THE INFLUENCE OF MALADAPTIVE METACOGNITIONS IN EDUCATION: RETHINKING PRONESS TOWARD ADDICTION

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Treva Etsitty

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The following faculty members have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirement for the Doctor of Education with a major in Educational Psychology and Leadership.

Jason Herron, Committee Chair

Jody Fiorini, Committee Member

Marlene Schommer-Aikins, Committee Member

Phillip Mullins, Committee Member

Jaehwan Byun, Committee Member

Accepted for the College of Applied Studies

Clay Stoldt, Interim Dean

Accepted for the Graduate School

Coleen Pugh, Dean

ABSTRACT

Metacognition plays a role in motivation, executive function, declarative and procedural knowledge, and has been found to develop as early as three years of age (Marulis & Nelson, 2021). Metacognition is "thinking about thinking" (Flavell, 1992), operates across ordered levels of concepts (Seow et al., 2021), and is the knowledge and cognitive process that involves the appraisal, control, and monitoring of thinking (Flavell, 1979). Dysregulation of metacognition has the potential to develop into maladaptive coping rather than healthy self-regulation skills (Wells & Matthews, 1996), which in turn, can develop into mental illness or addiction (Chen, et al., 2021). Maladaptive metacognitions have been implicated in the learning of associations between stimuli, modification of behavior through motivation, and performance of an action to obtain a reward (Liljeholm & O'Doherty, 2012). To what extent pornography exposure and use that began in adolescence interfere with metacognitions in the adult population is lacking in research, therefore, this study aimed to identify associations between pornography use and maladaptive metacognitions in a sample of adults who actively used, or were attempting to quit, using pornography. A survey was created and posted in several Facebook groups, on twitter, and sent through messages. It was also posted on sites dedicated to those who are attempting to quit using pornography. A total of 3301 responses were recorded, however, only 877 were used for the purpose of this study, the rest were omitted due to being incomplete. Results confirmed that pornography use was a predictor of maladaptive metacognitions.

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CHAPTER 1

INTRODUCTION

Metacognition plays a role in motivation, executive function, declarative and procedural knowledge, and has been found to develop as early as three years of age (Marulis & Nelson, 2021). Metacognition, in essence, is “thinking about thinking” (Flavell, 1992) and operates across ordered levels of concepts which include the ability to make decisions based on isolated events (local confidence) and how one perceives their abilities and skills (global beliefs) (Seow et al., 2021). Metacognition refers to knowledge and cognitive processes involving the appraisal, control, or monitoring of thinking (Flavell, 1979), and it is through the cognitive process of metacognition that an individual develops concepts such as knowledge of others, of different tasks that require cognitive thought, and of possible strategies to navigate and/or cope through different tasks (Flavell, 2000). Metacognition can also play an important role in student academic success through practice self-regulation learning strategies and environmental nurturing of the integration of new knowledge with existing knowledge (Ohtani & Hisasaka, 2018). Healthy development of the ability to reason with one's own judgments of knowledge is a crucial component for effective navigation through life. Dysregulation of the development of metacognitive beliefs has the potential to develop into maladaptive strategies that further develop into maladaptive coping mechanisms (Wells & Matthews, 1996), which can later develop into mental illness or dysfunction (Chen, et al., 2021).

Development of self-regulation is generally a normal process that occurs during early childhood and extends through the lifespan. The maturity of the brain, social factors, and coping

mechanisms play a role in how self-regulation skills are practiced in the adolescent brain (Andrews, et al., 2018). The ability to plan, monitor, comprehend, reflect, and perform tasks in educational settings require aspects of self-regulation, a form of metacognition (Cromley & Kunze, 2020), therefore it is suggested that teaching strategies that enhance this ability are of importance given how metacognitive skills appear to predict academic performance (Ohtani & Hisasaka, 2018). Moreover, expression of creativity and experimenting with knowledge has been proven beneficial for developing information about creative metacognitive strengths and limitations (Kaufman & Beghetto, 2013). Students who were taught cognitive strategies through instructional learning were shown to have higher cognitive skills than their peers (Apaydin & Hossary, 2017). Therefore, enhancing a student's awareness of their metacognitive abilities through the learning process allows the students to not only be conscious of self, but it also allows them to be involved in the learning situation, which in turn activates memories, previous knowledge, and abilities that are directly related to their metacognitive processes (Wagener, 2013).

The Self-Regulatory Executive Function Model

The Self-Regulatory Executive Function model (S-REF) is a model that explains self-regulation processing that is driven by self-beliefs (Wells & Matthews, 1994). It proposes that metacognitive beliefs that become dysfunctional activate pathways associated with maladaptive coping mechanisms that can perpetuate the cycle of psychological distress. This distress becomes persistent and strengthens when dysfunctional thinking patterns and coping mechanisms of emotional responses are activated. The features of this model are:

1. Unconscious or automatic thought processes that produce conscious intrusive thoughts that garner attention.

2. Capacity limited conscious processing meant to regulate and appraise the importance of the intrusive thoughts and subsequent actions.

3. Processing and response to the intrusive thoughts that is guided by stored knowledge from long-term memory and metacognitive beliefs.

Maladaptive coping such as rumination, thought suppression, avoidance, and substance use, are linked to dysfunctional metacognitive beliefs such as the worry about the need to control thoughts, worrying about planning for potential threats, the inability to control rumination of negative thoughts, and more (Spada & Roarty, 2015). Executive function plays an important role in self-regulation because working memory, flexible shifting of attention, inhibition, and purposeful regulation of behavior contribute to reasoning abilities (Blair, 2016) otherwise known as cognitive processes. Dysfunctional metacognitions disrupt the ability to self-regulate cognitive processes through metacognitive biases and beliefs, and the S-REF model serves as a distinction between those cognitive and metacognitive processes (Bright et al., 2018). The distinction being that unconscious metacognitive processes activate cognitive thoughts and emotional responses to the thoughts.

Metacognitive processing of external events relies on declarative beliefs and procedural beliefs. Declarative beliefs are what allow for thoughts regarding the appraisal of external events and procedural beliefs are actions towards the event, the extent of which are dependent upon the

significance of the event (Wells & Matthews, 1996). Through these beliefs, The S-REF model operates at three levels, the first of which consists of an operating process that is intrusive, stimulus-driven, and occurs outside of conscious awareness. Intrusions include feelings of anxiousness, pain, and other affective responses. The second level is the conscious, voluntary system of processing aimed at the maintenance of self-regulation which is in response to the intrusions that occur within the first level (Spada & Roarty, 2015). It is within this second level that implementation of self-regulated processing strategies are meant to help reduce the discrepancies between desired and current states of self-regulation with effective coping mechanisms. The third level refers to metacognitive knowledge, which is beliefs and information about the conscious system of processing that holds either positive or negative content such as worrying about thoughts, rumination, and worry about danger (Wells & Matthew, 1994).

For emotional disorders, the S-REF model proposes that metacognition plays a role in maladaptive self-regulation strategies that account for a deficit in processing external and internal events and is referred to as the Cognitive-Attentional Syndrome (CAS). “This syndrome consists of heightened self-focused attention, reduced efficiency of cognitive functioning, activation of self-beliefs and self-appraisal, attentional bias and capacity limitations” (Wells & Matthews, 1996, p. 883). The Cognitive Attentional Syndrome (CAS) is defined as a combination of unhelpful coping strategies activated by underlying maladaptive metacognitions, along with a combination of negative thinking processes. Unhelpful coping strategies include the inability to move away from self-focused thinking, continued worry and rumination, and thoughts of a perceived threat in the environment (Fisher & Wells, 2009). CAS asserts the inability to effectively self-regulate with healthy coping strategies in response to a trigger can prolong emotional distress. In other words, the importance of the event significantly impacts the

duration of negative emotions experienced leading up to and following the event, effectively activating pathways for maladaptive coping mechanisms, leading to rumination, worry, reduced cognitive functioning, and inability to regulate emotions. In those with impulse control disorders, a causal link was observed between reduced cognitive functioning and impulsiveness (Soutschek & Tobler, 2020) which could indicate the possibility for problematic responses to situations that cause distress due to the reduction of an individual's ability to monitor and control declarative and procedural beliefs.

The S-REF model also describes a set of metacognitive beliefs that include dysfunctional beliefs about the ability to control thoughts and beliefs about cognitive self-consciousness. Since metacognitive beliefs can influence knowledge and cognitive processes, they have been shown to also play a role in addictive behaviors, as seen in a systematic review of 38 studies that assessed the role of metacognitive beliefs and tendency towards alcohol use, gambling, problematic internet use, nicotine use, and gambling (Hamonnier & Varescon, 2018).

> The evidence tends to show that people who engage in addictive behaviors hold dysfunctional generic metacognitive beliefs, metacognitive beliefs about addiction-related thoughts, and metacognitive beliefs about craving. These metacognitive beliefs are more prevalent in clinical than control populations and predict addictive behaviour category membership, the severity of addictive behaviour and craving, as well as relapse (Hamonnier & Varescon, 2018, p. 60).

Dysfunctional metacognitive beliefs are those that can continue to reinforce addictive behavior by way of holding onto maladaptive beliefs through internal self-talk, rumination, and emotional responses regarding the addiction. These beliefs can vary in duration and intensity, which is

generally how prediction of the severity of the addiction and possibility of relapse is possible (Hamonnier & Varescon, 2018).

Mental Health and Addiction in Adolescence

Disruption in healthy development of metacognitive strategies and self-regulation that occurs in adolescence could potentially cause problems long-term. "Adolescence being defined as a transition phase towards autonomy and independence, is a natural time of learning and adjustment particularly in the setting of long-term goals and personal aspirations" (Jadhav & Boutrel, 2019). It could be argued that an adverse experience prior to full prefrontal development could interfere with adult trajectory and prefrontal cortex development, potentially exposing a vulnerability in thinking, subsequently creating a tendency towards an addiction (Jadhav & Boutrel, 2019). Disruption in healthy development of self-regulation skills can be seen among 8480 students in Taiwan, where the combination of internet addiction tendencies and poorer mental and physical health significantly impacted mental well-being (Yu & Chao, 2016). Working memory disfunction was found in a study of 30 juvenile participants who were considered addicted to pornography, also demonstrating diminished memory capabilities (Prawiroharjo, et al., 2019). Of 648 students, a relationship existed between internet pornography preference and internet addiction with classroom introversion exacerbating the risk towards both (Alexandraki, et al., 2018). Efrati, et al., (2021) found a relationship between impulsiveness, thought suppression, and dysregulated metacognitions in three behavioral disorders (internet gaming disorder, compulsive sexual behavior disorder, and problematic social network use) among 474 teenagers in Israel. The severity of internet gaming disorder and dysregulated metacognitive beliefs was associated with higher levels of impulsiveness and maladaptive

metacognitions, while lower monitoring of thinking processes were associated with the severity of compulsive sexual behavior disorder and impulsiveness (Efrati, et al., 2021). Uncontrolled metacognitive beliefs were also associated with the severity of problematic social networking usage and higher impulsiveness (Efrati, et al., 2021), and a relationship between maladaptive metacognitions and compulsive sexual behavior among 718 adolescent participants was also found (Efrati, et al., 2020). A relationship between internet pornography and alcohol consumption was found in a study with 610 adolescents, asserting that the inhibition effects of alcohol could lead to a tendency towards reenacting pornographic scenes (Morelli, et al., 2017). Parental bonding and care appeared to serve as a buffer for internet addiction as shown in 2,017 Greek high school student participants that were screened for internet addiction over a two-year period whereas parental overprotection appeared to be counterproductive to internet addiction prevention (Siomos, et al., 2012).

Dysfunctional Metacognitions

Metacognition is the ability to process thoughts and feelings and having this ability is important for developing self-awareness and critical thinking skills. When it comes to learning environments, metacognition helps individuals gain valuable insight into how their thought processes work and allows for improved ability to adapt to changes and integration of new information. The ability to monitor and reflect on one's thought processes have been linked to success in education (Cromley & Kunze, 2020; Wagener, 2013; Ohtani & Hisasaka, 2018; Apaydin & Hossary, 2017; Kaufman & Beghetto, 2013) and has also been shown to reduce impulsive decisions (Soutschek & Tobler, 2020). Recent research reflects how metacognition begins in children as young as age three and is directly related to motivation and executive functioning (Marulis & Nelson, 2021). As we have shifted toward more technology over the

years in educational classrooms, how screen time impacts the cognitive or metacognitive processing has raised concerns over long-term implications. “Overall increased screen time is associated with negative outcomes such as lowered self-esteem, increased incidence and severity of mental health issues and addictions, slowed learning and acquisition, and an increased risk of premature cognitive decline (Neophytou, et al., 2021, 724). This concern is further evidenced in another study that found excessive screen time was associated with lower communication abilities and lower problem-solving abilities in children (Rocha, et al., 2021).

Maladaptive metacognitions have been associated with depression (Chen et al., 2021) and anxiety (Knapp et al., 2021), and have been implicated as contributing factors in addictive behaviors (Bahramnejad et al., 2012, Hamonniere & Varescon, 2018; Spada & Roarty, 2015). Behavioral addictions are generally present with comorbid symptomatology as underlying conditions that work against recovery, such as anxiety and depression (Mansueto et al., 2016; Jauregui et al., 2016). Successful recovery from an addiction has been shown to have direct associations with metacognitive strategies since recovery relies on reflection of thoughts and implementation of tools needed to navigate effectively through withdrawals and triggers, (Spada & Roarty, 2015; Hamonnier & Varescon, 2018; Zhou et al., 2021) and to serve as a buffer against the cycle often associated with addiction. Teaching metacognitive strategies may even be useful in prevention of addiction (Bahramnejad et al., 2012; Ünal-Aydın et al., 2021).

Research Background

The aim of this study is to examine the relationship between pornography use and maladaptive metacognitions in a population of adults. Although previous studies have discussed aspects of pornography exposure and use in adolescence and components of executive function such as working memory were shown to be affected (Prawiroharjo, et al., 2019), little is known

about how maladaptive metacognitions are affected long term if pornography exposure or use begins in adolescence. It is therefore hypothesized that the absence of healthy self-regulation strategies created coping mechanisms that turned dysfunctional, which furthers maladaptive metacognitions, and these maladaptive metacognitions created a cycle of prolonged emotional distress.

Research Problem

The average age of exposure to pornography is 13, with introduction occurring in some as young as five years of age (American Psychological Association, 2017). A review of pornography related research by Owens, et al (2012) regarding exposure to internet pornography and adolescents, noted six relationships:

1. Exposure to sexually explicit material increased sexual thoughts and decreased cognitive attention towards other important things,

2. Exposure to violent genres of pornography made viewers 6 times more likely to be sexually aggressive than those who were not exposed,

3. Exposure to pornography increased the view that women were sexual objects,

4. There was a statistically significant relationship between pornography addiction recovery and aggressive behavior and/or delinquent behavior in school,

5. Exposure to aggressive genres of pornography also increased aggressive behaviors such as theft, manipulation of others, and rape, and

6. Exposure to internet pornography increased the likelihood of clinical depression and lowered the chance of bonding with a caregiver (Owens, et al., 2012).

