Although there is a high comorbidity rate between trauma/PTSD and problematic substance use, with the co-occurrence related to significant impairment across several domains, there are few studies involving individuals with both conditions, especially related to self-regulation. The present study aims to fill this gap. Further, prior work has generally measured self-regulation categorically, with strategies categorized as maladaptive or adaptive and therefore failing to account for the adaptiveness of the strategy in particular contexts. In the present study, self-regulation flexibility is examined to capture a more complete picture. The study also examines the role of various trauma characteristics—including total trauma exposure and trauma type—in the context of PTSS, problematic substance use, and self-regulation flexibility. The aims in the study involve examining trauma-exposed individuals. The specific hypotheses are as follows:

Hypotheses

Hypothesis 1: More severe PTSS will be related to less flexible coping and emotion regulation profiles.

Hypothesis 2: Trauma characteristics (e.g. trauma type, total trauma exposure) will be related to PTSS, problematic alcohol use, problematic substance use, and self-regulation flexibility. Specifically:

Hypothesis 2a: Greater trauma exposure will be related to a) more severe PTSS b) more problematic alcohol use c) more problematic substance use, d) less flexible coping, and e) less flexible emotion regulation.

Hypothesis 2b: Presence of sexual trauma will be related to a) more severe PTSS b) more problematic alcohol use c) more problematic substance use, d) less flexible coping, and e) less flexible emotion regulation.

Hypothesis 2c: Presence of childhood trauma will be related to a) more severe PTSS b) more problematic alcohol use c) more problematic substance use, d) less flexible coping, and e) less flexible emotion regulation.

Hypothesis 3: Together, less flexible coping and emotion regulation profiles, greater PTSS, and more problematic trauma characteristics (sexual and childhood traumas and greater exposure to trauma) will predict more problematic alcohol use, with each factor emerging as a unique predictor.

Hypothesis 4: Together, less flexible coping and emotion regulation profiles, greater PTSS, and more problematic trauma characteristics (sexual and childhood traumas and greater exposure to trauma) will predict more problematic substance use, with each factor emerging as a unique predictor.

Hypothesis 5: Individuals with polysubstance use and those with monosubstance use will have significantly different levels of PTSS and self-regulation flexibility, as well as different trauma characteristics. Specifically:

Hypothesis 5a: Individuals with polysubstance use compared to monosubstance use will be associated with a) more severe PTSS b) less flexible coping, and c) less flexible emotion regulation.

Hypothesis 5b: Individuals with polysubstance use compared to monosubstance use will be associated with more problematic trauma characteristics, including a) greater total trauma exposure, d) a greater presence of sexual traumas, and e) a greater presence of childhood traumas.

Hypothesis 6: Self-regulation flexibility will mediate the relationship between PTSS and problematic alcohol and substance use. Specifically:

Hypothesis 6a: Coping flexibility and emotion regulation flexibility will emerge as unique mediators in the relationship between PTSS and alcohol use. Trauma characteristics (sexual and childhood traumas and greater exposure to trauma) will serve as moderators in the relationship between PTSS and self-regulation flexibility.

Hypothesis 6b: Coping flexibility and emotion regulation flexibility will emerge as unique mediators in the relationship between PTSS and substance use. Trauma characteristics (sexual and childhood traumas and greater exposure to trauma) will serve as moderators in the relationship between PTSS and self-regulation flexibility.

Method

Participants and Procedures

Approval for the study was obtained from the Institutional Review Board at the University of Missouri- St. Louis (UMSL). The study aimed to recruit approximately 400 participants. Participants were recruited from the human subject pool at UMSL (SONA) based on an online announcement briefly describing the study to all students registered with SONA. Trauma-exposed students enrolled at the university over 18 years of age were eligible to enter the study via SONA, with no additional exclusionary criteria. SONA participants received course credit for participating in the survey. Participants were also recruited from Amazon Mechanical Turk (MTurk), which requires participants to be at least 18 years of age; no exclusionary criteria existed for MTurk as well, and workers did not have to be at a certain qualification level to participate. MTurk participants who were included in analysis were compensated with \$1.50. Participants from both SONA and MTurk completed the online survey on Qualtrics, which also included informed consent for the study.

In establishing the final sample for data analyses, data were screened and a number of individuals were removed from the sample. 53 participants were removed from the sample for providing incorrect responses for greater than 50% of the validity checks throughout the survey. Further, 12 participants from SONA were removed due to having greater than 50% of survey data incomplete, including responses on primary study variables. Another 8 MTurk participants were removed from the sample due to taking the survey in approximately 5 minutes or less in addition to failing at least 25% of the survey's validity checks. 406 participants remained after this initial data screening. After

controlling for traumatic exposure, 359 of the 406 participants comprised of the final sample for all analyses.

Measures

Demographics

Demographic information on participant sex, gender, race/ethnicity, age, education level, marital status and income level was obtained. Participant sex (female coded as 1, and male coded as 2) and age were utilized as covariates. Further, a Black or White race variable was created to examine differences in Black (coded 0) and White (coded 1) individuals across study variables.

Trauma Exposure

Trauma exposure was assessed using the Life Events Checklist-5 (LEC-5; Weathers et al., 2013), which is a self-report measure including 17 categories of traumatic stressors (e.g., motor vehicle accidents, natural disaster, sexual assault). For each category, participants indicate their degree of exposure: happened to me, witnessed it, learned about it, part of my job, not sure, or does not apply. For each traumatic event type endorsed, participants were asked to specify how many times each occurred; and the earliest and most recent age of occurrence. Participants reporting “happened to me” or “witnessed it” for a traumatic event were included in analysis. Total trauma exposure was calculated for analyses by summing the number of different types of traumas participants endorsed experiencing. A cut-off age of 18 was used to determine the presence of childhood trauma. Presence of sexual trauma was also obtained from this measure. The measure has good reliability and validity across samples (Gray et al., 2004).

Posttraumatic Stress Symptoms

PTSS was examined using the PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013), a 20-question self-report scale measuring DSM-5 PTSD symptoms in the past week. Participants indicated the degree of severity on a 5-point Likert scale from 0 (“Not at all”) to 4 (“Extremely”) for each question. Previous research (Bovin et al., 2016) has found a cut-off score of 33 to indicate probable PTSD. The PCL-5 produces a total score and separate scores for each cluster of PTSD: avoidance, intrusion, changes in arousal/reactivity, and negative changes in cognitions or mood. The PCL-5 has demonstrated good validity and reliability in previous samples, including a trauma-exposed college sample ($\alpha = .94$; Blevins et al., 2015). The reliability for the total score used in this study was also good ($\alpha = .96$).

Problematic Alcohol Use

The 10-item item Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) was used to assess for alcohol use and problems. A score of 8 or above out of 40 has been found to be indicative of problematic alcohol use (Saunders et al., 1993). The AUDIT has good validity and reliability established across samples, with greater sensitivity to problematic alcohol use compared to other measures and an internal consistency of .83 in a large sample of substance using individuals (Hays et al., 1995). In the current study, the internal consistency was good ($\alpha = .93$).

