Attentional bias to social media cues: An eye tracking study

Alyssa Marshall

A report submitted as a partial requirement for the degree of Bachelor of Psychology with Honours at the University of Tasmania, 2021

Statement of Sources

I declare that this report is my own original work and that contributions of others have been duly acknowledged.

Signed __________________________ Date___3-11-2021_____

Alyssa Marshall

Acknowledgements

Firstly, thank you to my supervisor, Dr. Jason Satel. Your support, feedback, and optimistic attitude has gotten me through this tough year and made this research project a memorable one. Even if I do not go on to do further research, I will look back to this experience fondly, despite setbacks.

Thank you to Allison, for your encouragement and understanding throughout the entire year.

An extra special thanks to Dr Halley Ponting for dedicating your time to helping organise surveys and giving feedback from literally the other side of the world. Your dedication amazes me, and I appreciate it more than I can put into words.

Thank you to Hannah and Sam, my fellow honours students, for your reassurance and support throughout the year. Knowing that I was not alone in my struggles was more valuable than you know.

To all the volunteers who helped with lab work, including Jason's PhD student Sam, thank you. Volunteers are the backbone of research.

Finally, Mia. You have been the most amazing emotional support this entire year. Thank you for being there when I needed a shoulder to cry on and encouraging me to keep going. I could not have done this without you.

Contents

Statement of Sources ii
Acknowledgements iii
List of Tables v
List of Figures vi
Abstract 1
Introduction **Error! Bookmark not defined.**
- **Addiction** 2
- **Behavioural Addiction** 3
- **Problematic Social Media Use** 5
- **Attentional Bias** 8

Method 14
- *Design* 14
- *Participants* 14
- *Apparatus/Instrumentation/Materials* 15
- *Procedure* 17

Results 18
Discussion 25
References 35
Appendix 1 50
Appendix 2. Survey 51
Abstract 3. Ethics Approval 92

List of Tables

Table 1. *Mean, Minimum, and Maximum Scores on Key Survey Scales* 25

Table 2. *Results of Assumption Testing* 26

Table 3. *Mean Reaction Times in Milliseconds for Each Group, Split by Condition* 29

Table 4. *Correlations Between Survey Scores and Reaction Time* 31

List of Figures

Figure 1. *Example of Congruent Trial in Experimental Task* 23

Figure 2. Q*uantile-Quantile Plot* 27

Figure 3. *Mean Reaction Time in Milliseconds Across Conditions for Each Group* 28

Figure 4. *Mean Reaction Time in Milliseconds Across Groups for Congruent and Incongruent Trials* 28

Figure 5. *Interaction Between Group and Congruency* 29

Attentional bias to social media words: An eye tracking study

Alyssa Marshall

Word Count: 9,067

Abstract

Many behaviours provide short-term rewards. However, when adverse consequences begin to occur, and individuals continue engaging in the behaviour, it becomes maladaptive, and may develop into a behavioural addiction. Determining which behaviours should be classified as behavioural addictions requires an understanding of the mechanisms that underly addiction. Attentional bias is believed to be an underlying mechanism for both substance abuse and gambling disorders, but there is limited research about its connection to Problematic Social Media Use (PSMU). This study used eye-tracking technology to explore whether individuals with differing levels of PSMU, measured by a post-experimental survey, had different attentional biases in the form of saccadic reaction time. The sample included 26 participants, aged 20-32 (M = 24.65, SD = 3.82) Results indicated that there was no effect of attentional bias on reaction time in individuals with differing levels of PSMU. However, measures of PMSU were significantly correlated with impulsivity and attention deficits, suggesting that there may be different factors involved in the maintenance of PSMU to other addictions. Further research with larger samples is needed to understand the role of attentional bias in PSMU and addiction.

Addiction

Addiction in Australia is a serious problem. Around one in 20 Australians suffer from a substance related addiction (Healthdirect, 2020) and up to 5% of adolescents aged 12-17 engage in problematic gambling behaviours (King et al., 2020). Substance addiction has a social cost of $176.51 billion per year in Australia alone (Manning et al., 2013). This cost includes medical issues, criminal charges, loss in productivity in a work setting, and the overhead associated with operating specific programs intended to prevent and treat substance abuse (Whetton et al., 2016; 2019; 2020a; 2020b). Similarly, behavioural addictions have a significant cost to society. In Australia, gambling disorder has an estimated cost of at least $4.7 billion per year (Breen, 2021). Social media and other internet related addictions also have significant societal cost including lost productivity in workplace and reduced wellbeing of employees (Priyadarshini et al., 2020).

Currently, the definition of clinical addiction is highly influenced by substance abuse research. Therefore, clinical addiction can be defined as a medical disease that leads to engagement in compulsive substance use (or behaviours) that persist despite harmful consequences (American Society of Addiction Medicine, 2019). Common harmful consequences of clinical addictions such as substance abuse include health problems, paranoia, depression, anxiety, aggression, hallucinations, and other short and long-term psychological issues (Botvin & Griffin, 2016). When talking about addiction, the first thing that comes to mind tends to be drug or alcohol abuse. However, many types of behaviours can and have been examined through the lens of addiction. For example, Gambling Disorder is currently recognised in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychological Association, 2013) as a clinical addiction due to the characteristic uncontrollable urge to persist with gambling despite consequences (APA, 2013). It is not unusual to see someone refer to various types of behaviour, such as internet use or gaming as “addictions”. However, there needs to be a distinction made between high levels of engagement in certain behaviours, and compulsive/addictive engagement (Andreassen et a., 2012).

Behavioural Addiction

In everyday conversations, one might admit to being ‘addicted’ to everyday behaviours such as eating, exercising, gaming, and engaging in social media. It could be argued that most behaviours have the potential to become problematic and develop into an addiction, but where do we draw the line between normal behaviour and behavioural addiction? Afterall, everyday behaviours like eating and using social media can be necessary and rewarding, with positive outcomes for social, emotional, physical, and psychological health (Akram & Kumar, 2017; Andreassen et al., 2016; Siddiqui & Singh, 2016). However, the key to achieving positive outcomes from such behaviours is by engaging in them with moderation (Grant, 2010). Making sure to balance behaviours and only spend a ‘typical’ amount of time engaging in any one behaviour seems straight forward enough. However, time spent doing certain behaviours is not enough to determine whether someone is addicted or not (Grant et al., 2010). For example, the average Australian spends over six hours, or one quarter, of their day online (Kemp, 2021). Despite such high engagement, it was estimated in late 2020 that only around 6-8% of internet users show signs of addiction (Pan et al., 2020). It is worth noting that there is minimal research examining the rates of internet addiction, due to the lack of consensus on its definition, so estimates of internet addiction prevalence may not reflect reality.

Clearly, engagement time does not define behavioural addiction, so what does? Grant and colleagues (2010) define behavioural addiction as behaviours that produce short-term rewards that result in habit formation and persistent engagement despite awareness of negative consequences. So, individuals engage in behaviours and enjoy the positive consequences associated with them. They then repeat this behaviour compulsively, seeking reward. Individuals may then develop a habit of performing this behaviour even when adverse social, emotional, or physical consequences become apparent. Some consequences include sleep problems, depression, anxiety, cravings, and interpersonal conflict (Andreassen et al., 2016). Continuing the behaviour provides short-term relief from adverse consequences, which is a reward in itself (Grant et al., 2012). However, over time, as problems are avoided, they grow larger and harder to escape from, and the behaviour no longer provides a reward. Regardless, the individual may continue engaging in the behaviour due to it becoming a habitual response, thus the behaviour is reinforced and maintained, reflecting addiction. This process of habit formation is known as operant conditioning and is a popular behaviourist theory in the addiction literature (Messinis, 1999; Verplanken et al., 2018). A limitation to behaviourist theories of addiction is that not everyone continues to engage in behaviours once negative consequences outweigh rewards; it is hard to determine which individuals are susceptible to developing behavioural addictions using behaviourist theories alone (Griffiths & Delfabro, 2001). Regardless, behaviourist theories of addiction are a good starting point for understanding why behaviours can be classified as "addictions".