A review by Kang, et al., (2020) states that it is possible to identify children who are addicted to pornography using EEG signals. “Our study shows that the porn addiction in children

will make them more impulsive and may affect their learning ability, poor decision making, memory problem, and emotion regulation" (Kang, et al., 2020, 11). Another study has shown that frequent usage of pornography can facilitate erroneous sexual beliefs, as well as preference to the screen over a partner in adolescence (Wright et al., 2019), which could be exacerbated due to hindrance of brain maturity and understanding of healthy coping mechanisms (Jadhav & Boutrel, 2019).

The purpose of this study was explore aspects of self-regulation and maladaptive metacognitions that may develop from long-term pornography use in the adult population. Since little is known about the long-term impacts of pornography exposure, this research aims to fill a gap while also providing insight as to why it may be difficult to abstain after exposure, especially if exposure occurs in adolescence.

Research Questions

For the present study, this research aims to explore if the variables associated with substance and behavioral addiction recovery techniques work in a similar way to those who use pornography excessively and those attempting to abstain from pornography use to further understand the role of maladaptive metacognitions. These variables include items such as exercise, meditation, and therapy. If exposure occurs in adolescence, it could be possible that in response to triggers, activation of the CAS occurred, and pornography use became a maladaptive coping mechanism due to inefficient self-regulation strategies. The research proposes the following questions:

1. Is there a relationship between excessive pornography use and maladaptive metacognitions?

2. Is there a relationship between excessive pornography use and variables associated with addiction recovery, such as exercise, meditation, and therapy?
3. Is there a relationship between variables associated with addiction recovery and maladaptive metacognitions?

CHAPTER 2

LITERATURE REVIEW

Craving is a critical component of addiction (Caselli & Spada, 2010). A maladaptive coping mechanism that continues the addiction cycle involved with craving is desire thinking. Desire thinking involves a voluntarily process in the engagement of mental elaboration of the desired substance and serves as a maladaptive way to manage cravings. This can be an effective strategy short-term, however, over time it paradoxically escalates craving due to the desired object that is craved and mentally elaborated on is not actually obtained (Caselli & Spada, 2010).

The Self-Regulatory Executive Function Model (S-REF) model that explains self-regulation processing that is driven by self-beliefs, describes desire thinking as a form of extended thinking and is a key component in the maintenance of CAS when it is in the context of addictive behaviors (Spada & Roarty, 2015). Caselli & Spada (2011) describes two types of desire thinking, the first of which is verbal perseveration, and the second being imaginal prefiguration. Verbal perseveration is an elaborate self-talk strategy that focuses on the need to obtain the desired object whereas imaginal prefiguration is the mental construction of the desired object (Caselli & Spada, 2011). The desired object becomes more compelling over time as the addict perceives the substance as the only possible relief from cravings, as evidenced in one study where craving was found to impair memory, metacognitive processing, and performance in participants who were craving caffeine (Palmer, et al., 2017).

Dysfunctions in metacognitive beliefs that are associated with stress, depression, and anxiety disrupt metacognitive processing (Chen, et al., 2021), which is often the case in behavioral and substance addiction and withdrawal. Since addictive behavior often presents with a comorbid diagnosis such as stress, anxiety, or depression, this can further pave the way for the manifestation of maladaptive metacognitions that keep the addict in the loop of addiction (Knapp et al., 2021; Amendola et al., 2020; Alexandraki et al., 2018; Efrati et al., 2020; Efrati et al., 2021). Although tendencies towards addiction are often thought to begin in adulthood, it can start as early as 12 to 13 years of age with some children being exposed even younger (National Institute on Drug Abuse, 2020). The adolescent brain could potentially be more susceptible to problems associated with addiction given how risk taking and sensation seeking are primary factors in typical adolescent development (Jadhav & Boutrel, 2019).

Two areas of the brain that are suspected to contribute to metacognitive processing are the lateral frontopolar cortex (Qiu et al., 2018), and anterior lateral prefrontal cortex (Miyamoto et al., 2021), both of which make up parts of the prefrontal cortex. In one study that induced disruption in metacognitive processing in the anterior lateral prefrontal cortex, it was shown that this disruption interfered with appropriate decision-making (Miyamoto et al., 2021). Another factor that can influence and disrupt metacognitive thought are maladaptive metacognitive beliefs associated with depression and anxiety (Chen et al., 2021), both of which can also be seen alongside addiction. Developing self-regulation skills and appropriate coping mechanisms in response to emotions plays a critical role in prefrontal cortex development.

The areas of the brain most suspected to contribute to addiction are the basal ganglia, the extended amygdala, and the prefrontal cortex (U.S. Office of the Surgeon General & United States Substance Abuse and Mental Health Services Administration, 2016). The basal ganglia is

responsible for the formation of addictions due to its role in controlling the rewarding experience associated with substance use. The extended amygdala is the part of the brain associated with the "fight or flight" response system which includes feelings such as stress and anxiety, both of which are also associated with substance use withdrawal. The prefrontal cortex is primarily associated with executive function, which also plays a role in exerting control over substance use (U.S. Office of the Surgeon General & United States Substance Abuse and Mental Health Services Administration, 2016).

Dysfunctional Metacognitions, Addiction, and Executive Function

Metacognition and executive function play a role in cognitive development, memory, and motivation (Marulis & Nelson, 2021). They have been linked to self-regulated learning strategies and integration of current knowledge (Ohtani & Hisasaka, 2018) and operate across ordered levels of concepts such as local confidence and global beliefs (Seow et al., 2021). Maladaptive metacognitions have been implicated in psychological disorders (Wells & Matthews, 1994), and are associated with depression (Chen et al., 2021) and anxiety (Knapp et al., 2021), as well as contributing factors in addictive behaviors (Bahramnejad et al., 2012, Hamonniere & Varescon, 2018; Spada & Roarty, 2015).

Processing information in the environment involves the use of the striatum, the area of the brain associated with cognition, mainly action planning, decision-making, motivation, reinforcement, and reward perception (Liljeholm & O'Doherty, 2012) and has been implicated in the learning of associations between stimuli, modifying behavior through motivation, and performance of an action to obtain a reward. The striatum is connected to the prefrontal cortex and this connection influences decision making through processes of executive function, which includes the ability to distinguish the difference between stimuli that is of importance and stimuli

that is not through midbrain signals to the prefrontal cortex, both of which produce dopamine. (Blair, 2016). Overstimulation of the prefrontal cortex with too many dopamine neurotransmitters causes a decrease in activity, which can in turn, inhibits reasoning ability (Blair, 2016). It is through this process of reasoning inhibition that can lead to compulsive or addictive behaviors, such as when people find themselves unable to control the use of a formerly harmless activity such as sex (or pornography), gambling, work, internet and chatroom usage, shopping, or exercising (Tao et al., 2010).

The nucleus accumbens is the main component of the striatum and plays a critical role in behavior modification through its activation of dopamine neurons evidenced in Pavlovian reward-circuit learning(Day & Carelli, 2007). This style of learning can work against an individual who lacks the ability to self-regulate, which can lead to behavioral addictions. “Thus, understanding reward-related Pavlovian learning could shed light on a variety of human activities, including drug taking, food seeking, social attachment, and sexual behavior” (Day & Carelli, 2007, p. 1). The facilitation of Pavlovian learning along with the inhibition of working memory was evidenced by participants addicted to pornography, who indicated cue-reactive responses when watching preferred sexual images while also showing increased activity in the ventral striatum, the area of the brain that places value on a rewarding stimulus (Brand et al, 2016). In other words, this type of cue-reactive learning could imply impairments of executive function including inhibition of reasoning and decreased working memory capabilities. These impairments were further evidenced during a test of working memory capabilities in participants with problematic sexual behavior who had better recall of pornographic pictures presented rather than task-relevant pictures when compared to healthy controls (Sinke et al., 2020). Moreover, similar inhibition in working memory occurred in another study when participants were

presented pictures that contained explicit imagery among those with problematic sexual behavior (Laier et al., 2013).

> A significant postulate of this commentary is that all addictions create, in addition to chemical changes in the brain, anatomical and pathological changes which result in various manifestations of cerebral dysfunction collectively labeled hypofrontal syndromes. In these syndromes, the underlying defect, reduced to its simplest description, is damage to the "braking system" of the brain (Hilton & Watts, 2011).

Addictive behaviors have been shown to be associated with the need to control thoughts as well as lack of cognitive confidence: "From the perspective of the metacognitive model of addictive behaviour, metacognitive beliefs contribute to the initiation and preservation of addictive behavior because they promote harmful thinking styles and dysfunctional coping strategies, which in turn increase the likelihood of engaging in addictive behaviour" (Hamonnier & Varescon, 2018, 60). Tendency towards addiction and maladaptive metacognitive beliefs was found in a study that administered the Short Version of the Metacognitive Questionnaire (MCQ-30) to 200 first year male university students: "The results of the study indicated that metacognition is perhaps the most important mediator of psychoactive drug use in those looking for treatment" (Bahramnejad, et al., 2012, 69). Negative cognitive experiences, otherwise known as metacognitive consequences (stress, anxiety, depression), were shown to be highly associated with substance use (Toneatto, 1999), while maladaptive metacognitions have also been associated with distressing and out of control sexual thoughts, feelings, and behaviors (Thomas, et al., 2020). Maladaptive metacognitions about desire thinking have also been shown in relation

to cravings for pornography in participants with problematic pornography usage (Allen, et al., 2017). To further substantiate the relationship between metacognitive beliefs and addiction, evidence for metacognitive therapy as a therapeutic intervention for maladaptive metacognitions has shown success in treating addictions (Spada & Roarty, 2015).

Brain model of addiction

The brain disease model of addiction (BDMA) is the current model used to explain how addiction impacts the individual's brain (Basu, 2020). However, this model may have inadvertently added more stigma to those in recovery, as Sussman (2021) stated: "..terms ascribed to persons in recovery now include being weak-willed, immoral (willful misconduct), and sick" (Sussman, 2021, 186). Lang and Rosenberg (2017) in a survey of 612 participants found that when it comes to addiction, the public seems unwilling to affiliate themselves with someone they know that suffers from alcohol, heroin, gambling, marijuana, or pornography addiction.. "A large nationwide sample of the lay public was less willing to affiliate with those described as having an alcohol, heroin, or gambling addiction than those with a marijuana or pornography addiction. Furthermore, women were less willing to affiliate with someone addicted to pornography than were men" (Lang & Rosenberg, 2017, 83). Similar results were found in the study by Lindsay, et al., (2020) with sexual addiction being one of the less understood addictions (Lindsay, et al., (2020).

The BDMA does not put much emphasis on how social factors can shape how addiction and recovery occurs, as evidenced by the work of Basu (2020) who traveled to five countries to see how social responses to addiction played a role in individual recovery. These social factors included narratives for isolation, pain, frustration, recovery, and hope, all of which play a role in

addiction and successful recovery, and all of which should be considered as essential social aspects of not just recovery, but also prevention (Basu, 2020). As discussed in a phenomenological study with 18 participants who had successfully achieved long-term recovery: "These findings suggest that the relationships most helpful for initiating abstinence involved recognition by a peer or a caring relationship with a service provider or sibling" (Pettersen, et al., 2019, 5). With excessive pornography use not being recognized as an addiction, resources for those who struggle with it may find it difficult to receive the adequate support needed to successfully abstain from use. Furthermore, a crucial element in maintaining long-term success in recovery is through positive relationships with others with whom the addict can connect to without fear of shame, guilt, or being stigmatized over their past (Pettersen, et al., 2019). Addressing addiction and recovery to integrate levels of understanding, experience, and control over their recovery could produce successful results (Wiers & Verschure, 2021) and help the individual learn metacognitive strategies that would be helpful for long-term success.

People in recovery were once viewed as weak-willed if they struggled with an addiction (Sussman, 2021). However, successfully quitting an addiction can be challenging if help is not available or difficult to access. Considering new evidence, it takes more than willpower alone to be successful in recovery (Snoek et al., 2016) as employment of various strategies in recovery is contingent on the knowledge one possesses regarding the effectiveness of those strategies or tools, one of which is abstaining from the triggers and effective navigation through withdrawals that are associated with the addiction. "Supporting this view, participants in recovery cite more strategies and are more enthusiastic about them than those who have not succeeded in controlling substance use" (Snoek et al., 2016, p. 106). Stigma being attached to people in recovery can make it difficult to abstain from triggers associated with the addiction (Sussman, 2021). Several

aspects of the stigma include blaming the individual for their shortcomings and inability to prevent the addiction from occurring in the first place, considering them dangerous, criminal, sinners, dirty, worthless, no job potential, hopeless, and living in denial (Sussman, 2021). Alleviation of the stigma would be helpful for individuals who suffer from addiction and/or struggle with recovery and part of this is through public education, activism efforts, peer recovery support services, and health communications literacy (Sussman, 2021).

The Neurobiology of Addiction

The average age of exposure to pornography is 13, with exposure occurring as young as five years of age (American Psychological Association, 2017). Exposure that occurs during adolescence could be a cause for concern (Wright et al., 2019). Understanding the neurological aspect of addiction in how it relates to interference with the striatum and NAc provides insight to the aspects of maladaptive metacognitions, especially if exposure occurs during a time when the brain is not fully developed because the human brain mechanisms are designed to provide reinforcements to make experiences related to survival rewarding (Hyman, 2006). However, these same mechanisms can become hijacked by certain drugs such as those with psychostimulant properties like cocaine and amphetamines (Hyman, 2006, Koob, 2010). Once hijacked, the brain mechanisms create reinforcements that further the behavior associated with consumption of a drug such as seeking, intake, and tolerance. Substance addiction is characterized by the individual's need to take the drugs, tolerance of the drug, loss of control over intake of the drug, followed by negative emotional states after the drug has worn off (Koob, 2010). Since humans learn cues in their environment, a form of Pavlovian learning (Day & Carelli, 2007), these cues can also motivate substance seeking behaviors (Hyman, 2006) and become driving forces that motivate the addict toward the substance, which eventually causes

structural changes in the brain. Structural changes such as motivation associated with drug administration, tolerance, and withdrawal are due to alterations in the natural reward system of the brain, otherwise known as the dopaminergic system (Koob, 2010). The dopaminergic system plays a role in cognitive flexibility and regulation of executive function and the alterations of the dopaminergic system are what influences the continuation of addictive behaviors by labeling cues associated with the addictive substance, along with consumption of the substance, as rewarding and reinforcing (Brewer, 2007).