Substance Use and Frequency

The presence of lifetime, past year, and past 30 day use of the following classes of substances used for non-medical reasons (including prescription medications not used as prescribed) was obtained, with examples of substances within each class given to participants: cannabis, cocaine, prescription stimulants, methamphetamine, inhalants,

sedatives or sleeping pills, hallucinogens, opioids, and other. To qualify as having monosubstance use, individuals must have endorsed only using one substance (including alcohol) in the past year. Use in past year included individuals who drank alcohol at least “monthly or less” and used substances at least “less than once a month.” To qualify as having polysubstance use, individuals had to endorse using two or more substances in the past year, including alcohol. A “no use” group (coded as 0) was created for individuals who neither engaged in monosubstance use (coded as 1) or polysubstance use (coded as 2).

Problematic Substance Use

The Drug Abuse Screening Test (DAST-10; Skinner, 1982) was used to examine problems related to substances other than alcohol. It is a 10-item measure examining problems related to substance use in the past 12 months, with responses including “Yes” or “No” for each item. A score of 3 out of the possible 10 is indicative of a potential substance use problem. The DAST-10 has demonstrated good reliability and validity across samples, including having an internal consistencies above .86 in psychiatric samples (Yudko et al., 2007). The internal consistency of this measure in the current study was adequate ($\alpha = .79$).

Coping Flexibility

Coping flexibility was measured using the Coping Flexibility Scale (CFS; Kato, 2012), a 10-item scale based on the dual-process of coping flexibility. For each item, participants indicated how much each stress-coping situation applies to them: “very applicable,” “applicable,” “somewhat applicable,” and “not applicable.” The measure includes a total flexibility scale as well as two subscales, evaluation coping and adaptive

coping. The measure and its two subscales have demonstrated good validity and reliability in non-Western samples, with Cronbach's alpha coefficients above 0.86 in both a student and employee sample (Kato, 2012, 2015). However, the limited psychometric studies in Western samples have only demonstrated good psychometrics for the total flexibility scale, with weaker support for the two subscales (Jones, 2015; Reed, 2016). Given that this is the only scale examining both processes of monitoring and discontinuing ineffective strategies as well implementing effective strategies, it is being used in the current study. Only the total score was utilized in analyses, which was computed by summing the evaluation coping and adaptive coping subscale scores. Internal consistency was adequate for the total score in the current study ($\alpha = .74$).

Emotion Regulation Flexibility

Emotion regulation flexibility was assessed using the Flexible Regulation of Emotional Expression (FREE; Burton & Bonanno, 2016). The FREE is a 16-item self-report scale that assesses individuals' perceived ability to modulate emotional expressions across different scenarios. The items responses are based on a 6-point Likert scale ranging from "unable" to "very able." There is an overall expressive flexibility scale, as well as two subscales, Enhance and Suppress, which measure the ability to enhance and suppress emotional expression, respectively. The overall expressive flexibility scale, utilized in the current study, was computed by summing together the average of the Enhance and Suppress subscale scores, then subtracting the polarity of the scales (the absolute value of the difference between the subscales) from the sum. Previous research has demonstrated good reliability and validity for the three scales, with internal consistencies greater than 0.70 (Burton & Bonanno, 2016). In the current study,

the internal consistency of this measure was good for the overall flexibility scale ($\alpha = .87$).

Data Analysis

Analyses were conducted using SPSS 26. Prior to analyses, data were screened for missing data, univariate and multivariate outliers, multicollinearity, normality, linearity, homogeneity of variances, and homoscedasticity. No missing data were detected for the primary study variables. Z-scores for univariate outliers were assessed with a cutoff of three standard deviations from the mean. Three univariate outliers were identified among DAST-10 scores. One multivariate outlier was identified upon inspection of Mahalanobis distances. No significant differences in results were identified with the inclusion of these cases, therefore the cases were not removed in subsequent analyses. For all analyses, statistical significance was defined as $p < .05$. Exploratory analyses were conducted to examine relationships with demographic variables (e.g. gender, race, age) and other study variables (e.g., PTSS, coping flexibility, and emotion regulation flexibility) using Pearson correlations to screen for covariates, which will be controlled for in subsequent analyses.

For Hypothesis 1, two separate regressions were run to examine the relationships between PTSS and coping flexibility, and PTSS and emotion regulation flexibility. If covariates were included in the model, a hierarchical regression was conducted, with covariates entered into the first step of the model. A priori power analysis using G*Power 3.1 (medium effect size of $f^2 = 0.15$, power = .80, alpha = .05) indicated that 55 participants are required for this hypothesis (Cohen, 1992; Faul et al., 2007). For a small effect size ($f^2 = 0.02$), a total of 395 participants would be needed.

For Hypothesis 2, bivariate correlations among study variables were first examined to explore relationships between trauma characteristics, PTSS, problematic alcohol and substance use, and self-regulation flexibility, followed by regression analyses for variables that emerged as significantly related based on the correlation matrix. A priori power analysis using G*Power 3.1 (medium effect size= 0.3, power = .80, alpha = .05) indicated that 84 participants are required to conduct the correlation analysis (Cohen, 1992; Faul et al., 2007). To obtain a small effect size (0.1), a sample of 782 participants would be required. For the regression analysis, as in Hypothesis 1, 55 and 395 participants would be needed, for a medium and small effect size, respectively.

For Hypothesis 3 and 4, multiple hierarchical regressions were run with covariates added in the first step, and coping flexibility, emotion regulation flexibility, PTSS, and trauma characteristics added in the second step as predictors for alcohol and substance use. Power analysis (medium effect size of $f^2 = 0.15$, power = .80, alpha = .05) indicated that 98 participants are required for this hypothesis. For a small effect size ($f^2 = 0.02$), 688 participants would be required.

For Hypothesis 5, independent-samples T-tests were conducted to examine differences in PTSS, trauma characteristics, coping flexibility, and emotion regulation flexibility among individuals with monosubstance use and those with polysubstance use. Power analysis (medium effect size of $f^2 = 0.50$, power = .80, alpha = .05) indicates that 128 participants are required for this hypothesis, with 64 participants in each group. For a small effect size (0.20), 788 total participants would be needed, with 394 individuals in each group.

In Hypothesis 6, the PROCESS macro for SPSS was utilized to investigate the mediational functions of coping and emotion regulation flexibility in the relationship between PTSS and problematic alcohol use/problematic substance use, with trauma characteristics serving as potential moderators in the relationship between PTSS and self-regulation flexibility. The PROCESS macro tests for mediation by computing the indirect path following the *ab* product term approach and the bias-corrected confidence intervals using a bootstrapping procedure. Power analysis (medium effect size of $f^2 = 0.15$, power = .80, alpha = .05) indicates that 98 participants are required for this hypothesis. For a small effect size ($f^2 = 0.02$), 688 participants would be required.