There is a consensus that behavioural addiction is a real issue (APA, 2013; Grant et al., 2010; Pinna et al., 2015), but it is less agreed upon which behaviours are addictive. The DSM-5 currently only recognises Gambling Disorder as an official behavioural addiction (APA, 2013). However, the DSM-5 has included some notes suggesting further research be undertaken on other behaviours which may deserve a place as a diagnosable clinical disorder (APA, 2013). For example, the DSM is currently considering Internet Gaming Disorder for the next edition (APA, 2013) and there are numerous studies suggesting Social Media Addiction, Internet Addiction, Work Addiction, and more, for consideration for classification in future editions (Parekh, 2018; Pinna et al., 2015). It is important that behavioural addiction is studied in detail so that diagnostic criteria and treatment methods can be developed. Research indicates that problematic behaviours reflecting behavioural addiction result in several consequences ranging from minor to severe which significantly impact both individuals and society (Grant et al., 2010). To reduce the impact of behavioural addiction, researchers need to understand the underlying mechanisms of behavioural addiction. If we understand what causes and maintains problematic behaviours, we can develop preventative and treatment strategies. While it is possible that common mechanisms underlie all behavioural addictions, not enough research has been done to identify what they may be. Instead, it may be easier to focus on one potential form of behavioural addiction at a time and see what mechanisms underlie it, then generalise from there. This thesis will focus on PSMU which has a growing body of research behind it (Andreassen et al., 2016; Heuer et al., 2021; Kim et al., 2017; Moqbel & Kock, 2018).

Problematic Social Media Use

Since the beginning of Covid-19 lockdowns, time spent online has increased noticeably (Kemp, 2021). As of January 2021, around 80% of Australians report having a social media account (Kemp, 2021). Of these social media users, 96.4% have visited or used social media within the month of surveying, classifying them as active users (Kemp, 2021). Additionally, only 29.8% of social media users use it for work purposes, suggesting that it is more of a leisure activity (Kemp, 2021). As previously mentioned, the average Australian spends over six hours per day online (Kemp, 2021). Out of these six hours, one hour and 46 minutes are spent on social media (Kemp, 2021. In an average month, respondents report spending around 18.2 hours on Facebook alone (Kemp, 2021). The 2021 digital report (Kemp, 2021) did not report the range of hours spent on Facebook beyond the average. However, human behaviour is variable by nature; a statistical average does not reflect the range of scores, and it is likely that some people spend much more or less than the average hours reported (Geirdal et al., 2021; Sciberras et al., 2020). Due to social desirability bias, which is the tendency to respond to surveys in a way that they assume would be favourable to others, it is likely that individuals also underreport the amount of time spent on social media (Durak & Seferoğlu, 2019). Around 96% of Australians own a smart phone, making it easy to access the internet and social media on demand (Kemp, 2021). Despite high penetration and engagement rates, PSMU is not a problem for most social media users. For most people, social media use is associated with positive consequences for their social and emotional wellbeing (Andreassen et al., 2016). Studies show positive relationships between social media use and enhanced feelings of social connectedness, knowledge, and entertainment (Al-Menayes, 2015; Andreassen et al., 2016). However, as with other behaviours that may result in addiction, social media use can be associated with poorer mental health for a small percentage of people (Sciberras et al., 2020). Social media use that causes poor mental health can be described as PSMU (Andreassen et al., 2016).

PSMU is social media use that involves high levels of intensity and time spent engaging with social media, paired with negative symptoms associated with its use (Andreassen et al., 2016). Such symptoms include items such as anxiety when unable to check social media, depression, fear of missing out, failed attempts at reducing time spent engaging with social media, and interpersonal conflict (Al-Menayes, 2015; Andreassen et al., 2016). For some individuals, such consequences have negatively affected relationships with friends and family, as well as having impacted performance at work or school (Andreassen et al., 2016; Priyadarshini et al., 2020; Sciberras et al., 2020**)**. Like clinical addictions such as substance abuse, the effect of PSMU is costly. Studies have shown that high levels of social media engagement negatively impact workplace productivity, mental health, and overall social-emotional wellbeing (Priyadarshini et al., 2020). PSMU is an important topic to study as social networking sites are literally catered towards addiction. They are designed to capture and hold onto audience attention using of visually simple, pleasing, and recognisable imagery (Saura et al., 2021; Zakon, 2020). Algorithms present novel posts in a reward-like manner, where they are presented at random intervals (Bhargava & Velasquez, 2021; Griffiths, 2018). Rewarding users at random intervals is a technique that is utilised by slot machines and other gambling activities and has been found to induce addiction in those who are vulnerable to it (Laskowski et al., 2019). Since social networking sites are designed to be addictive, it is important to not only understand who is vulnerable to PSMU, but also what mechanisms underpin it. Such understanding could allow researchers to develop better methods of intervention to bring behaviours back to healthy levels in a world where abstaining from social media is nearly impossible.

There is some research examining who is vulnerable to developing PSMU. Through the lens of addiction, researchers have identified several personality traits associated with higher levels of social media use (Andreassen et al., 2016; Blackwell et al., 2017) These traits include extraversion, neuroticism, attachment style, impulsivity, sensation seeking, and fear of missing out (Blackwell et al., 2017; Sindermann et al., 2020). Interestingly, there is some overlap with the personality traits that are commonly associated with addiction. Individuals with substance abuse or gambling disorders often have higher than usual impulsivity and sensation seeking (Grant et al., 2010). As with currently recognised addictive disorders, PSMU is believed to be maintained by several factors other than personality-based vulnerability (Al-Menayes, 2015). Although it is important to understand who is vulnerable to developing behavioural addictions such as PSMU, it is also important to understand the mechanisms that underlie and maintain these addictive behaviours so that interventions to help individuals alter their behaviours to a healthy and adaptive level can be developed. One leading theory of underlying processes of addiction is attentional bias (Field et al., 2013a).

Attentional Bias

Attentional bias has been identified as one of the key mechanisms behind addiction (Field et al., 2013a; Field et al., 2009, Franken, 2003). Attentional bias is defined as the tendency to attend to stimuli which have high saliency or personal relevance for the individual (Cox et al., 2014). There is evidence to suggest that individuals with addiction show an attentional bias toward stimuli that are relevant to their addiction. For example, a picture of a cigarette is more likely to maintain the attention of a smoker than a picture of a leaf (Ehrman et al., 2002: Goudriaan et al., 2010). Although there is evidence of attentional bias underlying addiction across different types of substances and behaviours, not all studies have used the same technique to study it. Differing techniques derive from varying definitions of attentional bias.

Attentional bias is studied differently based on which type of attention the researcher intends to measure (Parr & Friston, 2019). There are two types of attention: overt and covert. Overt attention is when someone looks directly at that which they are attending to (Parr & Friston, 2019). On the other hand, covert attention is defined as paying attention to something in the peripheral without orienting toward it (Parr & Friston, 2019). Identifying which type of attention is being referred to in attentional bias studies is important because it affects the interpretation of data. A study examining overt attentional bias in addiction might do so by measuring the amount of time participants spend gazing at stimuli and comparing that against some measure of behavioural addiction (Thomson et al., 2021). One method of studying covert attentional bias is by measuring reaction time to targets that appear after a centrally fixated cuing period. However, it is important that measures are put in place to ensure that participants complete tasks as instructed, or results may not reflect what researchers intend to measure (Field & Cox, 2008). Clearly defining which type of attentional bias is being measured is important for the interpretation of findings (Field & Cox, 2008; Parr & Friston, 2019).