The neurobiology of addiction that influences the dopaminergic systems has been shown to have the same structural changes in behavioral addictions as we would see in someone who suffers with substance addiction (Brewer & Potenza, 2007). Conditioned responses to cues that are drug-related can include stimuli that are external or interoceptive (Hyman, et al, 2006) meaning the cues don't have to be external to have an influence on behaviors and actions. These conditioned responses in the dopaminergic system that occur in behavioral addictions also cause a release of dopamine to produce feelings of pleasure when primed with cues in the environment or internal cues that are related to the behavioral addiction (Brewer, 2007). Dopamine is known for its role in motivation and absence of dopamine removes the motivation of obtaining a substance or behavior, therefore dopamine plays a powerful role in motivation to obtain the reward (Hyman, et al, 2006).

Molecular underpinnings in new research has shown that addiction pathways are induced due to several proteins in the brain, one of which is DeltaFosB (Nestler, 2008). DeltaFosB is part of the Fos family and is encoded by the fosB gene, which heterodimerizes with other family proteins known as Jun, to activate and bind to other sites in the brain (Nestler, 2008). The Fos family proteins that activate during certain behavioral or cellular situations show that after acute

consumption or administration of several drugs of abuse, they induce rapidly and transiently in specific brain regions (Nestler, 2008) one of which being the nucleus accumbens (NAc), which is critical for the reinforcement of rewarding behavior, including sexual rewards (Pitchers, et al., 2010). This leads to structural changes and alterations in the NAc, such as the formation of dendritic spines that persist long after the removal of the drug or behavior ceases (Hedges, et al., 2009). Although the Fos family proteins are unstable and return to basal levels within hours after drug administration, chronic administration of drugs creates biochemically modified isoforms of DeltaFosB after repeated exposure which persist some 6-8 weeks after the last intake (Nestler, 2008; Hedges, et al, 2009).

Molecular research has also asserted that the NAc also plays a role in mediating natural rewards, thus developing a relationship between natural rewards and the accumulation of DeltaFosB (Wallace, et al, 2008). In a study with experimental rats, it was indeed shown that DeltaFosB accumulates in the NAc for two types of natural rewards: sucrose and sex (Wallace, et al, 2008). “These increases were observed by Western blotting and immunohistochemistry; using both methods ensures that the observed protein product is indeed DeltaFosB and not full-length FosB, another product of the fosB gene” (Wallace, et al, 2008, 10276). Another study of experimental rats by Pitchers, et al., 2010 shows similar results, in that, accumulation of DeltaFosB is also caused by sexual experience and the accumulation occurs in several of the limbic-associated brain regions. “Specifically, reducing DeltaFosB-mediated transcription attenuated experience-induced facilitation of sexual motivation and performance, while overexpression of DeltaFosB in the NAc caused an enhanced facilitation of sexual behavior, in terms of increased sexual performance with less experience” (Pitchers, et al., 2010, 836). Hedges, et al., 2009 found similar results with female Syrian hamsters, adding that the

conditioned place of sexual activity causes dopamine to release in the NAc after repeated copulatory interactions with males (Hedges, et al, 2009). If the place of interaction with sexual experience becomes associated with dopamine release (Wallace, et al., 2008) this would imply that the setting also plays an important role in the rewarding behavior and motivation to perform the behavior associated with the reward. “It is reasonable to consider DeltaFosB as acting as a transcriptional nexus that is mediating both long-term modifications in behavior and the underlying neuronal plasticity consequent to the activation of the downstream targets of DeltaFosB” (Hedges, et al., 2009, 446). This has considerable impact on how an individual functions within their environment, and how motivation, seeking, thinking, urges, and desire thinking of natural rewards can impact and alter behavior. During the process of imaginal prefiguration in desire thinking, dopamine can be produced, which can then initiate verbal perseveration of the desired target, thus causing emotional distress until the desired target is obtained.

Tolerance to the drug or behavior of the addicted individual is also due to changes in the molecular structure of the brain (Love, 2015). As dopamine floods the reward system, molecular signals occur which lead to tolerance, such as activation of the CREB protein. CREB activates in the NAc in response to stimuli and regulates neural plasticity (Barrot, et al., 2002). Increased CREB activity in the brain’s reward pathway decreases the response to stimuli which in turn, creates tolerance. When an addict abstains from a substance or behavior CREB reduces quickly whereas DeltaFosB levels drop slowly over time, making DeltaFosB the primary component of addiction (Love, 2015, Nestler, 2001).

Cognitive Processing in Long-Term Addiction. The human brain contains more neurons than other species, and it is thought through the evolutionary process of human brain development, that this growth of additional neurons were responsible for new neural circuits and cognitive functioning that greatly contributed to cultural evolution (Muchnik, et al., 2019). This additional growth of neuronal functioning eventually gave rise to cognition in the way we know and understand it today. Cognitive processing of information relies heavily on executive function capabilities as well as metacognitive abilities, as mentioned above. Rapid shifting of attention from one task to another, or from one stimulus to another requires a substantial amount of effort and increases cognitive load. When cognitive load occurs, it decreases the ability to process information efficiently in the environment, thus, negatively impacting executive function. In those with psychological disorders, cognitive capacity is already compromised, as evidenced in a review of 200 peer-reviewed studies in patients with psychological disorders, where it was found that the majority reported reduced grey matter in crucial areas of the brain responsible for cognitive processes, which in turn, created disruptions in cognition (McTeague, et al., 2016).

Cognitive processing deficits in individuals with long-term addictions was evidenced in a study that assessed 23 patients who were admitted to a hospital for recovery treatment from substance addiction (Lopera, et al. 2019). These deficits include impairments in attention, focus, executive function, memory, and ability to learn and retain information (Rajeswaran & Bennett, 2018). Another process associated with the cycle of addiction that plays a role in maladaptive metacognitions, is that of affective processes. “Affective processes include physiological and subjective responses to addiction-related stimuli, reward sensitivity and reward anticipation, experiences of gratification, emotion (dys-) regulation, mood management, and stress sensitivity (Wegmann & Brand, 2021, 1-2). The role of affective processes shows that dysfunctional generic

metacognitive beliefs have an influence over metacognitive beliefs about thoughts related to addiction, and metacognitive beliefs about craving, and can also predict not only the severity of the addiction, but also cravings related to the addiction (Hamonniere & Varescon, 2018).

Triphasic Metacognitive Formulation of Addictive Behaviors

Understanding of the neurobiological underpinnings of addiction shows how addiction related cues can have considerable impact on how an individual is able to function within their environment. The cues that activate neural pathways impact how motivation, seeking, thinking, urges, and desire thinking of natural rewards can alter behavior by putting a strain on cognitive resources. This process can eventually create a system of coping mechanisms that work against the individual who is experiencing distress from the cycle of addiction.

Cognitive Attentional Syndrome (CAS) is a range of coping mechanisms that are argued to extend negative thinking and negative emotions in response to an external event, according to the S-REF model (Wells & Matthews, 1994). The external event in terms of addiction is associated with stimuli-related cues in the environment as well as internal cues based on triggers that occur during unconscious processing. As a result, these negative emotions and thoughts consist of the need to control worry, need to control thoughts, desire thinking, and rumination. During periods of psychological distress, metacognitive techniques serve to reduce worry through the introduction of healthier coping mechanisms in response to stimulus-driven intrusions (Spada & Roarty, 2015). For addictive behaviors, CAS and metacognitive beliefs are broken down into three phases, which are pre-engagement, engagement, and post-engagement (Spada, et al., 2014). The pre-engagement phase is associated with triggers, urges, memories, thoughts, and images which in turn, guide judgment toward coping mechanisms which then activate metacognitive beliefs associated with the appraisal of the addictive substance. This

activation of CAS leads to preservation of the intrusive thoughts which increase urges and cravings. During the engagement phase, positive metacognitive beliefs and thoughts associated with those beliefs are activated and changes how metacognitive processing is monitored, which in turn, reduces the ability to self-regulate behavior. In the post-engagement stage, withdrawal symptoms and self-blame activate positive metacognitive beliefs, which activates rumination, which in turn increases the likelihood of relapse or re-engagement in the substance (Spada & Roarty, 2015).

The triphasic metacognitive formulation of addictive behaviors proposes that aspects of the CAS such as attentional bias, extended thinking (e.g., desire thinking, rumination and worry), disruption in metacognitive monitoring and thought suppression should be associated with addictive behaviors and lead to maladaptive consequences including increased levels of craving and engagement. The formulation also proposes that metacognitive beliefs should be associated with aspects of the CAS and addictive behaviors. (Spada & Roarty, 2015, 12).

Attentional bias consists of automatic processing and implementation of strategies that can lead to dysfunctional coping styles. These coping styles are what appraises and determines the relevance of the stimuli, thus, allowing the implementation of metacognitive beliefs as a strategy for determining whether to engage in or disengage from thoughts associated with the stimuli. Extended processing of the stimuli such as rumination and worry, can lead to the continuation of desire thinking of the stimuli. Thought suppression, which is the attempt to suppress thoughts and urges associated with the stimuli, paradoxically causes further thinking of thoughts and urges. Disruptions in metacognitive monitoring create problems with attentional processing, thus, reducing cognitive processing. Metacognitive beliefs are both positive and negative in nature and are both related to maladaptive thinking patterns. Positive beliefs are

thoughts that allow for engagement in the substance whereas negative beliefs are related to the lack of executive control over the regulation of engaging in the addictive substance (Spada & Roarty, 2015)

Metacognition in Problematic Internet Usage. Problematic internet usage, internet addiction, and social media addiction are not currently recognized by the DSM-V as disorders. Regardless, there have been several studies that have found dysfunctional metacognitive beliefs after administering the MCQ-30 to participants who fell into one of the three categories, with one study noting a significant relationship between internet addiction and metacognition, as well as a relationship between general health and metacognition (Bidi, et al., 2012). Feeling unable to control thoughts when faced with a stressful event could incapacitate metacognitive processing, leading to an overestimation of environmental threat and underestimation of coping abilities. "The experience of emotional tension in persons with high scores of uncontrollability and risk involves them in using maladaptive coping strategies which would in turn cause the concepts of threatening in process more accessible and stress and negative excitement more intensified" (Bidi, et al., 2012, 54). In another study it is suggested that maladaptive metacognitive beliefs are associated with problematic social networking usage, asserting the possibility that problematic social networking usage exhibits similar symptoms of other addictions (tolerance, mood modification, relapse, withdrawal, etc.), further stating that individuals with problematic social networking usage scored higher on all subunits of the MCQ-30, with the exception of cognitive self-confidence, than that of the control participants (Balıkçı, et al., 2020). A relationship between depression and dysfunctional metacognitions in those with smartphone addiction in Chinese adolescents was found (Zhou, et al., 2021) as well as a relationship between dysfunctional metacognitions and social networking addiction among adolescence (Ünal-Aydın,

et al., 2021). Activation of the dopaminergic reward system and deactivation of executive functioning was found among participants addicted to Instagram (Nasser, et al., 2020) and maladaptive personality functioning was found in a sample of adolescent participants addicted to the internet, video games, and mobile phones (smartphones) (Amendola, et al., 2020).

Metacognition and Online Gambling Addiction. Gambling disorder is listed in the DSM-V as a behavioral disorder and is characterized as a persistent and recurrent problem related to gambling behavior that causes impairment or distress that reaches clinical significance (American Psychiatric Association, 2013). After administration of the MCQ-30, such impairments were found in the case of 69 pathological gamblers, where MM were present in participants with comorbid mental disorders (Mansueto, et al., 2016). Another study of 124 pathological gamblers found similar results (Jauregui, et al., 2016), with another suggesting that metacognitive biases played a role in pathological gambling while at the same time providing empirical support for metacognitive training to dispel these false beliefs (Moritz, et al., 2021).

Metacognition and Alcohol Use Disorder (AUD). AUD is listed in the DSM-V and is characterized as a brain disorder that involves chronic relapses, increased consumption over time, and inability to reduce or eliminate consumption regardless of negative consequences that occur with continued usage (American Psychiatric Association, 2013). According to S-REF theory, metacognitive beliefs serve as strategies for self-regulation that become counterproductive in psychological disorders, such as anxiety and depression (Wells & Matthews, 1996): In a study of 10 problem drinkers, it was found that if the participants had the initial goal of drinking to reduce or eliminate unwanted thoughts or emotions, they were unaware of whether their goal had been reached or not and continued to drink until they felt ill, which could indicate dysfunctional metacognitive beliefs in response to emotional changes (Spada &

Wells, 2006). Another study found a relationship between alcohol use and dysfunctional metacognitions in four of the five units of the MCQ-30 when administered to 97 participants as well as positive metacognitions in two of the five units for proneness to problem drinking (Spada & Wells, 2005) suggesting the presence of maladaptive metacognitive processing in relation to alcohol consumption.

Recovery tools used in treatment programs

Meditation as a tool in recovery does appear to offer some promising results in decreasing maladaptive metacognitions. One finding that emerged from a meta-analysis was that spiritual meditation significantly reduced addiction related consequences and appeared to have an impact on the discontinuation of drug intake among participants (Kadri, et al., 2020). Mindfulness meditation appeared to contribute to the reduction of stress and other factors that stem from maladaptive coping skills that, if left unmanaged in recovery, would allow the individual who is recovering unable to deter themselves from a relapse (Witkiewitz & Bowen, 2010). One of the factors of mindfulness meditation is its use of metacognitive techniques. “In vipassana meditation, mindfulness regulates attention in such a way that attention is directed to monitor the ever-changing experiences from moment to moment so that the practitioner attains the ‘metacognitive insight’ into the nature of things” (Kuan, 2012, 35). It is suggested that if a client in recovery is open to meditation, that meditation techniques should be taught in counseling, so the individual has another tool for recovery to utilize outside of therapy (Pruett, et al., 2007). This method of teaching client’s meditation was performed in a study of 72 cocaine-dependent participants, and the integration of meditation and acupuncture suggests that meditation may help improve attention, prevent relapse, and reduce tension because participants were able to utilize these tools at home (Chen, et al., 2013). This was also demonstrated in

another study where participants were given tools to take home to practice meditation: “The mindfulness practices employed in the course were designed to help clients increase awareness of and change the relation to challenging situations, including negative emotional states, without “automatically” or habitually reacting” (Witkiewitz & Bowen, 2010, 369). This demonstrates an increase in metacognitive functioning as individuals in recovery can redirect thoughts away from compulsive habits, thus remaining abstinent from substances.

Exercise, Recovery, and Metacognition. We all understand the benefits that exercise can provide for overall physical health and well-being. Regardless, some people have trouble finding the time or motivation for it despite evidence that supports the benefits of exercise on cognition and metacognition (Stern, et al., 2019; Raichlen & Alexander, 2017).

Participants who were recovering from methamphetamine addiction that participated in an exercise and cognition program for a duration of 3 months found that negative mood states associated with withdrawal and cravings were reduced (Lu, et al., 2021) and in a completed 8-week trial of an exercise program there was a reduction in depression symptoms among methamphetamine users in recovery (Haglund, et al., 2014). A study with Sprague-Dawley rats who were introduced to chronic exercise on a treadmill over an 8-week period suggests that exercise may serve as a prevention from addiction (Fontes-Ribeiro, et al., 2001).