Results

Descriptive Analyses

Among the 406 participants who successfully completed the survey with respect to inclusion and exclusion criteria, 359 were found to be exposed to a criterion-A trauma and were used for analysis. Of the 359 participants, 189 participants were from SONA, and the remaining 170 were from MTurk. Table 1 contains demographic data for all participants, as well as from each data source.

Table 1

Demographic Characteristics for SONA (n=189) and MTurk (n=170) Participants

Characteristic	Total Sample N (%)	SONA N (%)	MTurk N (%)
Age M (SD)	29.98 (10.16)	25.11 (7.53)	35.39 (9.97)
Female Sex	232 (64.6%)	162 (85.7%)	70 (41.2%)
Race			
White, Non-Hispanic	232 (64.6%)	124 (65.6%)	108 (63.5%)
Black	74 (20.6%)	41 (21.7%)	33 (19.4%)
Asian or Pacific Islander	22 (6.1%)	6 (3.2%)	16 (9.4%)
Other	31 (8.6%)	18 (9.5%)	13 (7.6%)

Highest Education			
High School/Some College	185 (51.5%)	161 (85.2%)	24 (14.1%)
College	101 (28.1%)	23 (12.2)	78 (45.9%)
Some Graduate School or greater	73 (20.3%)	5 (2.7%)	68 (40%)

Analyses of group differences between participants recruited through SONA and MTurk demonstrated a number of significant differences (refer to Table 1). SONA participants were younger ($M = 25.11$, $SD = 7.53$) than MTurk participants ($M = 35.39$, $SD = 9.97$) and this difference was statistically significant, $t(359) = 10.94$, $p < .001$. Participant sex was significantly different for the two data sources, $X^2(1, N = 359) = 77.66$, $p < .001$. 85.7% of SONA participants were female, while 41.2% of MTurk participants were female. Race of participant was also found to be significantly different between the two data sources, $X^2(6, N = 359) = 13.12$, $p = .041$. Education level was significantly different between the two sample sources, $X^2(4, N = 359) = 186.28$, $p < .001$. All participants completed high school, however 85.2% of SONA participants completed high school or some college, whereas 85.9% of MTurk participants completed college, some graduate school, or completed graduate school.

Table 2 contains data for clinical characteristics on all primary study variables and subscales for the total sample as well as by group. Due to differences in demographic variables for SONA and MTurk participants, differences in study variables were also examined. No significant differences were found for number of traumas experienced (trauma exposure; $p > .05$) or emotion regulation flexibility ($p > .05$). Compared to MTurk participants, SONA participants endorsed greater childhood trauma, $t(307) = -7.17$, $p < .001$, as well as sexual trauma, $t(350) = -9.37$, $p < .001$. PTSS were greater for MTurk participants compared to SONA participants, $t(357) = 5.38$, $p < .001$. Further,

MTurk participants reported greater alcohol problems, $t(224) = 8.23, p < .001$, as well as substance use problems, $t(304) = 6.86, p < .001$. Finally, MTurk participants reported slightly greater coping flexibility, $t(352) = 2.04, p = .042$.

Table 2

Clinical Characteristics for SONA (n=189) and MTurk (n=170) Participants

Characteristic	Total Sample	SONA	MTurk
	M (SD)	M (SD)	M (SD)
PTSS	34.11 (20.49)	28.79 (19.05)	40.02 (20.46)
Problematic Alcohol Use	7.48 (8.80)	4.05 (4.54)	11.29 (10.64)
Problematic Substance Use	1.86 (2.28)	1.12 (1.78)	2.69 (2.48)
Emotion Regulation Flexibility	7.72 (1.73)	7.59 (1.73)	7.86 (1.73)
Coping Flexibility	12.72 (4.83)	12.23 (5.29)	13.26 (4.20)
Trauma Characteristics			
Trauma Exposure	5.87 (3.82)	5.75 (3.16)	6.01 (4.44)
	N (%)	N (%)	N (%)
Sexual Trauma	145 (40.4%)	115 (60.8%)	30 (17.6%)
Childhood Trauma	245 (68.2%)	159 (84.1%)	86 (50.6%)

Some differences between the two data sources were expected; certainly, one reason for recruiting from two sources was to diversify the sample such that the results are more generalizable. As such, despite the differences in demographics and study variables, the samples were combined for analyses. Table 3 includes Pearson correlations among the study variables in the full sample.

Table 3

Bivariate Correlations Among Study Variables

Variable	1	2	3	4	5	6	7
1. PTSS	—						
2. Problematic Alcohol Use	.42***	—					
3. Problematic Substance Use	.41***	.54***	—				
4. Emotion Regulation	.22***	.14**	.12*	—			

Flexibility							
5. Coping Flexibility	.07	.08	.01	-.19***	—		
6. Trauma Exposure	.46***	.29***	.34***	.19***	-.15**	—	
7. Sexual Trauma	.09	-.01	-.03	.01	-.05	.39***	—
8. Childhood Trauma	.11*	.01	.05	.02	-.11*	.41***	.40***

Note. $N = 359$; * $p < .05$, ** $p < .01$, *** $p < .001$

With the sample combined, participant sex, age, and race were explored as potential covariates for inclusion in analyses. Bivariate correlations with these variables were carried out with primary study variables (PTSS, problematic alcohol use, problematic substance use, coping flexibility, and emotion regulation flexibility) and trauma characteristics (number of traumas experienced, presence of childhood trauma, and presence of sexual trauma). Male sex of participant appeared to have a significant relationship with problematic alcohol use and problematic substance use ($p < .001$ for both). Older age had a significant relationship with problematic alcohol use ($p < .001$), problematic substance use ($p = .001$), and emotion regulation flexibility ($p = .005$). Female sex and younger age were significantly associated with presence of childhood trauma and sexual trauma ($p < .001$ for all). Since the majority of participants identified as White (64.6%) or Black race (20.6%), significant differences in primary study variables were examined for White versus Black participants. Of note, no significant differences emerged in data based on these racial classifications ($p > .05$). Due to power limitations, differences among other racial categories were not examined. Participant sex and age were used as covariates in further analyses.

Relationship between PTSS and Self-Regulation Flexibility

For Hypothesis 1, in examining the relationship between PTSS and coping flexibility, covariates were not entered into the regression model as age and sex did not

have a relationship with PTSS or coping flexibility. The result of the regression indicated that the model was not significant, $B = .02$, $SE B = .01$, $F(1, 357) = 1.81$, $p > .05$.