Studies exploring overt attentional bias in behavioural addiction often have mixed results. For example, many studies have found that addicted individuals spend significantly more time gazing at addictive stimuli than non-addicted control groups (Freijy et al., 2014; Jiang et al., 2017). Despite longer gaze times, studies of overt attention rarely find significant differences in reaction time between addiction-cues and non-addiction control cues, regardless of group (Freijy et al., 2014; Jeromin et al., 2016; Jiang et al., 2017). Studies of overt attention all share one key limitation; they are not necessarily exploring attentional bias. Instead, overt attention studies are likely to be measuring biases in initial orienting and effects of retinal stimulation (Field & Cox, 2008; Parr & Friston, 2019). If an individual is looking directly at a stimulus on the right side of the screen, they will react more quickly to a target that appears in the same location than one on the opposite side of the screen. This does not necessarily mean that the participant has an attentional bias for the image they were looking at. Instead, reaction times reflect repeat retinal stimulation. When stimuli are presented in the same location of the retina multiple times (like in congruent trials), there are higher levels of activation in retinotopic cortical cells, making it easier to respond to the target (Satel et al., 2019). One method of avoiding repeat retinal stimulation and measuring attentional bias more accurately is by using a central fixation cross that participants must keep their eyes on (Zhang et al., 2019). Many studies use a fixation cross, but do not use eye-tracking to ensure participants remain on fixation, so findings must be interpreted with caution (Freijy et al., 2014; Petrova et al., 2013). If participants are instructed to maintain fixation, but nothing is put in place to ensure this, data may not reflect what researchers intend to measure. It is important that eye-tracking is utilised to ensure participants follow the task instructions, making data interpretation more straight forward (Pretrova et al., 2013).

Eye-tracking software is crucial for measuring covert attentional bias accurately (Satel et al., 2019).

In an experimental context, covert attention is when participants focus their attentional resources on peripheral stimuli without moving their eyes (Satel et al., 2019). For studies of covert attention, it is important to not only instruct participants to not move their eyes off fixation unless a saccadic response (eye movement to visual probe) is required, but to also track their eyes to ensure they are doing this because our eyes naturally want to move toward stimuli. A popular method of measuring covert attentional bias is using a visual probe paradigm accompanied by eye-tracking. This technique should result in more valid results than ones without eye-tracking (Satel et al., 2019), however few studies have explored covert attentional bias in behavioural addiction. There are currently no published studies that used eye-tracked visual probe tasks for PSMU, but there are a few related studies using this paradigm for other types of addiction such as substance abuse disorders (i.e., Emery & Simons, 2015; Field et al., 2004; Field et al., 2013a; Sinclair et al., 2016). Studies of covert attentional bias in substance abuse disorders are a good starting point for understanding how covert attentional processes underlie behavioural addictions like PSMU. For example, on average, alcoholics react more quickly to cues relating to alcohol than control groups (Emery & Simons, 2015; Field et al., 2004; Field et al., 2013a; Sinclair et al., 2016). Additionally, alcoholic participants react more quickly to alcohol cues than non-alcohol cues; this difference was typically not found in control groups (Emery & Simons, 2015; Field et al., 2004; Field et al., 2013a; Sinclair et al., 2016). Visual probe paradigms with eye-tracking have also found that individuals with other behavioural addictions, like gambling disorder and problematic internet gaming, react more quickly to addictive cues than control cues, and this effect is not found in non-addicted groups (Hønsi et al., 2013; Kim et al., 2018). With such consistent results across different types of addiction, it could be assumed that there must be some underlying influence of attentional bias in the maintenance or acquisition of addictive behaviour. Typically, addicted individuals are faster to respond to addiction-related stimuli than control stimuli, and this difference is not found in non-addicted control groups (Jeromin et al., 2016). This is believed to be due to increased saliency of certain types of stimuli in individuals with addictions (Grant et al., 2010).

Valyear and colleagues (2017) use behavioural theories of conditioning to explain how drug related stimuli develop incentive salience. I will use the example of nicotine addiction to illustrate what was discussed by Valyear and colleagues (2017). An individual will engage in a behaviour, such as smoking cigarettes, and receive positive reinforcement from it, i.e., a chemical reward (Valyear et al., 2017). Over time, with repeated substance use, the individual begins to associate items, such as a lighter, or the balcony table they always smoke at, with this positive reinforcement. Eventually, seeing pictures of a lighter will trigger thoughts about the substance, and result in cravings (Valyear et al., 2017). This association may persist even when the substance, or behaviour, no longer provides positive rewards. Instead, the behaviour may be maintained as performing it helps escape negative consequences such as withdrawal (Valyear et al., 2017). While models of conditioning explain how individuals come to associate stimuli with addictive behaviour, it does not explain why some people develop addictions and others do not. Regardless, conditioning is a useful model for understanding how attentional bias maintains addiction by triggering cravings (Hester et al., 2006; Jeromin et al., 2016). In a visual probe task, attentional resources are directed to the salient object of addiction, typically resulting in faster reaction times to targets presented in the same location as the addiction cue. (Field et al., 2009; Field et al., 2013a; Grant et al., 2010).

There are very few studies examining attentional bias specifically for social media addiction, so it is hard to know whether social media cues capture the attention of those with high levels of PSMU in a similar way to how alcohol cues maintain the attention of alcoholic participants (Emery & Simons, 2015). Assuming that PSMU is like other addictions, it would make sense for it to share underlying processes like attentional bias toward addiction-related stimuli. If not, then it may not hold the same status as gambling disorder as a behavioural addiction, or it may be unique due to the way it is designed. Social media imagery is highly familiar and recognisable to many individuals, raising concerns as to why it might trigger craving in some individuals but not others. It is likely that the familiarity of such imagery would result in faster reaction times for many people due to familiarity effects (Balas et al., 2007). Due to the highly familiar nature of social media, it is difficult to draw a line between PSMU and healthy social media use based purely on how individuals respond to related imagery. Instead, experiments should compare reaction times against a validated measure of PSMU to identify differences in reaction times between groups of individuals with different levels of PSMU.

Since social media addiction is not currently recognised as a behavioural addiction in the DSM (APA, 2013), there is not an official measure to determine an individual's levels of PSMU and therefore no clear-cut way of determining whether they have high or low levels of PSMU. There are currently a few different scales that measure possible social media addiction that have been validated. One of these is the Bergen Facebook Addiction Scale (BFAS) developed by Andreassen and colleagues (2012). The BFAS initially included 18 items split evenly across six key elements of addiction. This was reduced to 6 items, each reflecting one of the following concepts: salience, mood modification, tolerance, withdrawal, conflict, and relapse (Andreassen et al., 2012). The scale has a good factor structure (RMSEA = .046, CFI = .99), as well as a good level of internal consistency (Cronbach's alpha = .83). There is also high test-retest reliability correlation (r = .82). Despite the BFAS being created specifically for Facebook, it can easily be modified to be used for social media "addiction" in general (Andreassen et al., 2016). Thus, this thesis will use a modified version of the BFAS, known as the Bergen Social Media Addiction Scale (BSMAS, Andreassen et al., 2016) to assess participants level of social media use.