CHAPTER 3

METHODOLOGY

The purpose of this study is to examine the relationship between maladaptive metacognitions and excessive pornography use in the adult population. It is hypothesized that results will be comparable to previous studies examining maladaptive metacognitions in

problematic internet use (Balıkçı, et al., 2020, Bidi, et al., 2012, Nasser, et al., 2020, Ünal-Aydın, et al., 2021, Zhou, et al., 2021), alcohol use disorder (Spada & Wells, 2006), and online gambling disorder (Mansueto, et al., 2016, Moritz, et al., 2021, Jauregui, et al., 2016). Therefore, this research proposes the following questions:

1. The first question states that there will be a relationship between excessive pornography use and maladaptive metacognitions. The relationship will show that as pornography use increases, maladaptive metacognitions will also increase.
2. The second question states that there will be a significant relationship between pornography use and activities associated with substance abuse recovery programs. It is also assumed that pornography use contains an emotional component, which will be evidenced by the responses in the Triggers section in Recovery Elements. More specifically, as pornography use increases, emotional struggles will also increase while items such as meditation and exercise, which serve to increase metacognitive abilities, will decrease
3. The third question states that there will be a relationship between emotional struggles, and tools used in substance addiction recovery groups, with dysfunctional metacognitions. It is assumed that as emotional struggles increase, maladaptive metacognitions will also increase which continues the cycle of addiction. It is also assumed that tools used in substance addiction recovery programs will serve to decrease maladaptive metacognitions.

Participants

The Internal Review Board (IRB) at Wichita State University reviewed and approved the survey to be administered on January 7th, 2020. Participants had to be at least 18 years of age or older to participate in the survey. The assessments, along with demographic information questions, were compiled onto one survey on Qualtrics and distributed via anonymous link. No personal information was collected, and respondents were able to remain anonymous. The survey was posted on various social media pages such as Twitter, Facebook, and Reddit, as well as sent via Facebook Messenger to help initiate the snowball sampling effect. It was also posted in several Facebook groups for the same reason.

A research proposal was sent to the NoFap (2011) website for permission to post the survey link to members of that community on January 9th, 2022, to sample the very population we were seeking. Permission was granted to sample from both the NoFap (2011) website, as well as the subreddit of NoFap on January 19th, 2022. An anonymous account was made in both places, and the survey was posted in various forums on the NoFap (2011) website as well as the subreddit forum of NoFap. Considering the participation rates greatly increased after posting the surveys on NoFap (2011) and the subreddit of NoFap, it has led the researchers to believe most participants came from one of these sites.

Over 3000 participants responded to the questionnaire. However, 2423 participants had to be excluded from the analysis due to incomplete data leaving a sample of 877 participants. Participants (n=877) provided consent to participate and were 18 years of age or older. Participants self-reported on the assessment that contained demographics, pornography use history, the BPS, MCQ-30, MDTQ, and Recovery Elements.

Demographics

Data collected included gender (table 1), age (table 2), relationship status (table 3), education level (table 4), whether they were seeing a mental health professional (table 5), or if they felt they needed to see a mental health professional (table 6), and religious affiliation (see table 7).

As shown in Table 1, the primary gender of participants were male.

TABLE 1

PARTICIPANT GENDER

GENDER	NUMBER
Male	849
Female	18
Nonbinary	5
Transgender	2
Prefer not to say	3
Total	877

As shown in Table 2, the most common age group of participants was 20-24.

TABLE 2

PARTICIPANT AGE GROUPS

AGE	NUMBER
18-19	200
20-24	357
25-29	185
30-39	106
40-49	13
50-59	12
60+	4
Total	877

As shown in Table 3, the most common relationship status selected was single.

TABLE 3

RELATIONSHIP STATUS

RELATIONSHIP STATUS		NUMBER
Valid	Single	617
	Dating but not committed	37
	Committed relationship	162
	Married	54
	Other	5
	Total	875
Missing	System	2
Total		877

As shown in Table 4, there is some variation in education.

TABLE 4

HIGHEST EDUCATIONAL DEGREE OBTAINED

EDUCATION	NUMBER
Some high school	61
High school graduate	178
Some college	237
Associate degree	35
Bachelor's degree	261
Master's degree	73
Doctorate degree	9
College certificate	13
Medical professional	10
Total	877

As shown in Table 5, most participants are not currently seeing a professional.

TABLE 5

PARTICIPANTS SEEING A PROFESSIONAL

CONDITION		NUMBER
	Anxiety	16
	Depression	7
	ADHD	13
	Autism	4
	Bi-Polar Disorder	1
	Addiction/Compulsion	7
	Something not Listed	18
	I am not seeing a professional	682
	Total	748
Missing	System	129
Total		877

As shown in Table 6, most participants did not feel as though they needed to see a professional.

TABLE 6

PARTICIPANTS WHO FEEL THEY NEED TO SEE A PROFESSIONAL

CONDITION		NUMBER
	Anxiety	45
	Depression	25
	ADHD	22
	Autism	6
	Bi-Polar Disorder	1

	TABLE 6 (continued)	79
	Addiction/Compulsion	
	Something not Listed	31
	I am not seeing a professional	337
	Total	546
Missing	System	331
Total		877

As shown in Table 7, there is much variation within the participants' religious and/or spiritual views.

TABLE 7

RELIGIOUS/SPIRITUAL VIEWS

VIEWS	NUMBER
I don't have a religion/I am not spiritual	211
I believe in something, but I don't follow a particular religion or spiritual practice	208
I practice a religion, but I am not heavily involved (Christianity, Catholicism, etc.)	216
I am heavily involved in religion	101
I include spiritual practices in my life, but I am not heavily involved in them	80
I am heavily involved in spiritual practices	15
I practice something, but don't feel as though any of these apply to me	29
Prefer not to say	17
Total	877

The history of individual pornography use questions were also included in the survey and participants had the option to skip the section if they felt uncomfortable with the questions. We asked how many years participants viewed pornography, the duration in which they had last

viewed pornography, the age they were first exposed to pornography, the most frequent means of accessing pornography, if they are actively trying to quit using pornography, if their significant other is aware of the pornography use, if their significant other was supportive in their efforts to quit using pornography, and if they were actively trying to quit using pornography. Most participants reported they had first been exposed to pornography under age 15 (n= 830), they last viewed pornography within 0-3 months from the time they responded to the survey (n=803), and they were trying to quit using pornography (n= 741). The most frequent means of viewing was through a smartphone (n=447) and high-speed internet on a computer (n=344).

Research Tools

The assessments that will be used for the purpose of this study include, The Brief Pornography Screener (BPS), The Short Form of the Metacognitions Questionnaire (MCQ-30), Metacognitions about Desire Thinking Questionnaire (MDTQ), and Recovery Elements. The BPS consists of five questions and will help determine problematic use of pornography, with those scoring four points or higher indicating problematic pornography usage (Kraus, et al., 2020). The MCQ-30 consists of 30 questions with five subscales that measure maladaptive metacognitions (Wells & Cartwright-Hatton, 2004). These scales include the following: Negative beliefs about uncontrollability of danger, cognitive confidence, positive beliefs, cognitive self-consciousness, and negative beliefs about the need to control thoughts. The MDTQ consists of three subscales that measure metacognitions about desire thinking (Caselli & Spada, 2013), which for the purpose of this study the desired item is pornography. These subscales include the following: Negative metacognitions about desire thinking and need to control desire-related thoughts. Recovery Elements consist of various tools used in recovery as well as frequency of

triggers related to the addiction, and media use (For full review of Recovery Elements, see Appendix).

The Short Form of the Metacognition Questionnaire (MCQ-30). The adult version of the Metacognitions Questionnaire-30 (MCQ-30) (Wells & Cartwright-Hatton, 2004), which is a shortened version of the Metacognitions Questionnaire, and measures metacognitive beliefs through self-report. The MCQ-30 is considered more economical, with good internal consistency (Wells & Cartwright-Hatten, 2004). It is a 30-item scale that will assess five different scales of metacognitive beliefs which are: Negative beliefs about uncontrollability of danger, cognitive confidence, positive beliefs, cognitive self-consciousness, and negative beliefs about the need to control thoughts. Participants rate each item on a 4-point Likert scale with higher scores indicating more maladaptive metacognitions. It has been validated as an assessment of metacognitive beliefs in at risk mental state for psychosis and has demonstrated good fit and very good internal consistency (Bright, et al., 2018), and has demonstrated a positive association between internet gaming disorder and maladaptive metacognitions in the Chinese adapted version (Zhang, et al., 2020).

The Metacognitions About Desire Thinking Questionnaire (MDTQ). The MDTQ contains 18 questions measured along three scales which are as follows; Positive metacognitions about desire thinking (8 questions), Negative metacognitions about desire thinking (6 questions), and need to control desire-related thoughts (4 questions). Participants rate each item on a 4-point Likert scale with higher scores indicating more maladaptive metacognitions related to desire. For this study, desire thinking is related to feelings towards pornography. The MDTQ has shown good psychometric properties as well as divergent and predictive validity (Caselli & Spada, 2013).

*The Brief Pornography Screener (BPS)***.** The BPS is a 5-question assessment where questions are answered as never (0 points), sometimes (1 point), and frequently (3 points), with participants scoring 4 or under as not likely having a problem with pornography usage (Kraus, et al., 2018). The BPS, which was developed by Kraus et al., (2018) has been used as a way to detect problematic pornography use (score range: 0–10) with higher scores indicative of more problematic pornography use. It has been demonstrated to have high internal consistency, elements of construct, convergent criterion, and discriminant validity (Cronbach's alpha 0.84), to determine if participants have a problem with pornography usage (Kraus, et al., 2020).

Recovery Elements. The NoFap (2011) website was founded in June of 2011 by Alexander Rhodes for the purpose of providing a community-based website for users seeking support from excessive pornography use and compulsive sexual behavior (NoFap, 2011). Multiple strategies have been reported by the users on the NoFap (2011) website as beneficial tools used to abstain from pornography use and include, but are not limited to, meditation, exercise, playing sports, reading, puzzle games, learning new things, involvement in religious or spiritual practices, adjusting sleep schedules, attending individual or group therapy, and speaking with an accountability partner. An accountability partner is akin to that of a sponsor and is an individual who also struggles with excessive pornography use, who shares insights and strategies they found helpful to other persons who feel stuck in their own process.

Maintaining a positive view in recovery is an important component of recovery (Snoek et al., 2016) and it has been reported on the NoFap (2011) website by users that how an addict views their own recovery can either benefit or hinder the process. However, having a positive attitude can be difficult due to stigma, and being stigmatized as a person in recovery can serve as a hindrance in seeking help for any addiction. This stigma could be due to how people in

recovery were once viewed as weak-willed if they struggled with an addiction (Sussman, 2021), despite evidence that shows to successfully quit an addiction it takes more than willpower alone (Snoek et al., 2016). It takes a positive attitude towards recovery, motivation to quit, along with the employment of various strategies to maintain a successful recovery (Snoek et al., 2016). How someone views recovery, uses various strategies for recovery, and motivation towards a successful recovery from pornography use may play a role in comorbid conditions which in turn, could play a role in metacognitive functioning.

Mindfulness meditation has been shown as a possible resource for increasing metacognitive processes by reducing anxiety (Knapp et al., 2021) and depression, both of which are implicated in persons with substance addictions (Kadri et al., 2020; Witkiewitz & Bowen, 2010; Kuan, 2012; Chen et al., 2013). Exercise has also been shown to provide overall physical and mental well-being, which is beneficial for recovery due to the increase in cognition and metacognition and reduction of stress, anxiety, and depression (Stern et al., 2019; Raichlen & Alexander, 2017). How either of these play a role in abstaining from excessive pornography use in adults is not understood, however, they could potentially prove to be as beneficial as they do in other treatment programs.

How an individual views their personal journey in recovery may influence recovery success and could be a part of the maladaptive metacognitions. For example, stigma, acceptance of personal responsibility and the ability to maintain positive views towards one's own recovery are important components of a successful recovery (Pettersen, et al., 2019; Snoek et al., 2016). If persons who are in recovery are unable to reflect on their decisions, it could lead them back into the addiction. Information in this section will be collected to better understand if a person recovering from pornography addiction feels as though they are in control of their own recovery

and will be based on self-reported tools from users on the NoFap (2011) website. Recovery Elements, for the purpose of this study, is a broad term to describe categories that will assess items such as, recovery tools, activities, trigger response, and engagement in media. Recovery tools include, but are not limited to meditation, exercise, individual therapy, group therapy, engaging in sports, practicing yoga, reading literature pertaining to pornography addiction, getting involved with religious or spiritual practices, and response/intensity to triggers. The effectiveness of these elements in general have not been studied in relation to pornography addiction, however, a few tools have been studied in relation to other addictions, such as exercise and meditation as described previously. The survey will include use of recovery tools, activities participants engage in, how much media participants consume, and how participants respond to triggers (for full review, see Appendix).

Procedures

Assessments were compiled in Qualtrics with a total of nine blocks. Participants had to be 18 years of age or older and had to consent to participate to proceed through the survey. They were provided the option to skip questions or sections deemed uncomfortable and were able to end the survey at any time. Participants who consented completed the survey via computer or mobile device at their convenience with the average time to complete the survey being 30 minutes. Survey administered contained the MCQ-30, MDTQ, BPS, Recovery Elements, history of pornography use, as well as demographic information. Once participants opened the survey, they had seven days to complete it. Survey remained opened from January 7th, 2022, to February 16th, 2022, with the last response being recorded February 23rd, 2022.

Data Analysis

A principal component factor analysis was used to better understand which of the recovery elements were most used. The primary purpose of a principal component analysis is to identify and compute which recovery elements for factors are the source of underlying changes being made, or not made, to abstain from pornography use, and to decrease maladaptive metacognitions. This procedure was appropriate for the purpose of this study as it enabled the investigation of which concepts were most used and allowed for the reduction of recovery elements to better understand which ones were most effective in decreasing maladaptive metacognitions and pornography use. After the principal component factor analysis was performed, a multiple regression analysis was performed to test if the recovery elements significantly predicted participants pornography use and maladaptive metacognition. Another multiple regression analysis was performed to see if the subscales of the MDTQ and MCQ-30 significantly predicted participants pornography use and maladaptive metacognition. Multiple regression analysis was appropriate for the purpose of this study because it assesses the strength of the relationship between the dependent variable and predicter variables, as well as establishes the importance of the predictors on the relationship.