In the hierarchical regression analysis examining the relationship between PTSS and emotion regulation flexibility, age was added into the first step of the model since it was found to be significant associated with emotion regulation flexibility. In the first step of the regression, older age was found to contribute significantly to the regression model and accounted for 2.2% of the variance in emotion regulation flexibility, $B = .03$, $SE B = .009$, $F(1, 357) = 8.08$, $p = .005$. When PTSS was added in the second step, PTSS was found to be significantly related to emotion regulation flexibility, $B = .02$, $SE B = .004$, $\beta = .21$, $t(356) = 4.05$, $p < .001$. Of note, both age and PTSS contributed significantly to the model and together explained 6.5% of the variance in emotion regulation flexibility, $F(2, 356) = 12.41$, $p < .001$.

Trauma Characteristics

In Hypothesis 2, first a bivariate correlation matrix (see Table 3 above) was examined to identify significant relationships between trauma characteristics (trauma exposure, presence of childhood trauma, presence of sexual trauma) and PTSS, problematic alcohol use, problematic substance use, and self-regulation flexibility. If a significant correlation was found, regression analyses were carried out to explore the relationships further.

Hypothesis 2a: Trauma exposure was found to be significant with all other study variables based on the correlation matrix, therefore regression analyses were conducted for these relationships, as displayed in Table 4 below.

Table 4

Regression Analysis for Trauma Exposure Predicting Variables

Dependent Variable	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>R</i> ²
PTSS	2.47	.25	.46	9.79***	.21
Problematic Alcohol Use	.66	.12	.29	5.65***	.08
Problematic Substance Use	.20	.03	.34	6.74***	.11
Coping Flexibility	-.18	.07	-.15	-2.77**	.02
Emotion Regulation Flexibility	.09	.02	.19	3.69***	.04

Note. $N = 359$; * $p < .05$, ** $p < .01$, *** $p < .001$

Hypothesis 2b: Sexual trauma was not found to have any relationships with the various other study variables, $p > .05$.

Hypothesis 2c: Childhood trauma had a significant relationship with PTSS, $B = 4.78$, $SE B = 2.31$, $\beta = .11$, $t(357) = 2.07$, $p = .039$. Childhood trauma was also significantly related to coping flexibility, $B = -1.12$, $SE B = .55$, $\beta = -.11$, $t(357) = -2.05$, $p = .041$. Childhood trauma was not found to have significant relationships with problematic alcohol use, problematic substance use, or emotion regulation flexibility.

Problematic Alcohol Use

In Hypothesis 3, a multiple hierarchical regression was run with self-regulation flexibility, PTSS, and trauma characteristics as predictors for problematic alcohol use. Age and sex were added as covariates in the first step of the model. In the first block, male sex and older age resulted in a significant model, $F(2, 256) = 11.45$, $p < .001$, $R^2 = .06$. In the second block, trauma characteristics, PTSS, and self-regulation flexibility variables were added. The model remained significant, $F(8, 350) = 14.71$, $p < .001$, $R^2 = .25$. However, as displayed in Table 5 below, only trauma exposure and PTSS, along with male sex and older age, were found to be significant predictors in the model. Of note, the various variables accounted for 25.2% of variance in problematic alcohol use.

Table 5*Hierarchical Regression Analysis for Variables Predicting Problematic Alcohol Use*

Variable	β	t	R^2	ΔR^2
Step 1			.06	
Sex	.19	3.57***		
Age	.12	2.35*		
Step 2			.25	.19
Sex	.18	3.55***		
Age	.10	1.99*		
PTSS	.33	6.10***		
Coping Flexibility	.09	1.85		
Emotion Regulation Flexibility	.05	1.00		
Trauma Exposure	.16	2.52*		
Childhood Trauma	-.01	-.26		
Sexual Trauma	-.03	-.45		

Note. $N = 359$; * $p < .05$, ** $p < .01$, *** $p < .001$

Problematic Substance Use

As in Hypothesis 3, a multiple hierarchical regression was run for Hypothesis 4 with self-regulation flexibility, PTSS, and trauma characteristics as predictors for problematic substance use. Age and sex were added as covariates in the first step of the model. In the first block, male sex and older age resulted in a significant model, $F(2, 256) = 11.79$, $p < .001$, $R^2 = .06$. In the second block, trauma characteristics, PTSS, and self-regulation flexibility variables were added. The model remained significant, $F(8, 350) = 14.94$, $p < .001$, $R^2 = .25$. However, as displayed in Table 6 below, only trauma exposure

and PTSS, along with male sex and older age, were found to be significant predictors in the model. Altogether, the various variables accounted for 25.3% of variance in problematic substance use.

Table 6

Hierarchical Regression Analysis for Variables Predicting Problematic Substance Use

Variable	β	t	R^2	ΔR^2
Step 1			.06	
Sex	.19	3.59***		
Age	.13	2.42*		
Step 2			.25	.19
Sex	.17	3.43***		
Age	.10	1.98*		
PTSS	.29	5.40***		
Coping Flexibility	.03	.56		
Emotion Regulation Flexibility	.02	.35		
Trauma Exposure	.23	3.77***		
Childhood Trauma	.01	.17		
Sexual Trauma	-.08	-1.44		

Note. $N = 359$; * $p < .05$, ** $p < .01$, *** $p < .001$

Differences in Participants with Mono- and Poly-Substance Use

Independent sample t-tests were conducted to examine differences in individuals with mono- and poly-substance use on trauma characteristics, self-regulation flexibility, and PTSS. To qualify as having polysubstance use, individuals had to endorse using two or more substances in the past year, including alcohol. Monosubstance use is defined as

using only one substance (including alcohol) in the past year. Use in past year included individuals who drank alcohol at least “monthly or less” and used substances at least “less than once a month.” Using this definition, 166 participants were categorized as mono-substance users, and 128 participants were categorized as poly-substance users. Table 7 contains the breakdown of substances used by mono- and polysubstance users.

Table 7

Substances Used by Mono- and Polysubstance Users

Substance	Monosubstance Use (n=166)	Polysubstance Use (n=128)
Alcohol	150	125
Cannabis	8	100
Cocaine	2	26
Amphetamine Type Substances	2	35
Inhalants	1	15
Sedatives	3	27
Hallucinogens	0	29
Opioids	0	11
Other	0	5

Hypothesis 5a: Poly-substance users had greater PTSS compared to mono-substance users, $t(292) = -3.56, p < .001$. Significant differences were not found for coping flexibility or emotion regulation flexibility among mono- and poly-substance users.

Hypothesis 5b: Results of the independent samples t-tests indicated that poly-substance users compared to mono-substance users reported greater total trauma exposure ($t(247) = -4.69, p < .001$), a greater presence of childhood traumas ($t(288) = -2.50, p = .013$), and a greater presence of sexual traumas ($t(266) = -2.98, p = .003$).

Of note, individuals with poly-substance use reported greater problematic alcohol use as well as greater problematic substance use ($p < .001$ for both). An exploratory

analysis including individuals ($n=65$) who did not endorse even “monthly or less” alcohol use or “less than once a month” substance use was conducted. Individuals with monosubstance use and this “no use” group did not show significant differences in PTSS, self-regulation flexibility, or trauma characteristics. Of note, individuals with monosubstance use, compared to those with “no use”, did report significantly greater problematic alcohol use ($p < .001$). Comparisons between the “no use” group and polysubstance group demonstrated similar results as when the mono- and poly-substance groups were compared.