This thesis aims to explore the role of covert attentional bias in PSMU using an eye-tracked dot-probe paradigm. Independent variables will be Group and Congruency. Group will have 3 levels: non-users, low levels of PSMU, and high levels of PSMU, and will be determined by responses to a questionnaire. Congruency refers to the cue-target presentation of each trial. Congruent trials are ones which present the target on the same side as the social media cue, while incongruent trials are ones which the target is on the opposite side to the social media cue. Hypothesis one is that there will be no main effect of trial type. Regardless of group, there will be no significant differences in reaction time between congruent and incongruent trials. Social media cues are familiar. Familiar stimuli tend to be more salient (Bortfield et al., 2013), and salient cues are known to elicit faster reactions (Donk & Soesman, 2010). However, our control cues will be similarly familiar to balance out any familiarity effects of social media cues. The second hypothesis is that there will be no significant differences between groups (regardless of trial types) in reaction times. The third and final hypothesis is that there will be a significant interaction between group and congruency, meaning that that individuals with high levels of PSMU are expected to have faster reaction times to congruent trials than incongruent trials, and that this difference in reaction times will be significantly larger than those in the low PSMU and non-user groups. If these hypotheses are supported, then our study will provide evidence for the existence and mechanisms behind PSMU or social media addiction. However, if this hypothesis is not supported, then attentional bias may not play as big of a role as expected for PSMU. The results of this study will be an important contribution to PSMU research, by exploring a novel concept, and providing direction for future studies

Method

Design

The experiment utilised a 3x2 mixed design. The between-subjects independent variable was Group (non-social media users, low PSMU, and high PSMU; between subjects). The within-subjects independent variable was Congruency (congruent and non-congruent). When the target appeared on the same side as the social media cue, it was congruent. When the target appeared on the opposite side to the social media cue, it was incongruent. The dependent variable was response time in milliseconds.

Participants

Our sample consisted of individuals aged 18+, recruited from the UTAS School of Psychological Sciences SONA subject pool, as well as from the general community via advertisement. Very few studies examining attentional bias in behavioural addiction have reported effect sizes, so calculating a minimum sample size was difficult. Existing studies typically included a sample size of around 50-70 participants (Jeromin et al., 2016; Jin et al., 2018; Mechelmans et al., 2014). To determine the minimum sample size for this study, a medium effect size of 0.30 with an alpha level of 0.05 and a power of 0.95 was inserted into G*power. The output of the G*power analysis suggested that we aimed to recruit at least 20 participants per group. However, due to delays with ethics approval and programming of the experimental code, we were unable to meet this goal and only managed to recruit a total of 29 participants. Due to incomplete data, three participants were removed from the analysis. Of the 26 remaining participants, 13 were female and the rest were male. Seven participants were left-handed. Participants were aged 20-32, with an average age of 24.65 (SD = 3.82). More than 53% (n = 14) of participants were students. Of the remaining 12 participants, 11 were employed either part time or full time, and one was unemployed.

Apparatus/Instrumentation/Materials

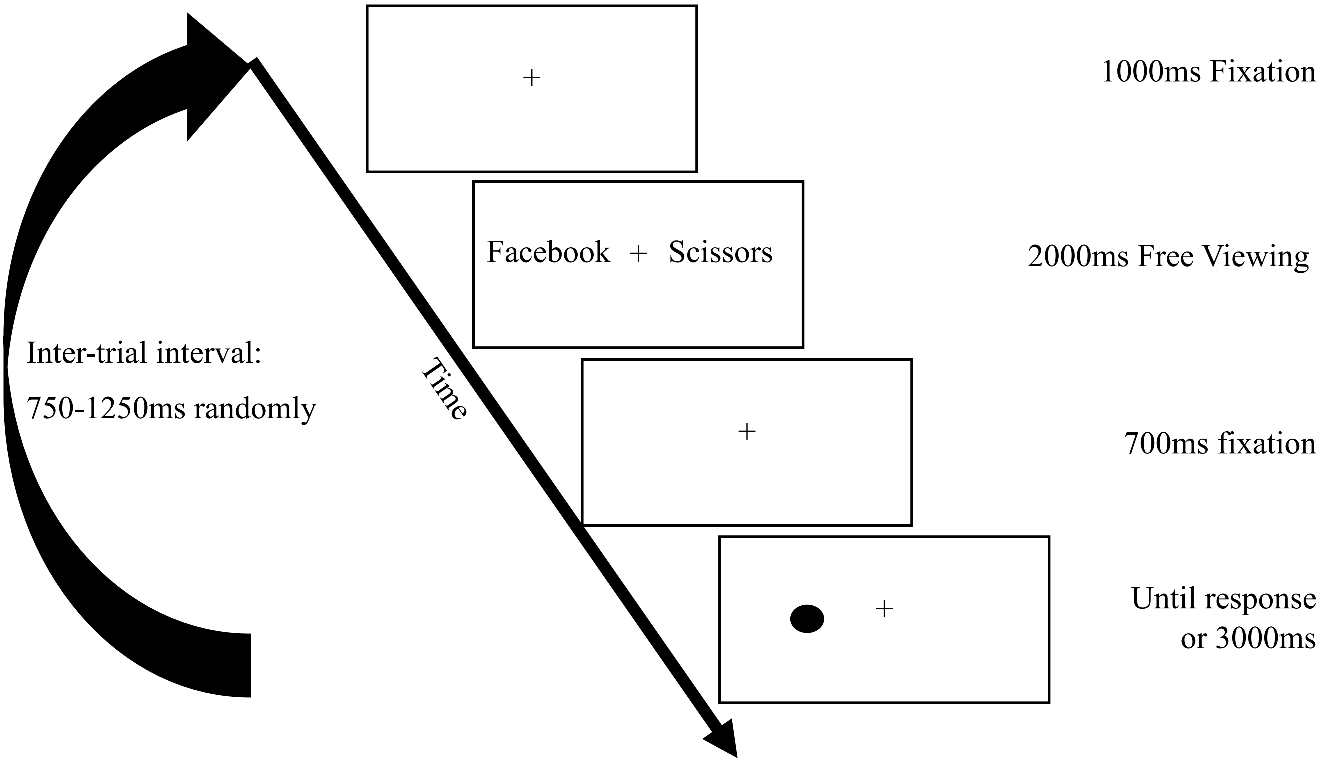
A survey to determine social media use and other descriptive measures was developed for the purpose of this study. The survey included the Bergen Social Media Addiction Scale (BSMAS) (Andreassen et al., 2012; Andreassen et al., 2016), as well as other items to identify social media use frequency. For example, one item asked to what degree participants have “tried to cut down on the use of social media without success?”, with a rating from very rarely to very often. Scales measuring attention problems (Montag et al., 2019), ADHD (Kessler et al., 2005), impulsivity (Steinberg et al. 2013), healthy lifestyle/mindfulness behaviours (Cox et al., 2015; Hill et al., 2013), and sensation seeking (Hoyle et al., 2002) were also included. The full measure can be found in Appendix 2.

The experimental part of the study used 20 words related to social media and 20 control words, as provided in Appendix 1. Words were used instead of images for simplicity since there have been very few studies investigating attentional bias in PSMU, and to ensure controls were matched for complexity (Freijy et al., 2014; Nikolaidou et al., 2019). Social media words included items such as social media platforms and common actions, while control words included neutral stationary-related words. Experimental words may have a familiarity effect due to how integrated social media is in modern life (Balas et al., 2007; Kemp, 2021**)**. However, by including similarly familiar stationary related words, we hoped that this effect was balanced out. Our main interest was the interaction between congruency and group; even if both groups were faster to respond to congruent social media trials, we were interested to see if one group was significantly faster. We ensured that the control words were of similar length and complexity to the social media words to reduce variability. Stimuli were presented as pairs of social media and control for use in the experiment. These pairs were presented randomly for each participant and counterbalanced.

The experiment utilised a program that automatically displayed stimuli and dot probes with specific timing. Figure 1 illustrates an example of a congruent trial, including the timing of each step.