CHAPTER 4

RESULTS

The purpose of this study was to examine the relationship between maladaptive metacognitions and excessive pornography use in the adult population. It was hypothesized that results will be comparable to previous studies that examined the relationship between maladaptive metacognitions in problematic internet use (Balıkçı, et al., 2020, Bidi, et al., 2012,

Nasser, et al., 2020, Ünal-Aydın, et al., 2021, Zhou, et al., 2021), alcohol use disorder (Spada & Wells, 2006), and online gambling disorder (Mansueto, et al., 2016, Moritz, et al., 2021, Jauregui, et al., 2016). The research questions of this study are as follows:

4. The first question states that there will be a relationship between excessive pornography use and maladaptive metacognitions. The relationship will show that as pornography use increases, maladaptive metacognitions will also increase.
5. The second question states that there will be a significant relationship between pornography use and activities associated with substance abuse recovery programs. It is also assumed that pornography use contains an emotional component, which will be evidenced by the responses in the Triggers section in Recovery Elements. More specifically, as pornography use increases, emotional struggles will also increase while items such as meditation and exercise, which serve to increase metacognitive abilities, will decrease
6. The third question states that there will be a relationship between emotional struggles, and tools used in substance addiction recovery groups, with dysfunctional metacognitions. It is assumed that as emotional struggles increase, maladaptive metacognitions will also increase which continues the cycle of addiction. It is also assumed that tools used in substance addiction recovery programs will serve to decrease maladaptive metacognitions.

The average score of the BPS was over four points (M=7.6) indicating problematic use among the sample collected (Kraus, et al., 2018). To better understand which of the recovery elements were most used, a principal component analysis was performed. Principal components analysis was used because the primary purpose was to identify and compute which recovery

elements for factors are underlying the changes being made or not made to abstain from porn use and decrease maladaptive metacognitions. Items used for analysis contained Eigenvalues over 1. The Kaiser Meyer Olkin (KMO) measure of sampling adequacy was conducted to examine the strength of a correlation between the variables. It is ideal for scores on the KMO to be closer to 1, with scores falling below 0.5 considered unacceptable. Five items were retained from tools for a cumulative percentage of 54.86% (see table 8). The KMO for tools is .769 ($p = .000$). Four items were retained for activities for a cumulative percentage of 61.96% (see table 9). The KMO measure for activities is .721 ($p = .000$). Three items were retained for engagement with media for a cumulative percentage of 46.16% (see table 10). The KMO measure for engagement in media is .695 ($p < .001$). Five items were retained for activities for a cumulative percentage of 63.31% (see table 11). The KMO measure for triggers is .920 ($p = .000$). All regression analyses were performed in IBM SPSS statistics version 27.

Question 1

The first question states that there will be a relationship between the Brief Pornography Screener and MCQ-30/MDTQ. The relationship will show that as pornography use increases, maladaptive metacognitions will also increase. To test this question, a multiple regression analysis was performed to see if dysfunctional metacognitions significantly predicted participants' pornography use. The results indicate the MDTQ explained 24% of the variance ($R2 = .238$, $F(1, 875) = 273.41$, $p<.001$) and MCQ-30 explained 11% of the variance ($R2 = .108$, $F(1, 875) = 140.58$, $p<.001$). It was found that the MDTQ significantly predicted pornography use ($\beta = .123$, $p < .001$) as did the MCQ-30 ($\beta = .025$, $p < .001$).

To further understand the extent to which maladaptive metacognitions influence pornography use and to test the linear relationship of each subscale, the BPS was analyzed with each subscale of the MCQ-30 and MDTQ separately.

A multiple regression analysis was performed to test if the subscales of the MDTQ significantly predicted participants' pornography use. The results indicate the MDTQ subscale PMDT explained 5% of the variance ($R2 = .053$, $F(1, 875) = 49.39$, $p<.001$). It was found that the PMDT significantly predicted pornography use ($\beta = .110$, $p < .001$). The subscale NMDT explained 30% of the variance ($R2 = .303$, $F(1, 875) = 381.21$, $p<.001$). It was found that the NMDT significantly predicted pornography use ($\beta = .305$, $p < .001$). The subscale NCDT 12% of the variance ($R2 = .119$, $F(1, 875) = 118.25$, $p<.001$). It was found that the NCDT significantly predicted pornography use ($\beta = .266$, $p < .001$).

A multiple regression analysis was performed to test if the subscales of the MCQ-30 significantly predicted participants' pornography use. Negative beliefs about thoughts concerning uncontrollability and danger explained 10% of the variance ($R2 = .102$, $F(1, 875) =99.03$, $p<.001$). It was found that the negative belief subscale significantly predicted pornography use ($\beta =.159$, $p < .001$). Negative beliefs about the need to control thoughts explained 8% of the variance ($R2 = .080$, $F(1, 875) =76.13$, $p<.001$). It was found that the negative belief subscale significantly predicted pornography use ($\beta =.115$, $p < .001$). Positive beliefs about worry explained 2% of the variance ($R2 = .016$, $F(1, 875) =14.40$, $p<.001$). It was found that the positive belief subscale significantly predicted pornography use ($\beta =.076$, $p < .001$). Cognitive confidence explained 4% of the variance ($R2 = .044$, $F(1, 875) =40.70$, $p<.001$). It was found that the cognitive confidence subscale significantly predicted pornography use ($\beta =.108$, $p < .001$). Cognitive self-consciousness explained 1% of the variance ($R2 = .012$, $F(1,$

875) =10.33, p = .001). It was found that the cognitive self-consciousness subscale significantly predicted pornography use (β =.066, p = .001)

Question 2

The second question states that there will be a significant relationship between pornography use and recovery elements used. More specifically, it is assumed that as pornography use increases, triggers and media will also increase while tools and activities decrease. A multiple regression analysis was performed to test if Recovery Elements significantly predicted participants' pornography use. To further understand how Recovery Elements are utilized, Tools and Triggers were ran separate from Media and Activities in the analysis. The results indicate that Tools and Triggers explained 1% of the variance (R2 = .011, F(2, 872) = 6.01, p =.003), and Activities and Media explained 1% of the variance (R2 = .013, F(2, 873) = 6.01, p =.001). It was found that tools (β =-.-.069, p=.001), triggers (β =.206, p=.000), activities (β =-.071, p=.018), and media(β =.119, p=.002) significantly predicted pornography use.

Question 3

The third question states that there will be a relationship between dysfunctional metacognitions and recovery elements used. It is predicted that tools and activities will decrease dysfunctional metacognitions whereas media and triggers will increase dysfunctional metacognitions. A multiple regression analysis was performed to test if Recovery Elements significantly predicted participants' dysfunctional metacognitions. For consistency, both the MCQ-30 and MDTQ were run with tools and triggers, then activities and media as it was when analysis was with the BPS. The results indicate that for the MCQ-30 Tools and Triggers explained 12% of the variance (R2 = .124, F(2, 870) = 61.56, p <.001) and Activities and Media

explained .7% of the variance (R2 = .007, F(2, 873) = 6.01, p =.049). It was found that tools (β =-.532, p=.000), triggers (β =.805, p=.000), activities (β =--.355, p=.046), but not media, significantly predicted dysfunctional metacognitions on the MCQ-30.

For the MDTQ, it was found that Tools and Triggers explained 16% of the variance (R2 = .158, F(2, 870) = 81.53, p <.001) and Activities and Media explained 2% of the variance (R2 = .016, F(2, 873) = 6.89, p =.001). Tools (β =-.211, p=.014), Triggers (β =.633, p=.000), Activities (β =--.343, p=.004), and Media(β =.393, p=.010) significantly predicted dysfunctional metacognitions on the MDTQ.

CHAPTER 5

DISCUSSION

The Self-Regulatory Executive Function model (S-REF) is a model that explains self-regulation processing that is driven by self-beliefs (Wells & Matthews, 1994). It proposes that metacognitive beliefs that become dysfunctional activate pathways associated with maladaptive coping mechanisms that can perpetuate the cycle of psychological distress. This distress becomes persistent and strengthens when dysfunctional thinking patterns and coping mechanisms of emotional responses are activated. Maladaptive coping such as rumination, thought suppression, avoidance, and substance use, are linked to dysfunctional metacognitive beliefs such as the worry about the need to control thoughts, worrying about planning for potential threats, the inability to control rumination of negative thoughts, and more (Spada & Roarty, 2015). For emotional disorders, the S-REF model proposes that metacognition plays a role in maladaptive self-regulation strategies that account for a deficit in processing external and internal events and is referred to as the Cognitive-Attentional Syndrome (CAS) (Wells & Matthews, 1996). The

Cognitive Attentional Syndrome (CAS) includes a combination of unhealthy coping strategies that are activated by underlying maladaptive metacognitions and negative thinking processes. These unhelpful coping strategies include the inability to move away from self-focused thinking, continued worry and rumination, and thoughts of perceived threats in the environment (Fisher & Wells, 2009). CAS asserts the inability to effectively self-regulate with healthy coping strategies in response to a trigger can prolong emotional distress

The S-REF model also describes a set of metacognitive beliefs that include dysfunctional beliefs about the ability to control thoughts and beliefs about cognitive self-consciousness. Since metacognitive beliefs can influence knowledge and cognitive processes, they can also play a role in addictive behaviors. These dysfunctional metacognitive beliefs are those that can continue to reinforce addictive behavior by way of holding onto maladaptive beliefs through internal self-talk, rumination, and emotional responses regarding the addiction. These beliefs can vary in duration and intensity, which is generally how prediction of the severity of the addiction and possibility of relapse is possible (Hamonnier & Varescon, 2018). The triphasic metacognitive formulation of addictive behaviors proposes that aspects of the CAS such as attentional bias, extended thinking (e.g., desire thinking, rumination and worry), disruption in metacognitive monitoring and thought suppression should be associated with addictive behaviors and lead to maladaptive consequences including increased levels of craving and engagement. The formulation also proposes that metacognitive beliefs should be associated with aspects of the CAS and addictive behaviors. (Spada & Roarty, 2015). The S-REF model describes desire thinking as a form of extended thinking and is a key component in the maintenance of CAS when it is in the context of addictive behaviors (Spada & Roarty, 2015). Caselli & Spada (2011) describes two types of desire thinking, the first of which is verbal perseveration, and the second

being imaginal prefiguration. The desired object becomes more compelling over time as the addict perceives the substance as the only possible relief from cravings, as evidenced in one study where craving was found to impair memory, metacognitive processing, and performance in participants who were craving caffeine (Palmer, et al., 2017).

Dysfunctions in metacognitive beliefs that are associated with stress, depression, and anxiety disrupt metacognitive processing (Chen, et al., 2021), which is often the case in behavioral and substance addiction and withdrawal. Since addictive behavior often presents with a comorbid diagnosis such as stress, anxiety, or depression, this can further pave the way for the manifestation of maladaptive metacognitions that keep the addict in the loop of addiction (Knapp et al., 2021; Amendola et al., 2020; Alexandraki et al., 2018; Efrati et al., 2020; Efrati et al., 2021). Although tendencies towards addiction are often thought to begin in adulthood, it can start as early as 12 to 13 years of age with some children being exposed even younger (National Institute on Drug Abuse, 2020). The adolescent brain could potentially be more susceptible to problems associated with addiction given how risk taking and sensation seeking are primary factors in typical adolescent development (Jadhav & Boutrel, 2019).

Question one tested the relationship between the BPS and MCQ-30. What was discovered was as porn use increased, dysfunctional metacognitions also increased. This could indicate that emotional struggles and dysfunctional metacognitions impact each other, which further the notion of the existence of Cognitive Attentional Syndrome (CAS). Upon further examination, each subscale of the MCQ-30 and MDTQ predicts pornography use which could indicate that pornography use is a coping mechanism in response to emotional distress, which paradoxically extends negative thinking and negative emotions in response to an external event, according to the S-REF model (Wells & Matthews, 1994). The external event in terms of

pornography addiction could be stimuli-related cues in the environment as well as internal cues based on triggers that occur during unconscious processing. These cues could result in negative emotions and thoughts that consist of the need to control worry, need to control thoughts, desire thinking, and rumination.

During periods of psychological distress, metacognitive techniques serve to reduce worry through the introduction of healthier coping mechanisms in response to stimulus-driven intrusions (Spada & Roarty, 2015). In question two, it is suggested that use of techniques in tools (meditation, mindfulness meditation, reading self-improvement books, changing routine, and introducing new coping mechanisms), and activities (playing puzzle games, memory games, doing puzzles, and drawing), could serve as healthier coping mechanisms to pornography use as use decreases when tools and activities increase. As discussed previously, meditation acts as a beneficial tool in substance addiction recovery programs due to its ability to decrease anxiety and depression. This is further evidenced in question three where tools and activities decrease maladaptive metacognitions in both the MCQ-30 and MDTQ.

For addictive behaviors, CAS and metacognitive beliefs are broken down into three phases, which are pre-engagement, engagement, and post-engagement (Spada, et al., 2014). The pre-engagement phase is associated with triggers, urges, memories, thoughts, and images which in turn, guide judgment toward coping mechanisms which then activate metacognitive beliefs associated with the appraisal of the addictive substance. As seen in question one, as the BPS increases so does the MDTQ. This posits a pre-engagement phase that may be associated with triggers, urges, memories, thoughts, and images, which in turn, activate CAS effectively preserving the intrusive thoughts that increase urges and cravings.

The engagement phase includes positive metacognitive beliefs and thoughts associated with those beliefs become activated and change how metacognitive processing is then monitored, which then reduces the ability to self-regulate behavior. The evidence of engagement is suggested where the subscales of both the MCQ-30 and MDTQ were analyzed individually with the BPS. As the BPS increased, so did positive metacognitive beliefs in both the MCQ-30 and MDTQ, which could be evidence of reduced ability to self-regulate.

In the post-engagement stage, withdrawal symptoms and self-blame activate positive metacognitive beliefs, which activates rumination, which in turn increases the likelihood of relapse or re-engagement in the substance (Spada & Roarty, 2015). Positive metacognitive beliefs increased as the BPS increased, as did the Triggers section of the Recovery Elements.

Attentional bias consists of automatic processing and implementation of strategies that can lead to dysfunctional coping styles. These coping styles are what appraises and determines the relevance of the stimuli, thus, allowing the implementation of metacognitive beliefs as a strategy for determining whether to engage in or disengage from thoughts associated with the stimuli. Extended processing of the stimuli such as rumination and worry, can lead to the continuation of desire thinking of the stimuli. Thought suppression, which is the attempt to suppress thoughts and urges associated with the stimuli, paradoxically causes further thinking of thoughts and urges. Disruptions in metacognitive monitoring create problems with attentional processing, thus, reducing cognitive processing. Metacognitive beliefs are both positive and negative in nature and are both related to maladaptive thinking patterns. Positive beliefs are thoughts that allow for engagement in the substance whereas negative beliefs are related to the lack of executive control over the regulation of engaging in the addictive substance (Spada & Roarty, 2015).

Excessive pornography may be used as a maladaptive coping strategy in response to negative thoughts, such as those seen on the MCQ-30 subscales, as well as the MDTQ subscales. It could serve as a coping mechanism to regulate their emotions to escape the difference between the thoughts they are trying to suppress and the desire to watch pornography. As pornography use increases, negative metacognitive beliefs and negative control of thoughts also increase on the MCQ-30, however, considering negative emotions from triggers also increase as porn use increases, the persistence in which the maladaptive thoughts increase could become a predictor for relapse once an attempt to quit pornography occurs. Engagement in pornography could also increase shame and other negative emotional states, thus contributing to their thoughts of feeling worthless and unloved, as evidenced by the increase in triggers, NMDT, and NCDT as the BPS score continues to increase.