Another exploratory analysis was conducted based on a different definition of mono- and poly-substance use. In this analysis, substance use in the past year was defined as drinking alcohol “2-4 times a month” or more, and using substances at least once a month. With this definition, 118 participants were labeled as mono-substance users, and 71 were poly-substance users. Results of independent sample t-tests indicated similar results as those above, with poly-substance users reporting more trauma exposure, childhood trauma, and PTSS ($p < .05$) compared to the mono-substance group. Presence of sexual trauma was not significantly different among poly- and monosubstance users ($p > .05$). As above, no group differences were found in self-regulation flexibility ($p > .05$).

Moderated Mediation Models

Hypothesis 6a: A mediation model was conducted to examine whether coping flexibility and emotion regulation flexibility emerge as unique mediators in the relationship between PTSS and alcohol use. Trauma exposure and childhood trauma were entered as moderators in the relationship between PTSS and self-regulation flexibility. Since sexual abuse was not found to be related to any of the study variables, it was not

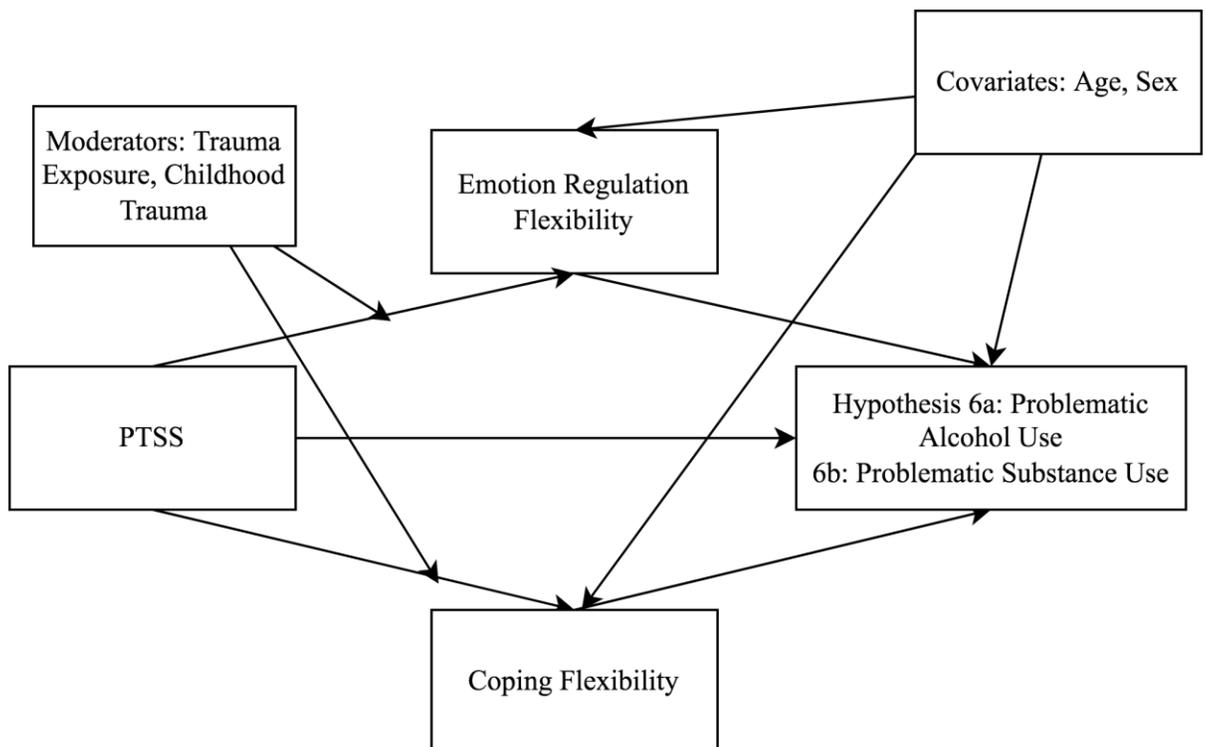
added as a separate moderator. Sex and age were added as covariates in the model. See Figure 1 for a figure of the hypothesized model. Together, PTSS, trauma exposure, the interaction between PTSS and trauma exposure, childhood trauma, the interaction between PTSS and childhood trauma, as well as age and sex accounted for a significant amount of variance in emotion regulation flexibility, $F(7,351) = 6.14, p < .001, R^2 = .11$. However, only older age ($b = .02, p = .006$), female sex ($b = -.39, p = .042$), and the interaction between PTSS and trauma exposure ($b = .003, p = .007$) were found to be significant predictors in this model. Of note, specifically a greater amount of trauma exposure and its interaction with PTSS was associated with emotion regulation flexibility. All the previously mentioned variables together also significantly accounted for variance in coping flexibility, $F(7,351) = 3.19, p = .003, R^2 = .06$. However, only PTSS emerged as a significant predictor for coping flexibility, ($b = .06, p = .011$). Finally, PTSS, emotion regulation flexibility, coping flexibility, sex, and age together significantly contributed to variance in problematic alcohol use, $F(5,353) = 21.89, p < .001, R^2 = .24$. PTSS ($b = .17, p < .001$), male sex ($b = 3.35, p < .001$), and older age ($b = .09, p = .039$) were the only unique predictors for problematic alcohol use. Neither emotion regulation flexibility nor coping flexibility was found to be significantly associated with problematic alcohol use. Overall, there was no evidence of mediation at any level of the moderators.

Hypothesis 6b: A second mediation model was run to examine whether coping flexibility and emotion regulation flexibility emerge as unique mediators in the relationship between PTSS and substance use. In this model, trauma exposure and childhood trauma were again entered as moderators, and age and sex were entered as

covariates. The results examining predictors for coping flexibility and emotion regulation flexibility are identical to the results above, given only the final variable was replaced (problematic substance use from problematic alcohol use) in the model. Similar to the results above, PTSS, emotion regulation flexibility, coping flexibility, sex, and age together significantly contributed to variance in problematic substance use, $F(5,353) = 19.78, p < .001, R^2 = .22$. However, again only PTSS ($b = .04, p < .001$), male sex ($b = .88, p < .001$), and older age ($b = .02, p = .038$) emerged as unique predictors for problematic substance use. Neither emotion regulation flexibility nor coping flexibility was found to be significantly associated with problematic substance use. Overall, there was no evidence of mediation at any level of the moderators.

Figure 1

Moderated Mediation Model



Discussion

There is a significant co-occurrence of PTSS and problematic alcohol/substance use, with about half of individuals with PTSD also having a SUD (Pietrzak et al., 2011). Despite this high comorbidity as well as the associated impairment across various domains, only few studies have explored pathways leading to the co-occurrence. One such pathway involves self-regulation, made up of coping and emotion regulation. In the present study, self-regulation flexibility, which captures the use of strategies across contexts, is explored as a factor associated with both PTSS and problematic substance use.