Figure 1

Example of Congruent Trial in Experimental Task



Participants undertook the experiment in a lab set up with a desk, computer, and an EyeLink 1000 Plus eye-tracking system. Participants were positioned 65cm away from the wide screen. Words used in the study were presented in size 36 font, with a fixation circle diameter of 0.4° of visual angle. There was 8.7° between the inside edge of each word and the fixation cross. The fixation cross itself had a diameter of 0.8° of visual angle. The human eye naturally moves even when focusing on one point, so we included an allowable drift from mandatory fixation points of 3°. The Eyelink system was programmed to not recognise an eye movement as a deliberate saccade unless it reached a minimum velocity of 22° per second, with an acceleration of 5000° per second squared. If a detected eye movement did not meet these constants, it would not be counted as a real eye movement.

Procedure

Participants were invited into the lab and set up in front of the computer and eye tracking equipment to ensure that they were remaining on fixation when necessary. After reading giving written informed consent, participants began the experimental phase. The dot-probe task began with a 1000ms blank period to ensure participants were fixating on the centre cross. This was followed by the presentation of both social media and control images for 2000ms, during which, participants were allowed brief free viewing before returning to the centre fixation point. Social media words were presented to each side equally across trials. Once these words disappeared, there was a 700ms blank period, followed by the onset of a dot probe on one side of the screen randomly (congruent to social media image 50% of the time). This probe stayed on the screen until a response was detected, or for 3000ms, after which it would be marked as a failed trial. Participants completed two blocks of 120 trials, half of which collected data for this study. The other half collected data for another student's study to reduce data collection time. Participants then completed a short survey to determine levels of social media use.

A quiet space with blacked out windows and floor lamps for consistent lighting was set up to provide participants with consistent conditions to complete the tasks. Someone was always in the room, out of sight, in case the participant needed help. The entire experiment required around one hour to complete, including information, consent, and set up procedures. Upon completion, participants received either Sona credit or $15 for their time. If there were technical difficulties that prevented participants from completing the study, they were still reimbursed for their time.

Results

Of a total of 3318 trials across all participants and all conditions, 46 (1.39%) were deleted for being too fast (<150ms), and 131 (3.95%) were removed for being too slow (>1000ms). A total of 3141 trials were thus included in the analysis. Table 1 shows the key descriptive statistics for scales included on the survey. On average, participants reported checking social media 12.81 times per day (*SD* = 11.70). A composite score, calculated by multiplying PSMU score by number of times social media is checked per day, was used to sort participants into groups. The mean composite score was 232.35 (*SD* = 237.70). Social media users were sorted into groups using Z scores. Ideally, anyone with a z score of >1.96 or <-1.96 would be considered to have unusual levels of PSMU. In a normal distribution, 95% of scores would fall between these cut offs (Field, 2013). However, due to time and sampling limitations, participants were grouped into the “low” group if z <0, and “high” if z >0. This resulted in four participants being in the non-user group, 14 in the low PSMU group, and eight in the high PSMU group.

Table 1

Mean, Minimum, and Maximum Scores on Key Survey Scales

	Mean (SD)	**Minimum**	**Maximum**
Total PSMU	14.5 (7.94)	0	28
Attention	25.46 (7.93)	11	45
Sensation Seeking	25.54 (6.64)	11	38
Healthy lifestyle	66.62 (8.09)	53	81
Impulsivity	19.23 (6.12)	9	35

Table 2 reveals the results of key tests of assumptions. Reaction times were positively skewed for the high PSMU group, meaning that reaction times tended to cluster below the mean. There were also concerns raised about the kurtosis of score distributions for incongruent trials and high PSMU groups, with most data falling close to the mean. The distribution of scores for non-users also raised concerns as it was too flat (not enough grouping around the mean. Through visual inspection of the quantile-quantile plot (Figure 2) the data did not appear to be normally distributed. The plots were non-linear and did not line up well with the point of reference. However, Shapiro-Wilk tests of normality suggested that normality was not a problem. Besides skew and kurtosis, no other assumptions were violated. However, analyses were interpreted with caution due to these violations of assumptions.

Table 2

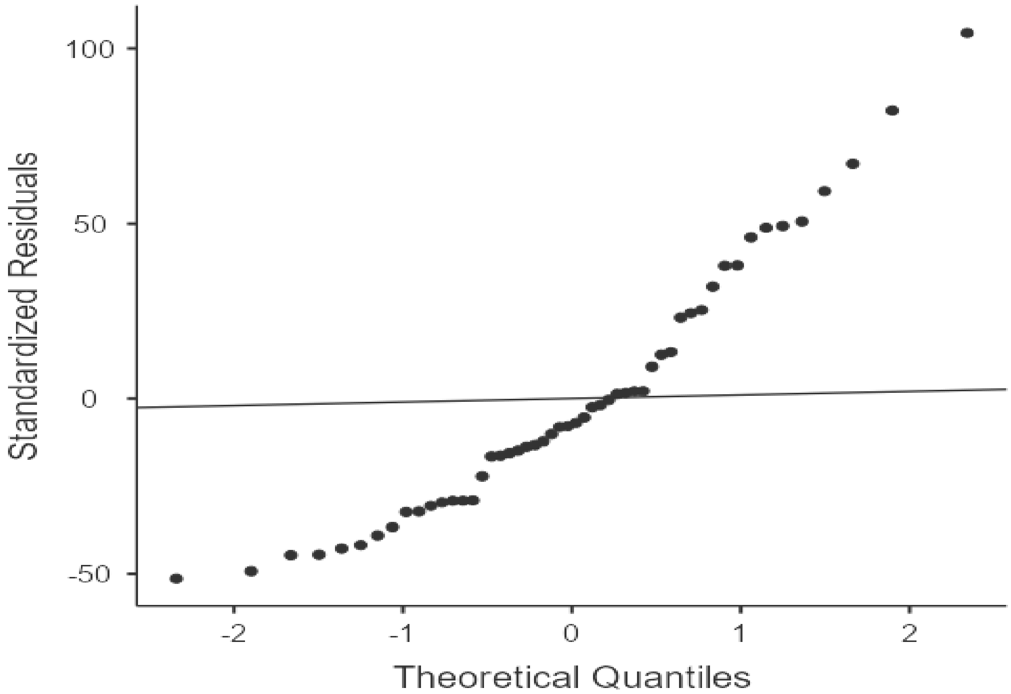
Results of Assumption Testing

Condition	**Skew**	**Kurtosis**	**Levene's test (*p*)**	**Shapiro-Wilk (p)**
Congruent	0.64	-0.50	0.89	.08
Incongruent	0.98	1.58*	0.21	.08
Non-user	-0.53	-2.78*	-	.47
Low PSMU	0.36	-0.60	-	.30
High PSMU	1.44*	1.35*	-	.06

Note: * indicates a violation of assumption

Figure 2

Quantile-Quantile Plot



Regardless of Congruency, the mean reaction times were 264.90ms (*SD* = 25.06) for non-users, 231.84ms (*SD* = 31.95) for the low PSMU group, and 246.67ms (*SD* = 46.73) for the high PSMU group. As shown by Figure 3, a repeated measures ANOVA with congruency as the within subject variable and group as the between subject variable revealed that there was no significant main effect of group, F (2,23) = 1.40, p = .266, η^2_p = 0.109. A non-significant main effect means that any observed difference between groups is due to chance and is not meaningful. When considered as a whole, the mean reaction time for congruent trials was 240.84ms (*SD* = 38.56) and 242.14 (*SD* = 37.90) for incongruent trials. This difference, shown in Figure 4, was non-significant, F (1,23) = 0.09, p = .766, η^2_p = 0.004. As shown in Figure 5, no significant interaction between group and congruency was found, F (2,23) = 0.101, p = .904, η^2_p = 0.009. The mean reaction time for each Group per trial type are shown in Table 3.