Tools and Activities had a significant impact, not only on the BPS, but also the MDTQ and MCQ-30. This could indicate that cognitive and metacognitive activities could serve as a buffer against dysfunctional metacognitions that appear to contribute to excessive pornography use. Use of Media increased as the BPS increased, which considering the type of media that is used (social media or movies), it may contain triggers that activate CAS, which can then lead to difficultly escaping distressful emotions facilitating an increase of dysfunctional metacognitions, then an inability to abstain from excessive use of pornography. Addressing excessive pornography use may require metacognitive techniques such as the ones used in substance addiction recovery programs as well as addressing the problem it appears to be among those who seek recovery from. Users often report distress in their daily lives, relationships, their lack of social abilities, lack of confidence, feelings of worthlessness, feeling ashamed, and inadequate

support systems (NoFap, 2011). Compounding factors may include shame, and the stigma that is unfortunately attached to recovering addicts (Pettersen, et al., 2019; Snoek et al., 2016).

Rethinking Addiction

With adequate sexual education programs lacking in the United States, with the focus being mostly on abstinence (Astle, et al., 2021), curious teens are often left to find their own answers to questions left unanswered either in the classroom, or through parental figures. This could lead them to simply typing sexual questions into a web browser, which is bound to produce results that contain explicit or pornographic material that may not be an actual representation of how a sexual relationship should be. This has the potential lead to more confusion, dysfunctional behavior, and misconstrued views on what a healthy sexual relationship should consist of, as evidenced by the work of Owens, et al., 2012 mentioned previously.

The MCQ-30 predicted internet addiction, alcohol use disorder, internet gambling disorder, and now pornography addiction. It has been a tool used to predict anxiety and depression, which are also considered contributing factors in the cycle of addiction. It appears evident that metacognitions, when dysfunctional, can impair the quality of life for an individual. Dysfunctional metacognitions were even stated to be a primary factor in contributing to addiction. This is further substantiated when we consider the evidence of metacognitive techniques used in treating anxiety, depression, and addiction.

Addiction treatments include various types of tools and techniques to enhance recovery efforts. However, when we consider prevention of the addiction, it may involve the use of techniques that serve as buffers to prevent maladaptive metacognitions from forming to begin with. Meditation can be difficult for some due to the inability to control thoughts, wandering minds, and difficulty sitting still. Mindfulness meditation comes in several forms, but it is

generally described as a practice in which attention is brought to internal awareness of bodily experiences through breathing exercises and attentional focus (Walsh et al., 2019) which can be helpful with assisting the individual to control the wandering mind and out-of-control thoughts. Through internal awareness of bodily experiences that come with mediation practices, it may help the practitioner become better aware of maladaptive responses to situations that evoke those feelings of anxiety, thus, helping to learn better coping mechanisms crucial in the reduction or alleviation of maladaptive mental responses. It has been suggested that through a framework of mindfulness-based stress reduction and mindfulness based cognitive therapy meditations, users can learn to control their thoughts as well as regulate mind wandering, thus, leading to enhanced cognition and metacognition (Kerr, et al., 2013). Metacognitive training has been proposed as a recovery tool for persons seeking treatment for mental illness (Lysaker, et al., 2020) and may also be effective for recovery from addictions. Mindfulness meditation has also been shown as a possible resource for increasing metacognitive processes by reducing anxiety (Knapp, et al., 2021) and depression, both of which are implicated in persons with substance and/or behavioral addictions (Kadri, et al., 2020; Witkiewitz & Bowen, 2010; Kuan, 2012; Chen, et al., 2013). According to the results from this research, it appears as though both meditation and mindfulness meditation help decrease dysfunctional metacognitions.

Among 33 participants attending graduate school, when mindfulness meditation and yoga was practiced some of the benefits reported were meaningful effects on emotional and mental wellbeing, increased ability to handle negative emotions, and increased clarity of thoughts along with increased metacognitive functioning (Shure, et al., 2008). Undergraduate students who participated in a three-week mindfulness meditation app study reported increased mood, reduced stress, and better attentional control and metacognitive functioning (Walsh, et al., 2019).

Increased thought control and better focus was found in another study of participants who participated in meditation practices over a 9-month period (Kok & Singer, 2017). Mindfulness serves as an avenue to help improve an individual's level of effective monitoring as well as learning to regulate mental activities, which allows for metacognitive processes to cultivate, decreasing maladaptive metacognitions and behavior patterns that are automatic (Deng, et al., 2019). Mindfulness has also been shown as a possible prevention of Facebook addiction among university students (Eskisu, et al., 2020). Given how meditation appears to increase cognitive monitoring and metacognition while decreasing unwanted thoughts, anxiety, and automatic behaviors associated with maladaptive metacognitions, it could serve as a resourceful tool for prevention.

Exercise is another tool that could be used for prevention (Fontes-Ribeiro, et al., 2001) given the benefits on cognition and metacognitive processes (Stern, et al., 2019; Raichlen & Alexander, 2017). Implementing exercise in recovery programs showed a decrease in negative mood states associated with withdrawal and cravings (Lu, et al., 2021) and a decrease in depression symptoms among methamphetamine users in recovery (Haglund, et al., 2014). Exercise has also been shown to provide overall physical and mental well-being, which is beneficial for recovery due to the increase in cognition and metacognition and reduction of stress, anxiety, and depression (Stern et al., 2019; Raichlen & Alexander, 2017).

Implications

Metacognition plays a role in motivation, executive function, declarative and procedural knowledge, and has been found to develop as early as three years of age (Marulis & Nelson, 2021). Metacognition is “thinking about thinking” (Flavell, 1992) and operates across ordered levels of concepts which include the ability to make decisions based on isolated events and how

one perceives their abilities and skills (Seow et al., 2021). Metacognition is the knowledge and cognitive processes that involve appraisal, control, and monitoring of thinking (Flavell, 1979), and it is through the cognitive process of metacognition that an individual develops concepts such as knowledge of others, of different tasks that require cognitive thought, and of possible strategies to navigate and/or cope through different tasks (Flavell, 2000). Metacognition can also play an important role in student academic success through practice self-regulation learning strategies (Ohtani & Hisasaka, 2018), and healthy development of the ability to reason with one's own judgments of knowledge is a crucial component for effective navigation through life. Students who were taught cognitive strategies through instructional learning were shown to have higher cognitive skills than their peers (Apaydin & Hossary, 2017). Enhancing a student's awareness of their metacognitive abilities through the learning process allows the students to not only be conscious of self, but it also allows them to be involved in the learning situation, which in turn activates memories, previous knowledge, and abilities that are directly related to their metacognitive processes (Wagener, 2013). The dysregulation of this development has the potential to become maladaptive long-term (Wells & Matthews, 1996), which in turn, can develop into mental illness or addiction (Chen, et al., 2021). Developing self-regulation skills in the classroom could prove beneficial to the prevention of not only dysfunctional metacognitive processes that occur later, but it may also disrupt the tendency toward addiction.

Limitations

This study evaluated metacognitions in participants with problematic pornography use who were actively trying to quit using pornography in adulthood. Therefore, it is unknown if these results could generalize, or if similar results could be found in a sample of participants who were not trying to quit using pornography, or who do not feel as though they have a problem

with their pornography use. Research that explores the potential impacts of early exposure to, or use of, pornography has on the developing brain is lacking, which is concerning given its similarities to the structural changes that substance use produces in the brain.

Future Research

Further research is warranted. In Evolutionary game theory (EGT), it is stated through mathematical models on animal studies that self-handicapping through use of an addiction could possibly explain a perceived need to preserve biological fitness (Newlin, 1999). This could make sense considering pornography consumption is tied to that of reproduction. Another possibility would be from a neuro-psycho-evolutionary approach, which explores addiction in the context of a loss of functional autonomy of the seeking or exploration system, which results in decline of cognitive processes (Alcaro, et al., 2021). Given the distress experienced by chronic use of pornography, the neuro-psycho-evolutionary approach may also be a consideration of explanation.

REFERENCES

REFERENCES

[1] Marulis, L. M., & Nelson, L. J. (2021). Metacognitive processes and associations to executive function and motivation during a problem-solving task in 3–5 year olds. *Metacognition and Learning*, *16*(1), 207-231. https://doi.org/10.1007/s11409-020-09244-6

[2] Flavell, J. H. (1992). Cognitive development: Past, present, and future. Developmental Psychology, 28(6), 998-1005. https://doi.org/10.1037/0012-1649.28.6.998

[3] Seow, T. X. F., Rouault, M., Gillan, C. M., & Fleming, S. M. (2021). How local and global metacognition shape mental health. *Biological Psychiatry (1969)*, *90*(7), 436-446. https://doi.org/10.1016/j.biopsych.2021.05.013

[4] Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *The American Psychologist*, *34*(10), 906-911. https://doi.org/10.1037/0003-066X.34.10.906

[5] Wells, A., & Matthews, G. (1996). Modelling cognition in emotional disorder: The S-REF model. *Behaviour Research and Therapy*, *34*(11), 881-888. https://doi.org/10.1016/S0005-7967(96)00050-2

[6] Chen, J., Tan, Y., Cheng, X., Peng, Z., Qin, C., Zhou, X., Lu, X., Huang, A., Liao, X., Tian, M., Liang, X., Huang, C., Zhou, J., Xiang, B., Liu, K., & Lei, W. (2021). Maladaptive metacognitive beliefs mediated the effect of intolerance of uncertainty on depression. *Clinical Psychology and Psychotherapy*, https://doi.org/10.1002/cpp.2589

[7] Liljeholm, M., & O'Doherty, J. P. (2012). Contributions of the striatum to learning, motivation, and performance: *An associative account. Trends in Cognitive Sciences*, *16*(9), 467-475. https://doi.org/10.1016/j.tics.2012.07.007

[8] Flavell, J. H. (2000). Development of children's knowledge about the mental world. *International Journal of Behavioral Development, 24*(1), 15-23. https://doi.org/10.1080/016502500383421

[9] Ohtani, K., & Hisasaka, T. (2018). Beyond intelligence: A meta-analytic review of the relationship among metacognition, intelligence, and academic performance. *Metacognition and Learning, 13*(2), 179-212. https://doi.org/10.1007/s11409-018-9183-8

[10] Andrews, J., Foulkes, L., & Blakemore, S. J. (2018). P.2.025 - age differences in social preference. *European Neuropsychopharmacology, 28*, S37-S38. https://doi.org/10.1016/j.euroneuro.2017.12.064

[11] Cromley, J. G., & Kunze, A. J. (2020). Metacognition in education: Translational research. Translational Issues in Psychological Science, 6(1), 15-20. https://doi.org/10.1037/tps0000218

[12] Kaufman, J. C., & Beghetto, R. A. (2013). In praise of clark kent: Creative metacognition and the importance of teaching kids when (not) to be creative. *Roeper Review, 35*(3), 155-165. https://doi.org/10.1080/02783193.2013.799413

[13] Apaydin, M., & Hossary, M. (2017). Achieving metacognition through cognitive strategy instruction. *International Journal of Educational Management, 31*(6), 696-717. https://doi.org/10.1108/IJEM-05-2016-0130

[14] Wagener, B. (2013). Autogenic training, metacognition and higher education. *Educational Psychology (Dorchester-on-Thames), 33*(7), 849-861. https://doi.org/10.1080/01443410.2013.785051

[15] Wells, A., & Matthews, G. (1994). Attention and emotion: A clinical perspective. Lawrence Erlbaum Associates, Inc.

[16] Spada, M. M., & Roarty, A. (2015). The relative contribution of metacognitions and attentional control to the severity of gambling in problem gamblers. *Addictive Behaviors Reports, 1*(C), 7-11. https://doi.org/10.1016/j.abrep.2015.02.001

[17] Blair, C. (2016). Developmental science and executive function. *Current Directions in Psychological Science : A Journal of the American Psychological Society, 25*(1), 3-7. https://doi.org/10.1177/0963721415622634

[18] Bright, M., Parker, S., French, P., Morrison, A. P., Tully, S., Stewart, S. L. K., & Wells, A. (2018). Assessment of metacognitive beliefs in an at risk mental state for psychosis: A validation study of the metacognitions Questionnaire-30. *Clinical Psychology and Psychotherapy, 25*(5), 710-720. https://doi.org/10.1002/cpp.2301

[19] Fisher, P., & Wells, A. (2009). A focus on metacognition. *Metacognitive therapy* (pp. 11-14). Routledge. https://doi.org/10.4324/9780203881477-6

[20] Soutschek, A., & Tobler, P. N. (2020). Know your weaknesses: Sophisticated impulsiveness motivates voluntary self-restrictions. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9*(46), 1611-1623 https://doi.org/10.1037/xlm0000833;10.5167/uzh-188474;

[21] Hamonniere, T., & Varescon, I. (2018). Metacognitive beliefs in addictive behaviours: A systematic review. *Addictive Behaviors, 85*, 51-63. https://doi.org/10.1016/j.addbeh.2018.05.018

[22] Jadhav, K. S., & Boutrel, B. (2019). Prefrontal cortex development and emergence of self-regulatory competence: The two cardinal features of adolescence disrupted in context of alcohol abuse. *The European Journal of Neuroscience, 50*(3), 2274-2281. https://doi.org/10.1111/ejn.14316

[23] Yu, T., & Chao, C. (2016). Internet misconduct impact adolescent mental health in taiwan: The moderating roles of internet addiction. *International Journal of Mental Health and Addiction, 14*(6), 921-936. https://doi.org/10.1007/s11469-016-9641-y

[24] Prawiroharjo, P., Ellydar, H., Pratama, P., Edison, R. E., Suaidy, S. E. I., Amani, N. Z., & Carissima, D. (2019). Impaired recent verbal memory in pornography-addicted juvenile subjects. *Neurology Research International*, 2019, 1-5. https://doi.org/10.1155/2019/2351638

[25] Alexandraki, K., Stavropoulos, V., Burleigh, T.L., King, D.L., Griffiths, M.D. (2018). Internet pornography viewing preference as a risk factor for adolescent internet addiction: The moderating role of classroom personality factors. *Journal of Behavioral Addictions, 70*(2), 423-432.