Relationship between PTSS and Self-Regulation Flexibility

Prior work has found inflexible coping in trauma-exposed individuals predicts worse outcomes, such that coping flexibility serves as a protective factor for PTSD following trauma (Galatzer-Levy et al., 2012; Park et al., 2015; Pinciotti et al., 2017). The current study did not find a significant relationship between coping flexibility and PTSS. Prior studies that found a significant association between coping flexibility and positive adjustment following trauma had a range of demographic characteristics, including various age and racial groups, as well as varying levels of PTSS. It is unlikely, therefore, that the demographic and clinical characteristics of the current sample contributed to the lack of significant findings. Notably, however, all the previous studies utilized a different coping flexibility scale, the Perceived Ability to Cope with Trauma (PACT) Scale, which specifically examines coping in the context of traumatic events (Bonanno et al., 2011; Boyraz et al., 2018; Galatzer-Levy et al., 2012; Park et al., 2015; Pinciotti et al., 2017; Rodin et al., 2017; Shigemoto & Robitschek, 2021). This is the first

study to our knowledge that utilized the Coping Flexibility Scale (CFS; Kato, 2012) in the context of trauma symptoms. The dual-process of coping flexibility in the CFS assesses the ability for individuals to identify that a coping strategy is not working, as well as the ability for the individuals to implement an alternative strategy (Kato, 2012). On the other hand, the PACT focuses on the perceived ability for individuals to move past the traumatic incident, as well as their ability to process the incident (Bonanno et al., 2011). Given the differences in the scales, it is not surprising that PTSS has previously been associated with the PACT since the scale focuses specifically on the trauma-specific aftermath. The use of the CFS in the current study is a more general measure of coping flexibility, and the lack of findings in the current study poses questions about the relationship between the CFS and the PACT. As such, more work is needed to examine the relationship of coping flexibility utilizing this scale with trauma and PTSS, as it is also important to examine individuals' ability to cope flexibly with distress and life stressors unrelated to the traumatic incident.

Previous research has also demonstrated that flexibility in choosing emotion regulation strategies may buffer against development PTSS following trauma (Levy-Gigi et al., 2016). In the present study, PTSS was significantly related to greater emotion regulation flexibility. One potential reason for this unexpected result may be the measure of emotion regulation that was used in the study. In particular, the study examined one aspect of emotion regulation flexibility, expressive flexibility, which measures one's ability to enhance or suppress emotions in various situations (Burton & Bonanno, 2016). It is possible that other facets of emotion regulation flexibility may be more instrumental in protecting against PTSS. Only one other study was found utilizing the FREE scale

used in the current study in the context of trauma symptoms, and this study did not find an association between emotion regulation flexibility and current or lifetime PTSS (Haim-Nachum & Levy-Gigi, 2021).

Furthermore, in a study conducted by Levy-Gigi et al. (2016), a performance-based paradigm was utilized to examine emotion regulatory choice flexibility, and the researchers found that high flexibility measured by the task served as a protective factor against PTSS. It is possible that a performance-based emotion regulation flexibility task may reduce bias in self-report measures of this construct. Various other studies have found such emotion regulation tasks related to psychological well-being, including lower PTSS (Bonanno et al., 2004; Fine et al., 2021; Gupta & Bonanno, 2011; Westphal et al., 2010). It is possible participants in the current study may have endorsed items to reflect how they would ideally suppress or enhance emotions in various situations, as opposed to what they truly do in such real-life situations. It is also possible that individuals with PTSS endorsed items in a more extreme fashion on the measure; it is possible expressive suppression was perceived as emotional numbing, and expressive enhancement perceived as a manifestation of physiological arousal. A performance-based task may be able to better gauge participants' real-life responses.

Results also found that older age of participant had a positive relationship with emotion regulation flexibility, despite a small body of research demonstrating that emotion regulation flexibility appears to stay stable throughout adulthood (Benson et al., 2019; Eldesouky & English, 2018). Again, the current study focuses on just one aspect of emotion regulation flexibility, expressive flexibility. It is therefore possible that as individuals mature past young adulthood, their expressive flexibility improves, such that

they are able to better suppress and enhance emotions in various situations compared to younger adults. However, more research is needed to support this result, especially with individuals across the lifespan.

Trauma Characteristics

Hypothesis 2 of the study examined relationships among various trauma characteristics—total trauma exposure, presence of childhood trauma, presence of sexual trauma—with PTSS, problematic alcohol and substance use, and self-regulation flexibility. In line with predictions, total trauma exposure was significantly related to various study variables. In particular, greater trauma exposure had a positive relationship with PTSS, in line with previous research (Briere et al., 2008; Park et al., 2015; Turner & Lloyd, 1995). Furthermore, total trauma exposure was related to problematic alcohol as well as substance use, in line with the large body of research finding associations between trauma exposure and problematic alcohol/substance use (e.g., Khoury et al., 2010).

This is the first study to examine the relationship between total trauma exposure and self-regulation flexibility. Notably, total trauma exposure was associated with less flexible coping, as predicted. This suggests that as individuals experience a greater number of trauma types, the resulting distress may interfere with their ability to appropriately cope. Future work is warranted to examine the longitudinal association of these variables to ascertain whether experiencing various trauma types may lead to less flexible coping over time. It may also be possible that less flexible coping makes individuals more at risk for experiencing greater traumas. The current study did also find a relationship between total trauma exposure and emotion regulation flexibility, but in the

opposite direction than what was predicted. Specifically, total trauma exposure was related to increased emotion regulation flexibility. Given that this is the only study examining the associations between these variables, future work is warranted to examine this relationship. As previously mentioned, the measure used in the study examines just one facet of emotion regulation flexibility, namely expressive flexibility. As such, it is possible that expressive flexibility has a unique positive relationship with trauma exposure, and other facets of emotion regulation may have a different relationship.

Contrary to predictions, sexual trauma was not found to be related to PTSS, problematic alcohol and substance use, and self-regulation flexibility. Despite 40.4% (N = 145) of the sample endorsing the presence of sexual trauma, it is possible that the study did not have sufficient power to detect significant relationships between the presence of sexual trauma and various study variables. This finding diverges from previous research. In particular, prior work has found that sexual trauma is associated with increased PTSS as well as problematic alcohol/substance use in various samples (Briere et al., 2008; Dworkin et al., 2021; Ouimette & Brown, 2003; Ullman et al., 2013). Of note, much of the previous research has examined individuals with a diagnosis of PTSD in the context of sexual trauma, while this study included all trauma-exposed participants, even those who may not meet criteria for PTSD. Although it is beyond the scope of the current study, it is possible that participants who endorsed a sexual trauma history may have experienced this traumatic incident in the distant past and subsequently recovered from more pronounced PTSS over time. It is also possible that individuals who experienced more recent sexual trauma did not endorse the item due to its sensitive nature. Results also suggest that presence of sexual trauma is not associated with self-regulation

flexibility. The current study appears to be the only one that has examined associations between sexual trauma and self-regulation flexibility, with prior work focusing exclusively on maladaptive and adaptive coping and emotion regulation strategies associated with sexual trauma. As such, more work is warranted to examine whether the current findings are supported.