Figure 3

Mean Reaction Time in Milliseconds Across Conditions for Each Group

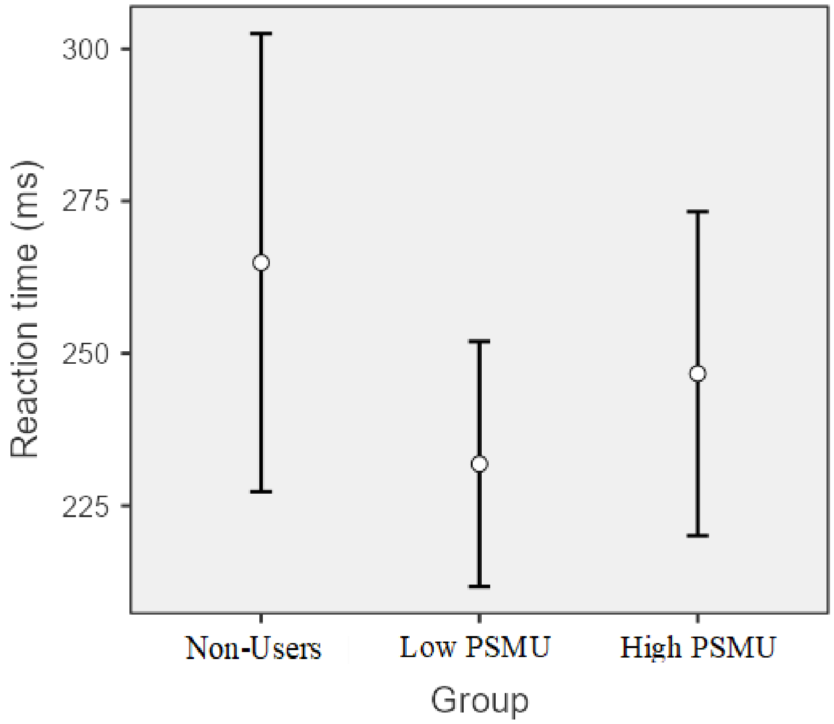


Figure 4

Mean Reaction Time in Milliseconds Across Groups for Congruent and Incongruent Trials

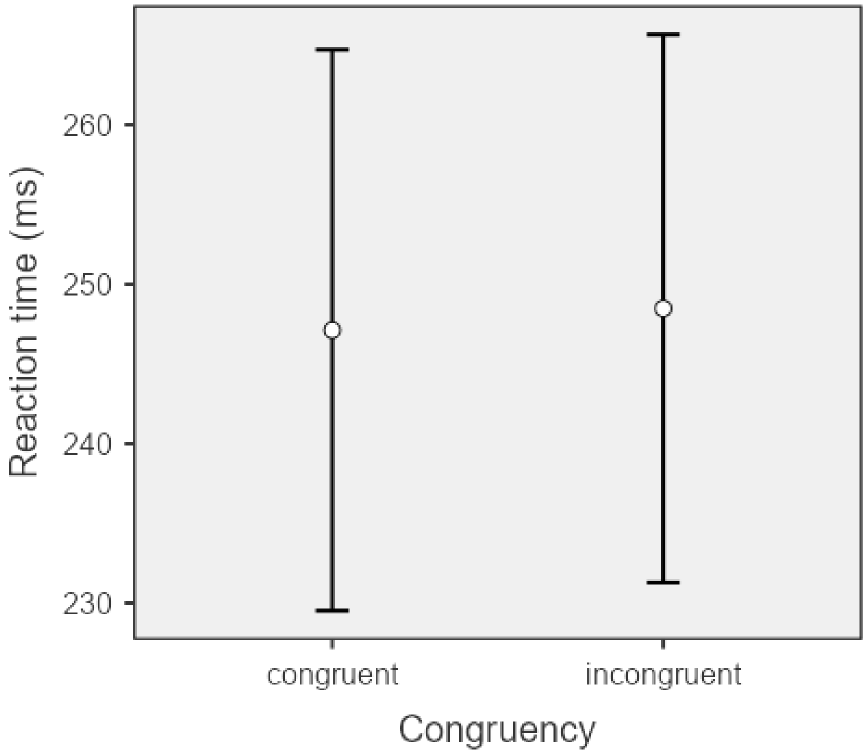


Figure 5

Mean Reaction Time in Milliseconds for Each Group in Each Condition

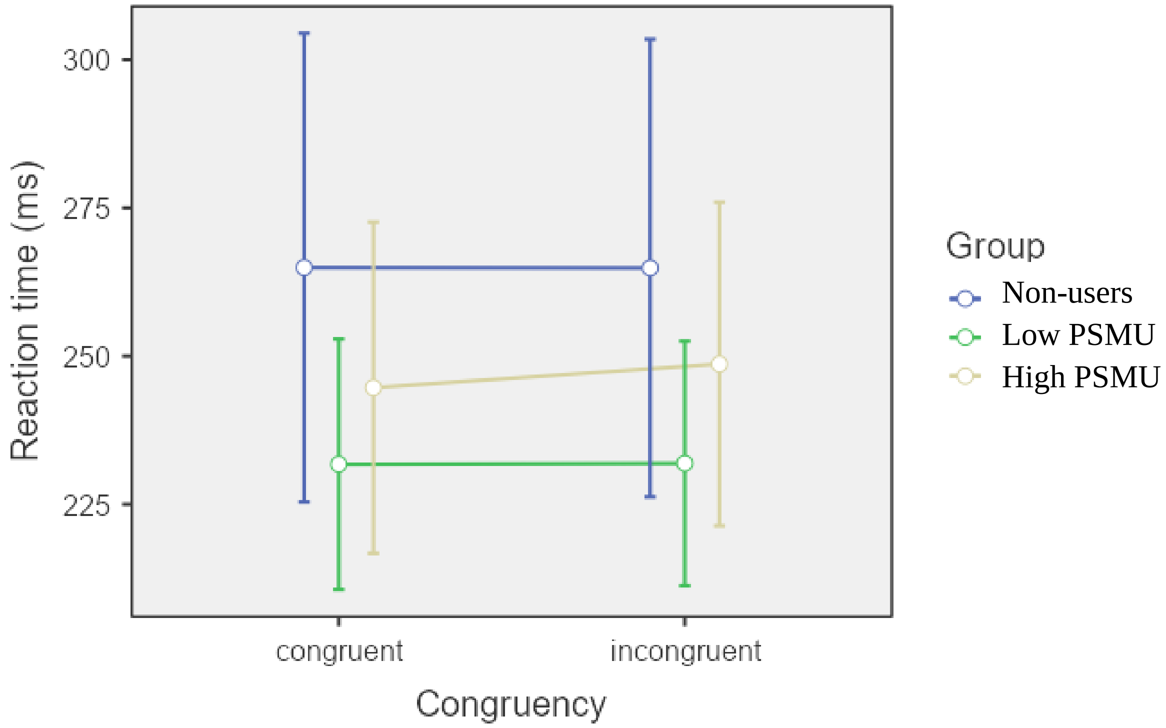


Table 3

Mean Reaction Times in Milliseconds for Each Group, Split by Condition

				95% Confidence Interval	
Congruency	**Group**	**Mean RT**	**SE**	**Lower**	**Upper**
Congruent	Non-users	264.932	19.103	225.415	304.450
	Low PSMU	231.760	10.211	210.637	252.883
	High PSMU	244.681	13.508	216.738	272.624
Incongruent	Non-users	264.870	18.659	226.271	303.469
	Low PSMU	231.914	9.974	211.282	252.546
	High PSMU	248.661	13.194	221.368	275.954

A correlation matrix was created to determine whether scores on PSMU scales were significantly correlated with reaction times. As shown in Table 4, no meaningful significant correlations were identified between measures of PSMU and reaction time. However, there was a significant positive relationship between PSMU and attention problems. Individuals with higher levels of PSMU tended to have higher scores of the attention problems and ADHD scales (Cox et al., 2015; Hill et al., 2013). There was also a significant positive relationship between PSMU and impulsivity; higher levels of PSMU were associated with higher scores on the impulsivity scale (Steinberg et al., 2013).