[26] Efrati, Y., Kolubinski, D.C., Caselli, G., & Spada, M. M. (2020). Desire thinking as a predictor of compulsive sexual behaviour in adolescents: Evidence from a cross-cultural validation of the Hebrew version of the desire thinking questionnaire. *Journal of Behavioral Addictions, 9*(3), 797-807. https://doi.org/10.1556/2006.2020.00062

[27] Efrati, Y., Kolubinski, D. C., Marino, C., & Spada, M. M. (2021). Modelling the contribution of metacognitions, impulsiveness, and thought suppression to behavioural addictions in adolescents. *International Journal of Environmental Research and Public Health, 18*(7), 3820. https://doi.org/10.3390/ijerph18073820

[28] Morelli, M., Bianchi, D., Baiocco, R., Pezzuti, L., & Chirumbolo, A. (2017). Sexting behaviors and cyber pornography addiction among adolescents: The moderating role of alcohol consumption. *Sexuality Research & Social Policy, 14*(2), 113-121. https://doi.org/10.1007/s13178-016-0234-0

[29] Siomos, K., Floros, G., Fisoun, V., Evaggelia, D., Farkonas, N., Sergentani, E., Lamprou, M., & Geroukalis, D. (2012). Evolution of internet addiction in greek adolescent students over a two-year period: The impact of parental bonding. *European Child & Adolescent Psychiatry, 21(*4), 211-219. https://doi.org/10.1007/s00787-012-0254-0

[30] Neophytou, E., Manwell, L. A., & Eikelboom, R. (2021). Effects of excessive screen time on neurodevelopment, learning, memory, mental health, and neurodegeneration: A scoping review. *International Journal of Mental Health and Addiction, 19*(3), 724-744. https://doi.org/10.1007/s11469-019-00182-2

[31] Rocha, H. A. L., Correia, L. L., Leite, Á. J. M., Machado, M. M. T., Lindsay, A. C., Rocha, Sabrina Gabriele Maia Oliveira, Campos, J. S., Cavalcante E Silva, A., & Sudfeld, C. R. (2021). Screen time and early childhood development in ceará, brazil: A population-based study. *BMC Public Health, 21*(1), 2072-2072. https://doi.org/10.1186/s12889-021-12136-2

[32] Knapp, A. A., Allan, N. P., Cloutier, R., Blumenthal, H., Moradi, S., Budney, A. J., & Lord, S. E. (2021). Effects of anxiety sensitivity on cannabis, alcohol, and nicotine use among adolescents: Evaluating pathways through anxiety, withdrawal symptoms, and coping motives. *Journal of Behavioral Medicine, 44*(2), 187-201. https://doi.org/10.1007/s10865-020-00182-x

[33] Bahramnejad, A., Rabani-Bavojdan, M., & Rabani-Bavojdan, M. (2012). The relationship of metacognitive beliefs and tendency to addiction in sistan and baluchistan university, zahedan, iran. *Addiction and Health*, *4*(1-2), 65-72.

[34] Mansueto, G., Pennelli, M., De Palo, V., Monacis, L., Sinatra, M., & De Caro, M. F. (2016). The role of metacognition in pathological gambling: A mediation model. *Journal of Gambling Studies, 32*(1), 93-106. https://doi.org/10.1007/s10899-014-9519-5

[35] Jauregui, P., Urbiola, I., & Estevez, A. (2016). Metacognition in pathological gambling and its relationship with anxious and depressive symptomatology. *Journal of Gambling Studies, 32*(2), 675-688. https://doi.org/10.1007/s10899-015-9552-z

[36] Zhou, H., Dang, L., Lam, L. W., Zhang, M. X., & Wu, A. M. S. (2021). A cross-lagged panel model for testing the bidirectional relationship between depression and smartphone addiction and the influences of maladaptive metacognition on them in chinese adolescents. *Addictive Behaviors, 120*, 106978-106978. https://doi.org/10.1016/j.addbeh.2021.106978

[37] Ünal-Aydın, P., Obuća, F., Aydın, O., & Spada, M. M. (2021). The role of metacognitions and emotion recognition in problematic SNS use among adolescents. *Journal of Affective Disorders, 282*, 1-8. https://doi.org/10.1016/j.jad.2020.12.103

[38] American Psychological Association. (2017, August 3). *Age of first exposure to pornography shapes men's attitudes toward women* [Press release]. https://www.apa.org/news/press/releases/2017/08/pornography-exposure

[39] Owens, E. W., Behun, R. J., Manning, J. C., & Reid, R. C. (2012). The impact of internet pornography on adolescents: A review of the research. *Sexual Addiction & Compulsivity, 19*(1-2), 99-122. https://doi.org/10.1080/10720162.2012.660431

[40] Kang, X., Handayani, D. O. D., Chong, P. P., & Acharya, U. R. (2020). Profiling of pornography addiction among children using EEG signals: A systematic literature review. *Computers in Biology and Medicine, 125*, 103970-103970. https://doi.org/10.1016/j.compbiomed.2020.103970

[41] Wright, P. J., Sun, C., Steffen, N. J., & Tokunaga, R. S. (2019). Associative pathways between pornography consumption and reduced sexual satisfaction. Sexual and Relationship Therapy, 34(4), 422-439. https://doi.org/10.1080/14681994.2017.1323076

[42] Caselli, G., & Spada, M. M. (2010). Metacognitions in desire thinking: A preliminary investigation. *Behavioural and Cognitive Psychotherapy, 38*(5), 629-637. https://doi.org/10.1017/S1352465810000317

[43] Palmer, M. A., Sauer, J. D., Ling, A., & Riza, J. (2017). Caffeine cravings impair memory and metacognition. *Memory (Hove), 25*(9), 1225-1234. https://doi.org/10.1080/09658211.2017.1282968

[44] Amendola, S., Spensieri, V., Biuso, G. S., & Cerutti, R. (2020). The relationship between maladaptive personality functioning and problematic technology use in adolescence: A cluster analysis approach. *Scandinavian Journal of Psychology, 61*(6), 809-818. (National Institute on Drug Abuse, 2020).

[45] Qiu, L., Su, J., Ni, Y., Bai, Y., Zhang, X., Li, X., Wan, X. (2018). The neural system of metacognition accompanying decision-making in the prefrontal cortex. *PLos Biol, 16*(4). https://doi.org/10.1371/journal.pbio.2004037

[46] Miyamoto, K., Trudel, N., Kamermans, K., Lim, M. C., Lazari, A., Verhagen, L., Wittmann, M. K., & Rushworth, M. F. S. (2021). Identification and disruption of a neural mechanism for accumulating prospective metacognitive information prior to decision-making. *Neuron (Cambridge, Mass.), 109*(8), 1396-1408.e7. https://doi.org/10.1016/j.neuron.2021.02.024

[47] United States. Public Health Service. Office of the Surgeon General, & United States. Substance Abuse and Mental Health Services Administration. (2016). *Facing addiction in america: The surgeon general's report on alcohol, drugs and heath.* U.S. Department of Health and Human Services, Office of the Surgeon General.

[48] Tao, R., Huang, X., Wang, J., Zhang, H., Zhang, Y., & Li, M. (2010). Proposed diagnostic criteria for internet addiction. *Addiction (Abingdon, England), 105*(3), 556-564. https://doi.org/10.1111/j.1360-0443.2009.02828.x

[49] Day, J. J., & Carelli, R. M. (2007). The nucleus accumbens and pavlovian reward learning. *The Neuroscientist (Baltimore, Md.), 13*(2), 148-159. https://doi.org/10.1177/1073858406295854

[50] Brand, M., Snagowski, J., Laier, C., & Maderwald, S. (2016). Ventral striatum activity when watching preferred pornographic pictures is correlated with symptoms of internet pornography addiction. *NeuroImage (Orlando, Fla.), 129,* 224-232. https://doi.org/10.1016/j.neuroimage.2016.01.033

[51] Sinke, C., Engel, J., Veit, M., Hartmann, U., Hillemacher, T., Kneer, J., & Kruger, T. H. C. (2020). Sexual cues alter working memory performance and brain processing in men with compulsive sexual behavior. *NeuroImage Clinical, 27,* 102308-102308. https://doi.org/10.1016/j.nicl.2020.102308

[52] Laier, C., Schulte, F. P., & Brand, M. (2013). Pornographic picture processing interferes with working memory performance. *The Journal of Sex Research, 50*(7), 642-652. https://doi.org/10.1080/00224499.2012.716873

[53] Hilton, D. L., & Watts, C. (2011). Pornography addiction: A neuroscience perspective. *Surgical Neurology International, 2*(1), 19-19. https://doi.org/10.4103/2152-7806.76977

[54] Toneatto, T. (1999). Metacognition and substance use. *Addictive Behaviors, 24*(2), 167-174. https://doi.org/10.1016/S0306-4603(98)00126-9

[55] Thomas, J., Katsikitis, M., Allen, A., & Kannis-Dymand, L. (2020). Desire thinking and metacognition associated with dysregulated sexuality. *Sexual Addiction & Compulsivity, 27*(1-2), 119-134. https://doi.org/10.1080/10720162.2020.1772155

[56] Allen, A., Kannis-Dymand, L., & Katsikitis, M. (2017). Problematic internet pornography use: The role of craving, desire thinking, and metacognition. *Addictive Behaviors, 70*, 65-71. https://doi.org/10.1016/j.addbeh.2017.02.001

[57] Basu, D. (2020). Of mice and men. The unforgettable narrative of how social factors shape substance use, addiction, and recovery.(N. N. de oration award 2019). I*ndian Journal of Social Psychiatry : Official Publication of Indian Association for Social Psychiatry, 36*(4), 270-276. https://doi.org/10.4103/ijsp.ijsp_393_20

[58] Sussman, S. (2021). Commentary: Addiction, stigma, and neurodiversity. Evaluation & the *Health Professions, 44*(2), 186-191. https://doi.org/10.1177/01632787211012036

[59] Lang, B., & Rosenberg, H. (2017). Public perceptions of behavioral and substance addictions. *Psychology of Addictive Behaviors, 31*(1), 79-84. https://doi.org/10.1037/adb0000228

[60] Lindsay, B. L., Bernier, E., & Szeto, A. C. H. (2021;2020;). An exploration on the public stigma of sexual addiction. *Sexual Addiction & Compulsivity, 27*(3-4), 293-321. https://doi.org/10.1080/10720162.2021.1904471

[61] Pettersen, H., Landheim, A., Skeie, I., Biong, S., Brodahl, M., Oute, J., & Davidson, L. (2019). How social relationships influence substance use disorder recovery: A collaborative narrative study. *Substance Abuse : Research and Treatment, 13*, 1178221819833379-1178221819833379. https://doi.org/10.1177/1178221819833379

[62] Wiers, R. W., & Verschure, P. (2021). Curing the broken brain model of addiction: Neurorehabilitation from a systems perspective. *Addictive Behaviors, 112*, 106602-106602. https://doi.org/10.1016/j.addbeh.2020.106602

[63] Snoek, A., Levy, N., & Kennett, J. (2016). Strong-willed but not successful: The importance of strategies in recovery from addiction. *Addictive Behaviors Reports*, *4*(C), 102-107. https://doi.org/10.1016/j.abrep.2016.09.002

[64] Hyman, S. E., Malenka, R. C., & Nestler, E. J. (2006). Neural mechanisms of addiction: The role of reward-related learning and memory. *Annual Review of Neuroscience*, *29*(1), 565-598. https://doi.org/10.1146/annurev.neuro.29.051605.113009

[65] Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of addiction: Neurocircuitry: A window into the network underlying neuropsychiatric disease. *Neuropsychopharmacology (New York, N.Y.), 35*(1), 217-238.

[66] Brewer, J. A., & Potenza, M. N. (2008;2007;). The neurobiology and genetics of impulse control disorders: Relationships to drug addictions. *Biochemical Pharmacology, 75*(1), 63-75. https://doi.org/10.1016/j.bcp.2007.06.043

[67] Nestler, E. J. (2008). Review. transcriptional mechanisms of addiction: Role of DeltaFosB. Philosophical Transactions. *Biological Sciences*, *363*(1507), 3245-3255. https://doi.org/10.1098/rstb.2008.0067

[68] Pitchers, K. K., Frohmader, K. S., Vialou, V., Mouzon, E., Nestler, E. J., Lehman, M. N., & Coolen, L. M. (2010). DeltaFosB in the nucleus accumbens is critical for reinforcing effects of sexual reward. *Genes, Brain and Behavior, 9*(7), 831-840. https://doi.org/10.1111/j.1601-183X.2010.00621.x

[69] Hedges, V. L., Chakravarty, S., Nestler, E. J., & Meisel, R. L. (2009). Δ FosB overexpression in the nucleus accumbens enhances sexual reward in female syrian hamsters. *Genes, Brain and Behavior, 8*(4), 442-449. https://doi.org/10.1111/j.1601-183X.2009.00491.x

[70] Wallace, D. L., Vialou, V., Rios, L., Carle-Florence, T. L., Chakravarty, S., Kumar, A., Graham, D. L., Green, T. A., Kirk, A., Iñiguez, S. D., Perrotti, L. I., Barrot, M., DiLeone, R. J., Nestler, E. J., & Bolaños-Guzmán, C. A. (2008). The influence of DeltaFosB in the nucleus accumbens on natural reward-related behavior. *The Journal of Neuroscience, 28*(41), 10272-10277. https://doi.org/10.1523/JNEUROSCI.1531-08.2008

71] Barrot, M., Olivier, J. D. A., Perrotti, L. I., DiLeone, R. J., Berton, O., Eisch, A. J., Impey, S., Storm, D. R., Neve, R. L., Yin, J. C., Zachariou, V., Nestler, E. J. (2002). CREB activity in the nucleus accumbens shell controls gating of behavioral responses to emotional stimuli. *Proceedings of the National Academy of Sciences. 99*(17), 11435-11440. https://doi.org/10.1073/pnas.172091899

[72] Love, T., Laier, C., Brand, M., Hatch, L., & Hajela, R. (2015). Neuroscience of internet pornography addiction: *A review and update. Behavioral Sciences, 5*(3), 388-433. https://doi.org/10.3390/bs5030388

[73] Nestler, E. J., Barrot, M., & Self, D. W. (2001). DeltaFosB: A sustained molecular switch for addiction. Proceedings of the National Academy of Sciences - PNAS, *98*(20), 11042-11046.

[74] Muchnik, S. K., Lorente-Galdos, B., Santpere, G., & Sestan, N. (2019). Modeling the evolution of human brain development using organoids. *Cell, 179*(6), 1250-1253. https://doi.org/10.1016/j.cell.2019.10.041

[75] McTeague, L. M., Goodkind, M. S., & Etkin, A. (2016). Transdiagnostic impairment of cognitive control in mental illness. *Journal of Psychiatric Research, 83*, 37-46. https://doi.org/10.1016/j.jpsychires.2016.08.001

[76] Lopera, R. E., Rincón Hurtado, A., Vargas Gonzalez, V., Arbeláez, J. F., Castaño Pérez, G. A., Buitrago Salazar, J. C., & Gaviria Arbeláez, S. (2019). Cognitive impairment in patients with dual pathology. *Addictive Disorders & their Treatment, 18*(1), 53-57. https://doi.org/10.1097/ADT.0000000000000150

[77] Rajeswaran, J., & Bennett, C. (2018). Cognitive rehabilitation in addictive disorders. Indian *Journal of Psychiatry, 60*(8), 490-493. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_17_18

[78] Wegmann, E., & Brand, M. (2021). Affective and cognitive processes involved in behavioral addictions. *Addictive Behaviors, 118,* 106885-106885. https://doi.org/10.1016/j.addbeh.2021.106885

[79] Spada, M. M., Caselli, G., Nikčević, A. V., & Wells, A. (2014;2015;). Metacognition in addictive behaviors. *Addictive Behaviors, 44,* 9-15. https://doi.org/10.1016/j.addbeh.2014.08.002

[80] Bidi, F., Namdari-Pejman, M., Kareshki, H., & Ahmadnia, H. (2012). The mediating role of metacognition in the relationship between internet addiction and general health. *Addiction and Health, 4*(1-2), 49-56.