Finally, Hypothesis 2 also examined the relationship between childhood trauma and various study variables. In line with predictions, childhood trauma had a significant relationship with PTSS. This finding is consistent with research demonstrating that individuals with a childhood trauma history having a more severe course of PTSD compared with individuals without childhood trauma (Bremner et al., 1996). Further, childhood trauma had a significant negative relationship with coping flexibility, such that the presence of childhood trauma was related to less flexible coping. This is the first study to examine these variables, and future work is warranted to examine whether experiencing trauma at a young age may interfere with the development of coping skills. Contrary to predictions and previous research, childhood trauma was not found to be associated with problematic alcohol or substance use. Further, childhood trauma also did not have a significant relationship with emotion regulation flexibility. A previous study found an association between childhood maltreatment and reduced expressive flexibility, the facet of emotion regulation that the current study examines (Pițur & Miu, 2020). In that study, an experimental task was utilized to measure expressive flexibility. Given the use of self-report in the current study, more work utilizing experimental tasks to examine regulation, including the various facets of regulation, is required.

Problematic Alcohol and Substance Use

In Hypothesis 3 and 4, trauma characteristics, PTSS, and self-regulation flexibility were proposed to have significant unique relationships in regression models predicting problematic alcohol and substance use. Only total trauma exposure and PTSS emerged as significant unique variables associated with problematic alcohol and substance use. This finding supports the large body of research demonstrating a strong relationship between PTSS and problematic alcohol/substance use (Clark et al., 1997; Mills et al., 2006; Norman et al., 2007). Contrary to expectations, presence of childhood trauma or sexual trauma did not appear to have a significant relationship with problematic alcohol/substance use. This finding was unexpected, since a large body of research with various samples has found strong relationships between childhood and sexual traumas and problematic alcohol/substance use (Bremner et al., 1993; Cross et al., 2015; Farrugia et al., 2011; Khoury et al., 2010; Lawson et al., 2013; Ouimette & Brown, 2003; Ullman et al., 2013). Childhood sexual trauma in particular is related to problematic alcohol/substance use, and it is possible that the present study may have found this relationship if there was sufficient power to investigate relationships between the specific types of childhood traumas endorsed and problematic alcohol/substance use.

Previous work has found that greater coping flexibility is associated with less negative alcohol outcomes, which was not supported in the current study (Borzyszkowska & Basińska, 2018; Boyraz et al., 2018; Roos, 2015). Of note, most previous studies demonstrating a significant relationship used different measures for coping flexibility. One study utilizing the CFS similarly did not find a relationship between marijuana use and coping flexibility, similar to the results of the current study (Kruczek, 2017). More work is warranted with the CFS and use of other substances in the

context of trauma to investigate whether distinct classes of substances have unique relationships with CFS. Emotion regulation flexibility was also not found to have significant relationships with problematic alcohol and substance use. Only a few previous studies have been conducted related to these variables, with one finding an unexpected result that greater emotion regulation flexibility is associated with greater use of illicit substances, and another finding generally non-significant or opposite results than predicted regarding emotion regulation flexibility and alcohol use (Jenzer, 2021; Yi, 2015). More work is needed in the context of emotion regulation flexibility and alcohol/substance use outcomes, including examining associations with distinct classes of substances. Further, given that this study did not focus specifically on SUDs, and instead examined problematic alcohol and substance use in a continuous fashion, it may be that alcohol/substance users who do not fully meet criteria for a SUD are able to flexibly utilize various coping and emotion regulation strategies rather than solely using substances as a primary strategy.

The current study also found that male sex and older age is associated with problematic alcohol/substance use. Previous research has also demonstrated males are more likely to drink alcohol, use substances, and develop SUDs (Becker & Hu, 2008; White et al., 2015). Regarding age, previous work has found that various factors are associated with substance use patterns across the lifespan, including onset of use, previous pattern of use (including during college), employment status, marital status, personality characteristics (Andrews & Westling, 2016; Arria et al., 2013, 2016; Kehinde et al., 2019; Merline et al., 2004). Of note, the majority of males in the study were MTurk participants, who were also older in age compared to SONA participants. Analyses of

group differences indeed found that MTurk participants have greater problematic alcohol/substance use compared to SONA participants. SONA participants are all currently enrolled in college. The undergraduate population at University of Missouri-St. Louis includes a non-traditional student body, with most students commuting to college rather than living in campus housing. As such, opportunities to drink alcohol and use substances may be less frequent compared to those at traditional college campuses. Given the unique college experience and age of participant being closer to the legal drinking age among SONA participants, it is not surprising that results suggested that SONA participants evidence less problematic alcohol/substance use patterns.

Differences in Participants with Mono- and Poly-Substance Use

Hypothesis 5 examined differences in participants who engage in mono- and polysubstance use on trauma characteristics, self-regulation flexibility, and PTSS. As predicted, individuals with polysubstance use compared to monosubstance use reported greater PTSS. This is in line with previous research finding that individuals misusing more than one substance experience greater PTSS, and an overall additive negative nature of polysubstance use in the context of trauma (Dworkin et al., 2018; Kearns et al., 2019). Extant research has found evidence for compounded symptoms and severity in individuals with PTSD and SUDs, including withdrawal symptoms mimicking PTSS and possibly encouraging substance users to continue using substances to relieve symptoms (Fareed et al., 2013; Parlato et al., 2010; Patel et al., 2017; Saladin et al., 1995). It is likely that polysubstance use heightens the interplay between PTSS and substance-related symptoms, resulting in greater PTSS.

Regarding differences among mono- and polysubstance users on trauma characteristics, results were also in line with predictions. Specifically, compared to monosubstance users, polysubstance users had greater total trauma exposure and were more likely to have a presence of childhood and sexual trauma. Extant research has found that polysubstance users, compared to monosubstance users, are associated with greater rates of childhood trauma (Martinotti et al., 2009). Research has also found associations between sexual trauma and greater use of substances (Ouimette & Brown, 2003; Ullman et al., 2013). Overall, research has demonstrated that individuals who both drink and use other substances, as opposed to either alone, have more complex trauma histories and greater PTSD severity (Kearns et al., 2019; Mills et al., 2006; Ruglass et al., 2016; Salgado et al., 2007; Ullman et al., 2013).