Table 4

Correlations Between Survey Scores and Reaction Time

	Total PSMU	Congruent rt	Incongruent rt	Overall rt	Attention	Sensation Seeking	Healthy lifestyle	Impulsivity
Total PSMU	—							
Congruent rt	-0.144	—						
Incongruent rt	-0.143	0.87**	—					
Overall rt	-0.149	0.967**	0.966**	—				
Attention	0.606**	0.114	0.219	0.172	—			
Sensation Seeking	-0.048	0.065	0.049	0.059	0.316	—		
Healthy lifestyle	-0.119	-0.201	-0.047	-0.129	-0.033	0.2	—	
Impulsivity	0.406*	0.237	0.31	0.282	0.818**	0.275	-0.223	—

Note: All values are Pearson's r, ‘rt’ stands for reaction time, * indicates a *p* value of <.05, ** indicates a *p* values of <.001

Discussion

There is evidence that attentional bias is a key mechanism behind clinically recognised addictions such as substance abuse and gambling disorders (Emery & Simons, 2015; Nikolaidou et al., 2019). The purpose of this study was to identify whether attentional bias also plays a role in social media addiction or PSMU. Evidence suggests that individuals with high levels of addictive behaviour have an attentional bias towards addiction related cues over un-related control cues (Nikolaidou et al., 2019). Based on a literature review, we hypothesised that a group with high levels of PSMU would show an attentional bias towards social media related cues over neutral cues, and that this effect would be greater than those with low levels of PSMU and non-users. However, the results obtained do not support our hypotheses, as no significant effects were found for any groups in either condition. Interestingly, there were significant moderate positive relationships between PSMU and both impulsivity and attentional problems. The implications of these correlations will be discussed in further detail below. First, a variety of explanations for the null effects will be discussed.

Existing studies examining attentional bias in behavioural addictions tend to share one common limitation: not including eye tracking to ensure participants complete the task as instructed, i.e., remain on fixation when instructed to. As discussed in the Introduction, it is possible that any significant effects found by such studies are artifacts of repeated retinal stimulation (Field & Cox, 2008). Participants' responses are affected if they are looking at cued locations when targets appear (Parr & Friston, 2019). Reaction time measures of attentional bias that use visual probe paradigms and eye-tracking to ensure participants follow instructions have less consistent results than those which do not use eye-tracking (Field et al., 2013b). It is possible that studies that have used eye-tracking as a control measure found no effects because they removed the effect of repeat retinal stimulation and biases in initial orienting (Field & Cox, 2008). Although useful and relatively easy to interpret, visual probe paradigms reflect more underlying processes than just attentional bias, so results need to be interpreted with caution (Field & Cox, 2008).

Field and Cox (2008) highlight some issues that may complicate the interpretation of results from visual probe paradigms. Firstly, if a stimulus is presented for only a short amount of time, participants can only shift their attention one time, and any biases in response time to targets will reflect biases in initial orienting (Field & Cox, 2008). The way that reaction time is interpreted is also influenced by Stimulus Onset Asynchrony (SOA). SOA refers to the time interval between cue offset and target onset (Field & Cox, 2008). Studies utilising different SOAs have found conflicting results, with some finding attentional bias in addicted groups for relatively short SOAs but not long ones (Noel et al., 2006), and others finding attentional bias for addicted groups in long SOAs but not short ones (Field et al., 2004). Field and Cox (2008) suggest that short SOAs typically only allow for participants to shift their attention toward one stimulus; finding attentional biases could reflect biases in initial orienting. When SOAs are longer, participants can shift their attention between the two stimuli multiple times; attentional bias could thus reflect disengagement from stimuli (Field & Cox, 2008). To infer biases in the maintenance of attention, Field and Cox (2008) suggest using an SOA of more than 500ms, to allow participants to shift their attention between stimuli and show biases in the maintenance of participants' attention. Studies examining attentional bias in behavioural addiction tend to use SOAs shorter than 500ms (i.e., Emery & Simons, 2015; Field et al., 2004; Field et al., 2013a; Sinclair et al., 2016**),** meaning that significant effects may reflect initial orienting. The present study used an SOA of 700ms, hence the different findings.

In studies of attention, it is also important to consider the difference between attentional bias (the tendency to respond faster to stimuli presented in the same location) and inhibition of return (IOR). IOR refers to the reduced reactivity to stimuli that have previously been attended to (Klein, 2000). Thus**,** IOR is reflected by the tendency respond slower to targets located where one has already attended (Klein, 2000). Since IOR encourages orienting toward novel locations, evolutionary theorists are led to believe that it may have developed to facilitate visual search behaviours such as foraging (Klein, 2000). Imagine you were foraging for berries, and you just picked all of the resources from one location, it would be beneficial to look in a new spot, rather than continuing to search the same location repeatedly; IOR is a mechanism that facilitates this (Klein, 2000). In the context of the present study, if it were assumed that participants in the high PSMU group attend to social media words more than control words, there should have been slower reaction times to congruent trials. However, since there was a free viewing stage, participant attention was likely drawn to both stimuli at some point, meaning that IOR should balance out across congruent and incongruent trials. The present study intended to measure attentional bias reflected by faster reaction times to stimuli in previously attended locations. It was hypothesised that the high PSMU group would have an attentional bias for social media cues, and therefore react faster to congruent trials where the target was in the same location as the experimental cue. Although the results did not reflect this, the social media cues may have still maintained the attention of participants in the high PSMU group, but mechanisms of IOR made them slower to react. However, IOR could not have replaced effects of attentional bias, as there would have been significant interaction effects. Instead, it is possible that the present study found no effects due to competing mechanisms of IOR and attentional bias, especially since a free viewing period was included. It is hard to determine what mechanisms are at play for social media addiction due to the lack of published research. Future studies could utilise electroencephology (EEG) to test for differences in attentional bias between groups, as behavioural measurements of attentional bias and IOR, like reaction time, can be difficult to interpret (Satel et al., 2019).

There is limited published research on attentional bias for social media addiction. This could be due to it being a relatively novel topic. Even though 80% of Australians use social media (Kemp, 2021), social networking sites only became popular in the last two decades (Ortiz-Ospina, 2019). Unlike topics such as gambling and substance abuse, which researchers have been exploring since last century, social media has not been around long enough for theories and models of social media addiction to be developed in full. Gambling disorder was only put into the DSM in the 5th edition (APA,2013), despite researchers examining it since at least the 1980's (Dell et al., 1981; Walker, 1989). In fact, when you search "social media addiction" on Google Scholar, the earliest publications appear to be from 2015 (e.g., Kirik et al., 2015). It takes time to develop theories/models, and even more time to test them. Social media addiction does not have the same theoretical or empirical base as other behavioural addictions. Researchers who have examined social media addiction through the lens of attentional bias have not used consistent methodology, from measures of PSMU through to experimental tasks utilised (Nikolaidou et al., 2019; Thomson & Hunter, 2021). A second plausible reason for lack of published research discussing attentional bias in social media addiction is publication bias, also known as the file drawer effect. In research, the file drawer effect refers to the tendency for research to only be published if results support researchers' hypotheses (Francis, 2012). Publication bias is a big issue in the field of psychology especially (Francis, 2012). It is possible that researchers have been studying attentional bias in social media addiction using visual probe tasks with eye-tracking, but finding null results. This could be due to methodological issues such as sampling or incorrect definition/usage of PSMU scales, or it could simply be that attentional bias is not a key mechanism behind social media addiction, unlike substance abuse (Emery & Simons, 2015; Hester et al., 2006; Jeromin et al., 2016).