[81] Balıkçı, K., Aydın, O., Sönmez, İ., Kalo, B., & Ünal-Aydın, P. (2020). The relationship between dysfunctional metacognitive beliefs and problematic social networking sites use. *Scandinavian Journal of Psychology, 61*(5), 593-598. https://doi.org/10.1111/sjop.12634

[82] Nasser, N. S., Sharifat, H., Rashid, A. A., Hamid, S. A., Rahim, E. A., Loh, J. L., Ching, S. M., Hoo, F. K., Siti Irma Fadillah Ismail, Tyagi, R., Mohammad, M., Suppiah, S., & Suppiah, S. (2020). Cue-reactivity among young adults with problematic instagram use in response to instagram-themed risky behavior cues: A pilot fMRI study. Frontiers in *Psychology, 11,* 556060-556060. https://doi.org/10.3389/fpsyg.2020.556060

[83] Moritz, S., Gehlenborg, J., Bierbrodt, J., Wittekind, C. E., & Bücker, L. (2021). A ghost in the machine? the predictive role of metacognitive beliefs, cognitive biases, and machine-related features in the severity of problematic slot machine gambling. *Personality and Individual Differences, 171*https://doi.org/10.1016/j.paid.2020.110539

[84] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

[85] Spada, M. M., & Wells, A. (2006). Metacognitions about alcohol use in problem drinkers. *Clinical Psychology and Psychotherapy, 13*(2), 138-143. https://doi.org/10.1002/cpp.478

[86] Kadri, R., Husain, R., & Omar, S. H. S. (2020). Impact of spiritual meditation on drug addiction recovery and wellbeing: A systematic review. *International Journal of Human and Health Sciences, 4*(4), 237. https://doi.org/10.31344/ijhhs.v4i4.208

[87] Witkiewitz, K., & Bowen, S. (2010). Depression, craving, and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology, 78*(3), 362-374. https://doi.org/10.1037/a0019172

[88] Kuan, T. (2012). Cognitive operations in buddhist meditation: Interface with western psychology. *Contemporary Buddhism, 13*(1), 35-60. https://doi.org/10.1080/14639947.2012.669281

[89] Pruett, J. M., Nishimura, N. J., & Priest, R. (2007). The role of meditation in addiction recovery. *Counseling and Values, 52*(1), 71-84. https://doi.org/10.1002/j.2161-007X.2007.tb00088.x

[90] Chen, K. W., Berger, C. C., Gandhi, D., Weintraub, E., & Lejuez, C. W. (2013). Adding integrative meditation with ear acupressure to outpatient treatment of cocaine addiction: A randomized controlled pilot study. T*he Journal of Alternative and Complementary Medicine (New York, N.Y.), 19*(3), 24-210. https://doi.org/10.1089/acm.2011.0311

[91] Stern, Y., MacKay-Brandt, A., Lee, S., McKinley, P., McIntyre, K., Razlighi, Q., Agarunov, E., Bartels, M., & Sloan, R. P. (2019). Effect of aerobic exercise on cognition in younger adults: A randomized clinical trial. *Neurology, 92*(9), e905-e916. https://doi.org/10.1212/WNL.0000000000007003

[92] Raichlen, D. A., & Alexander, G. E. (2017). Adaptive capacity: An evolutionary neuroscience model linking exercise, cognition, and brain health. *Trends in Neurosciences (Regular Ed.), 40*(7), 408-421. https://doi.org/10.1016/j.tins.2017.05.001

[93] Lu, Y., Qi, X., Zhao, Q., Chen, Y., Liu, Y., Li, X., Yu, Y., & Zhou, C. (2021). Effects of exercise programs on neuroelectric dynamics in drug addiction. *Cognitive Neurodynamics, 15*(1), 27-42. https://doi.org/10.1007/s11571-020-09647-w

[94] Haglund, M., Ang, A., Mooney, L., Gonzales, R., Chudzynski, J., Cooper, C. B., Dolezal, B. A., Gitlin, M., & Rawson, R. A. (2015). Predictors of depression outcomes among abstinent methamphetamine-dependent individuals exposed to an exercise intervention. *The American Journal on Addictions, 24*(3), 246-251. https://doi.org/10.1111/ajad.12175

[95] Fontes-Ribeiro, C. A., Marques, E., Pereira, F. C., Silva, A. P., & Macedo, T. R. A. (2011). May exercise prevent addiction? *Current Neuropharmacology, 9*(1), 45-48. https://doi.org/10.2174/157015911795017380

[96] NoFap (2011). NoFap. What is NoFap? Retrieved September 12, 2020, from https://nofap.com/about/

[97] Kraus, S. W., Gola, M., Grubbs, J. B., Kowalewska, E., Hoff, R. A., Lew-Starowicz, M., Martino, S., Shirk, S., Potenza, M. N. (2020). Validation of a brief pornography screen across multiple samples. *Journal of Behavioral Addictions, 9*(2), 259-271. https://doi.org/10.1556/2006.2020.00038

[98] Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: Properties of the MCQ-30. *Behaviour Research and Therapy, 42*(4), 385-396. https://doi.org/10.1016/S0005-7967(03)00147-5

[99] Caselli, G., & Spada, M. M. (2013). The metacognitions about desire thinking questionnaire: Development and psychometric properties: The metacognitions about desire thinking questionnaire. *Journal of Clinical Psychology, 69*(12), 1284-1298. https://doi.org/10.1002/jclp.21999

[100] Zhang, M. X., Lei, L. S. M., Wells, A., Dang, L., & Wu, A. M. S. (2020). Validation of a chinese version of the short form of metacognitions questionnaire (MCQ-30). *Journal of Affective Disorders, 277*, 417-424. https://doi.org/10.1016/j.jad.2020.08.028

[101] Kraus, S. K., Hoff, R. A., Gola, M., Kowalewska, E. and Potenza, M. N. (2018) Clinical Characteristics of Compulsive Pornography Users: A Military

[102] Sample. Presentation at the International Conference on Behavioral Addictions, 25 April 2018. Cologne, Germany

[103] Astle, S., McAllister, P., Emanuels, S., Rogers, J., Toews, M., & Yazedjian, A. (2021). College students' suggestions for improving sex education in schools beyond 'blah blah blah condoms and STDs'. *Sex Education, 21*(1), 91-105. https://doi.org/10.1080/14681811.2020.1749044

[104] Walsh, K. M., Saab, B. J., & Farb, N. A. (2019). Effects of a mindfulness meditation app on subjective well-being: Active randomized controlled trial and experience sampling study. *JMIR Mental Health, 6*(1), e10844-e10844. https://doi.org/10.2196/10844

[105] Kerr, C. E., Sacchet, M. D., Lazar, S. W., Moore, C. I., & Jones, S. R. (2013). Mindfulness starts with the body: Somatosensory attention and top-down modulation of cortical alpha rhythms in mindfulness meditation. *Frontiers in Human Neuroscience, 7,* 12-12. https://doi.org/10.3389/fnhum.2013.00012

[106] Lysaker, P. H., Kukla, M., Leonhardt, B. L., Hamm, J. A., Schnakenberg Martin, A., Zalzala, A. B., Gagen, E. C., & Hasson-Ohayon, I. (2020). Meaning, integration, and the self in serious mental illness: Implications of research in metacognition for psychiatric rehabilitation. *Psychiatric Rehabilitation Journal, 43*(4), 275-283. https://doi.org/10.1037/prj0000436

[107] Schure, M. B., Christopher, J., & Christopher, S. (2008). Mind-body medicine and the art of self-care: Teaching mindfulness to counseling students through yoga, meditation, and qigong. *Journal of Counseling and Development, 86*(1), 47-56. https://doi.org/10.1002/j.1556-6678.2008.tb00625.x

[108] Kok, B. E., & Singer, T. (2017). Phenomenological fingerprints of four meditations: Differential state changes in affect, mind-wandering, meta-cognition, and interoception before and after daily practice across 9 Months of training. *Mindfulness, 8*(1), 218-231. https://doi.org/10.1007/s12671-016-0594-9

[109] Deng, Y., Zhang, B., Zheng, X., Liu, Y., Wang, X., & Zhou, C. (2019). The role of mindfulness and self-control in the relationship between mind-wandering and metacognition. *Personality and Individual Differences, 141*, 51-56. https://doi.org/10.1016/j.paid.2018.12.020

[110] Eskisu, M., Cam, Z., Gelibolu, S., & Rasmussen, K. R. (2020). Trait mindfulness as a protective factor in connections between psychological issues and facebook addiction among turkish university students. *Studia Psychologica, 62*(3), 213-231. https://doi.org/10.31577/sp.2020.03.801

[111] Newlin, D. B. (1999). Evolutionary game theory and multiple chemical sensitivity. Toxicology and Industrial Health, 15(3-4), 313-322. https://doi.org/10.1177/074823379901500305

[112] Alcaro, A., Brennan, A., & Conversi, D. (2021). The SEEKING drive and its fixation: A neuro-psycho-evolutionary approach to the pathology of addiction. Frontiers in Human Neuroscience, 15, 635932-635932. https://doi.org/10.3389/fnhum.2021.635932

APPENDIX

APPENDIX

Brief Pornography Screener

(0=never, 1=sometimes, 2=frequently. Add up the scores, range will be 0 to 10)

1. You find yourself using pornography more than you want to.
2. You have attempted to "cut back" or stop using pornography, but were unsuccessful.
3. You find it difficult to resist strong urges to use pornography.
4. You find yourself using pornography to cope with strong emotions (e.g., sadness, anger, loneliness, etc.).
5. You continue to use pornography even though you feel guilty about it.

Metacognitions about desire questionnaire

1. I need to think about what I desire in order to feel motivated
2. When I begin thinking about a desired activity/object I cannot stop.
3. Imagining something I desire helps me to feel better.
4. If I imagine something I desire I will feel less its absence.
5. I cannot avoid thinking about a desired activity/object when it comes to my mind.
6. Imagining the desired activity/object makes me feel energized and ready to act.
7. Thoughts about certain desires should be always avoided.
8. I need to think about a desired activity/object not to be overwhelmed by worries.
9. Continuing to think about something I desire whilst I'm doing something different means I have no power over my mind.
10. I cannot stop thinking about a desired activity/object once I start
11. The more I imagine a desired activity/object the harder I find it to resist the impulse of doing it.
12. Imagining what I desire helps me to have greater control over my choices.
13. I need to imagine what I desire to avoid mistakes.
14. The images of what I desire persist not matter what I do to try to stop them
15. Not being able to control my thoughts about what I desire is a sign of weakness.
16. Images about what I desire come to mind even when I would not want this
17. to happen.
18. Imagining what I desire makes me feel I as though I have greater control
19. over what I have to do.
20. Continuously imaging what I desire without being able to stop means I
21. have no control.

Metacognitions Questionnaire-30 (MCQ-30)

Negative beliefs about uncontrollability of danger

1. 4.I could make myself sick with worrying
2. 21.When I start worrying, I cannot stop

APPENDIX (Continued)

3. 9.My worrying thoughts persist, no matter how I try to stop them
4. 2.My worrying is dangerous for me
5. 11.I cannot ignore my worrying thoughts
6. 15.My worrying could make me go mad
7. *Cognitive confidence*
8. 17.I have a poor memory
9. 8.I have little confidence in my memory for words and names
10. 24.I have little confidence in my memory for places
11. 26.I do not trust my memory
12. 29.I have little confidence in my memory for actions
13. 14.My memory can mislead me at times
14. *Positive beliefs*
15. 28.I need to worry in order to do well
16. 10.Worrying helps me to get things sorted out in my mind
17. 7.I need to worry in order to remain organized
18. 19.Worrying helps me cope
19. 23.Worrying helps me to solve problems
20. 1.Worrying helps me to avoid problems in the future
21. *Cognitive self-consciousness*
22. 18.I pay close attention to the way my mind works
23. 16.I am constantly aware of my thinking
24. 30.I constantly examine my thoughts
25. 12.I monitor my thoughts
26. 3.I think a lot about my thoughts
27. 13.I should be in control of my thoughts all of the time
28. 5.I am aware of the way my mind worlds when I am thinking through a problem
29. *Negative beliefs about the need to control thoughts*
30. 22.I will be punished for not controlling certain thoughts
31. 6.If I did not control a worrying thought, and then it happened, it would be my fault
32. 20.Not being able to control my thoughts is a sign of weakness
33. 25.It is bad to think certain thoughts
34. 27.If I could not control my thoughts, i would not be able to function

Recovery Elements

Tools:

1. Exercising
2. Meditation
3. Playing Sports

4. Practice mindfulness
5. Adjusted sleep schedule.

APPENDIX (Continued)

6. Finding healthy coping mechanisms to deal with internal triggers (i.e.: healthy ways to combat stress, boredom, etc.)
7. Attend therapy with a porn/sexual addiction specialist.
8. Attend therapy to work on any underlying conditions I may or may not have.
9. Attend group sessions dedicated to my recovery (SAA)
10. Reduced or eliminated activities with known triggers.
11. Involvement in online forums dedicated to my recovery.
12. Speaking with an accountability partner
13. Including activities related to my religion.
14. Including activities related to my spiritual practices.
15. Practicing yoga
16. Studying the scientific literature dedicated to addiction and recovery.
17. Reading books dedicated to self-improvement.
18. Changed my daily routine to reduce triggers/exposure associated with pornography.
19. Using porn blockers or other apps to reduce exposure to explicit content.

Activities:

1. Reading books
2. Creative writing
3. Drawing
4. Painting
5. Nature walks/hiking
6. Playing an instrument
7. Learning something new
8. Taking college courses
9. Doing puzzles
10. Playing puzzle games

11. Playing memory games

Engagement in media:

APPENDIX (Continued)

1. Watching TV
2. Facebook
3. Instagram
4. Twitter
5. Other social media not listed.
6. YouTube
7. Watching movies
8. Playing video games
9. Using the internet in unproductive ways

Triggers:

1. Explicit content on social media
2. Explicit content on YouTube
3. Explicit content on Television or movie scenes
4. Boredom
5. Anxiety
6. Stress
7. Need to escape.
8. Depression
9. Feeling unloved
10. Feeling rejected
11. Feeling unworthy
12. Feeling judged by others
13. Feeling lonely
14. Being alone
15. Sexual frustration

16. Peer pressure
17. Feeling lazy or unmotivated to do anything productive.

APPENDIX (Continued)

18. Experiencing the “chaser effect”
19. Masturbation
20. Fantasizing
21. Excess screen time
22. Access to the internet either in the bathroom or bedroom
23. Romance novels
24. Romantic movies