The present study is the first to examine differences in self-regulation flexibility in mono- and polysubstance users. Counter to predictions, results did not show a difference in self-regulation flexibility among mono- and polysubstance users. Notably, even when analyses focused on greater frequency of use of alcohol and substances, there was still not a significant finding with respect to self-regulation flexibility. Future work is warranted to study this phenomenon using other measures of self-regulation flexibility, including performance-based regulation tasks. It is also worth examining whether distinct classes of substance have unique associations with self-regulation flexibility.

Moderated Mediation Models

In Hypothesis 6 of the study, a moderated mediation model was run to examine self-regulation flexibility as a mediator in the relationship between PTSS and alcohol/substance use, with childhood trauma and total trauma exposure added as

moderators. The separate models run for problematic alcohol use and problematic substance use yielded similar results. In the first leg of the model, it was found that older age and female sex contributed to greater emotion regulation flexibility. The interaction between PTSS and total trauma exposure also emerged as a significant predictor for emotion regulation flexibility. Specifically, it was found that greater PTSS and total trauma exposure resulted in higher levels of emotion regulation flexibility. At low levels of total trauma exposure, PTSS level did not result in a significant change in emotion regulation flexibility. In other words, individuals who experienced greater PTSS in the context of greater total trauma exposure reported higher levels of emotion regulation flexibility than individuals with lower total trauma exposure. This result was opposite of predictions that greater PTSS and total trauma exposure would result in lower emotion regulation flexibility. Further, presence of childhood trauma did not have a significant contribution to the model. With respect to coping flexibility, only PTSS emerged as a significant predictor. It was unexpected that greater PTSS was associated with greater coping flexibility in the model, especially since no direct relationship was found between these variables in Hypothesis 1. Given that this is the first study to examine these variables in a moderation model, more work is warranted to add to the literature. In particular, measuring various other facets of emotion regulation flexibility and using performance-based tasks of the construct may shed more light on the relationship between trauma and emotion regulation flexibility in the context of trauma exposure.

Despite predictions that emotion regulation flexibility and coping flexibility would emerge as unique mediators in the models, it was not surprising that this result was not detected since previous hypotheses did not find relationships between these self-

regulation measures and problematic alcohol/substance use. In predicting both problematic alcohol and substance use, results indicated that older age, male sex, and greater PTSS emerged as unique predictors, in line with the study's previous findings.

Limitations and Future Directions

A number of limitations exist in the current study. Despite serving to improve the diversity and overall generalizability of the study, two sources of data may have contributed to some of the study's lack of significant findings. The majority of males in the study were MTurk participants. Further, MTurk participants were older than SONA participants. This difference in the two data sources makes it difficult to generalize the data to college-attending males and college-completed females. The samples also varied significantly in study variables, affecting internal validity and making it difficult to pinpoint the specific variables in each sample that may have contributed to results. In addition, the current study used a sample of convenience. Self-selection to complete a study investigating trauma and related concerns may limit generalizability of findings. Future studies may benefit from including participants from a single data source, especially since many of the relationships investigated in the current study have not been examined previously. It may therefore be helpful to prioritize internal validity in the study by using a more homogenous sample. Future work should also include a larger sample to increase statistical power.

Another limitation of the study was the self-report nature of all the measures, which may be prone to biases such as retrospective recall and social desirability. It is possible participants responded to self-regulation flexibility and substance use scales based on their values and ideals. Given the sensitive nature of traumatic experiences as

well as alcohol/substance use, participants may not have been fully forthcoming when responding to these items. A structured interview with a clinician would have been beneficial in measuring PTSS, as the clinician would also help the participant identify their index trauma. This would be especially useful since the majority of participants endorsed experiencing several traumas, making it difficult to know which of their traumas is most associated with distress. Further, extant work on coping flexibility within trauma-exposed samples utilized the PACT, whereas this study utilized the CFS. A future direction may be to examine how a more general measure of coping flexibility, measured with the CFS, may be related to trauma-focused coping flexibility, measured using the PACT. This information would be helpful in identifying whether coping flexibility with respect to trauma processing is associated with an individual's ability to cope flexibility with day-to-day stressors.

Further, a majority of studies that found significant results for emotion regulation flexibility utilized a performance-based measure, and another good option would be to utilize ecological momentary assessments to examine regulatory processes in real-time. The use of the FREE scale in the current study may have led to a less accurate picture of emotion regulation flexibility. Of note, the FREE focuses on just one facet of emotion regulation flexibility, namely expressive flexibility. Future work is needed to see how expressive flexibility may be related to other facets of emotion regulation in the context of trauma and alcohol/substance use. Overall, it appears as though more psychometric work clarifying the context of emotion regulation flexibility is warranted, given the several findings of this study that were opposite from predictions. Indeed, this newer

construct is an area with a growing body of theoretical and empirical work (Aldao et al., 2015; Burton & Bonanno, 2016).

Another limitation of the study is that it was cross-sectional in nature. This prevented any conclusions regarding causality. Longitudinal work is needed to examine whether experiencing trauma interferes with an individual's ability to self-regulate flexibly, and whether this then leads to problematic alcohol/substance use. Longitudinal work can also identify the trauma sequelae associated with various trauma types. Identifying how self-regulation flexibility is related to PTSS and problematic alcohol/substance use can also clarify theoretical models underpinning the comorbidity between PTSD and SUDs.

Due to statistical power limitation, the current study was not able to examine how various classes of substances may be associated with the other study variables. Future work examining the unique relationship for each class of substances is especially warranted given that previous work has found that different substances, as well as combinations of specific substances, are associated with different clusters of PTSD. It would be interesting to know how specific substances are associated with self-regulation flexibility, and this information can help clinicians to identify treatment goals.

The study sought to examine the role of self-regulation flexibility in the relationship between PTSS and problematic alcohol/substance use, but many other potential mediational and moderating factors exist in the relationship that are beyond the scope of the study. Examining individuals who are trauma-exposed certainly may give some clues as to the processes involved between PTSD and SUDs, but future work may

benefit from examining participants who meet criteria for both conditions for better clarity in results and conclusions.

Conclusion

The current study adds to the robust body of literature demonstrating that experiencing a trauma and subsequent PTSS is associated with problematic alcohol/substance use, with greater total trauma exposure and a presence of childhood trauma relating to greater PTSS. Individuals engaging in poly-substance use compared to individuals with mono-substance use were more likely to experience greater PTSS and a higher number of traumas, including childhood and sexual traumas. The study also found some unexpected results, including that PTSS is associated with greater emotion regulation flexibility, and is unrelated to coping flexibility. However, total trauma exposure and childhood trauma were found to be associated with lower levels of coping flexibility, which raises the question of whether these trauma characteristics interfere with an individual's ability to develop adaptive coping skills. Despite the study not finding support for self-regulation flexibility as a mediator in the relationship between PTSS and problematic alcohol/substance use, the study supports continued exploration into self-regulation flexibility as well as the associations of these variables with demographic factors, as the clinical implications would be considerable for treating comorbid PTSD and SUDs.

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