While there is sufficient evidence to show that social media use can be maladaptive and have negative outcomes for some individuals (Andreassen, 2016), it is possible that attentional bias is not one of the mechanisms that maintain PSMU. Research shows that drug related cues can acquire distinct properties that make them more salient to addicts, thus attracting more attentional resources (Lubman et al., 2008; Valyear et al., 2017). The saliency of drug cues is likely learned, where they become associated with the drug of addiction (Valyear et al., 2017). In the case of drug use, behaviour becomes controlled by environmental triggers such as seeing a cigarette or lighter, instead of behavioural outcomes such as the relaxing effect that cigarettes can give (Valyear et al., 2017). Drug-related cues develop high incentive salience, which is a means by which the cues can trigger cravings for incentives associated with the drug (Valyear, et al., 2017). Perhaps social media cues do not have high incentive salience like drug cues. There is minimal evidence to suggest that the word “Facebook” has incentive salience. Therefore, it could be assumed that PSMU may not be as closely related to drug addiction behaviours or neurobiological underpinnings as we first thought, and therefore may not align with models of addiction.

Neurobiological studies suggest that the mesolimbic dopamine pathway plays a key role in the maintenance of addiction (Powledge, 1999; Nestler, 2005). The pathway includes the ventral tegmental area (VTE) in the midbrain and the nucleus accumbens, and interacts with other areas such as the amygdala, hypothalamus, hippocampus, and prefrontal cortex (Nestler, 2005). Neuroimaging studies using fMRI found that individuals with substance abuse disorder had diminished BOLD responses in the mesolimbic system to non-drug cues, but enhanced BOLD responses to drug cues, compared to healthy control participants (Kalivas & Volkow, 2005; Jasinka et al., 2014). This pattern of response reflects an increased salience of drug-related stimuli (Kalivas & Volkow, 2005). Individuals with gambling disorder also had enhanced BOLD activity in mesolimbic regions in response to gambling related cues (Goudriaan et al., 2010; Meng et al., 2014). There are currently no published studies that examine BOLD reactivity to social media related cues in people with different levels of PSMU, but results from such studies could help determine whether social media addiction has neurobiological similarities to recognised addictions. If there is no evidence of increased BOLD reactivity to social media cues and reduced reactivity to control cues in high PSMU participants, then perhaps the salience of social media cues is not affected by levels of PSMU. This would help explain the findings of the present study. However, since this research does not yet exist, it would be beneficial for future researchers to take this direction.

Despite the ANOVA producing null effects, the present study identified significant correlations between PSMU and measures of attention problems. PSMU is relatively common in young people with attention problems such as attention deficit and hyperactivity disorders (ADHD) (Dalvi-Esfehani et al., 2019; Sümen & Evgin, 2021). Social media is designed in a way that requires little sustained attention and rewards rapid attention switching (Sümen & Evgin, 2021). Adolescents with ADHD may engage in social media to cope with boredom or stimulate their hyperactive brains. At the same time, engaging in social media rewards individuals with ADHD by providing short term positive reinforcement, thus strengthening the habit of engaging in social media when under-stimulated (Sümen & Evgin, 2021). Future studies should examine the co-morbidity between ADHD and PSMU. Perhaps PSMU is an expression or method of coping with symptoms of another disorder such as ADHD. Considering how impulsivity is a common link between PSMU and ADHD (APA, 2013; Rodríguez-Cintasa et al., 2016), it is worth studying.

The present study also identified a significant correlation between PSMU scores and impulsivity. Individuals who had higher levels of PSMU scored higher on the BIS-Brief (Steinberg et al., 2013). Correlational personality studies of addiction suggest that impulsivity plays a key role in the development, maintenance, and severity of addiction (Grant et al., 2010; Rodríguez-Cintasa et al., 2016). On average, people with substance abuse disorders are more impulsive than the general population (Rodríguez-Cintasa et al., 2016). Due to the correlational nature of personality-based studies of addiction, it is not known whether drug abuse leads to higher levels of impulsivity due to reduced inhibition, or if people with high levels of impulsivity are more likely to engage in substance abuse (Rodríguez-Cintasa et al., 2016). However, impulsivity is a well-established risk factor for the development and maintenance of substance abuse disorders (Oshri et al., 2017). There is also evidence that high levels of impulsivity are associated with gambling disorder (Ioannidis et al., 2019) as well as other non-clinical behavioural addictions (Grant et al., 2010). Previous examinations of the risk factors of PSMU or social media addiction have identified impulsivity as a key factor in identifying who may be at risk for developing social media addiction (Al-Menayes; 2015; Andreassen et al., 2016). Identifying who is at risk of developing addictive behaviours is important because it allows for the development of intervention and treatment programs to help those who need it. Perhaps researchers need to further explore unique factors associated with the development and maintenance of PSMU.

Fear of Missing Out (FOMO) has also been identified as a key factor for the development and maintenance of PSMU (Franchina et al., 2018). This factor may be unique to PSMU as there is currently no research exploring its connection to substance abuse or gambling disorder. However, there is some evidence that FOMO may play a role in internet gaming disorder (Duman & Ozkara, 2019). Perhaps the social nature of internet gaming and social media is an important factor underlying addictive behaviour. According to Maslow's (1943) hierarchy of needs, the need to belong is an important part of the human experience. By satisfying the need to belong, individuals can go on to develop a positive sense of self-esteem (McLeod, 2018). Maslow's (1943) hierarchy of needs focuses on human thriving and self-actualisation, rather than pathology, so referring to it in a discussion about addiction may seem counter intuitive. However, in the context of PSMU, it is important to consider how the desire to meet social and belongingness needs can become pathological (Andreassen, 2016). Individuals who experience FOMO engage in social media to reduce anxiety and increase feelings of belonging while satisfying social needs (Blackwell et al., 2017). However, relying on social media to fulfil social needs is associated with increased levels of loneliness and depression, as well as increased FOMO (Hunt et al., 2018). PSMU becomes a maladaptive cycle of brief relief from anxiety followed by more negative consequences (Hunt et al., 2018). However, the negative effects of PSMU are not permanent. Reducing one's engagement in social media is an effective technique in reducing loneliness and depression associated with PSMU (Hunt et al., 2018). Understanding how and what underlies and maintains PSMU is important for developing interventions to help addicted individuals reduce their engagement in social media without increasing anxiety due to FOMO.

The present study is not without its limitations. Due to circumstances out of our control, ethics approval was delayed, resulting in significantly reduced data collection time. We were unable to recruit the number of participants required to meet power requirements. Instead of 60 participants, we only had 26 eligible datasets. With such a small sample, we were unable to group participants properly. It would have been preferable to only classify participants as having high PSMU if their z score was >1.96, as that would have been meaningful; having that high of a composite PSMU score would be unusual, and thus reflect real differences in social media use (Field, 2013). However, the small sample meant that only 2 participants would fall under the high PSMU group, and the analyses would lack power. Instead, we decided to group individuals with z scores of >0 as high PSMU, and <0 as low PSMU, which is an arbitrary cut off. Alas, this was all we could do with the time and resources available. It is unlikely that the present study's high PSMU group models addiction, so results were interpreted with caution. Although the null effect found in the present study may be meaningful, type II errors are possible due to the lack of power. Further research with a larger, more powerful sample is required.

The present study provides insight and direction for future research. There are three key implications of this study's findings. The first is that with the introduction of eye-tracking to ensure participants remain on task, attentional bias may not be as important for understanding addiction as once thought. The second is that attentional bias may not underlie social media addiction, and that other factors such as attentional capacity, personality, and FOMO may be more important. PSMU may be inherently different from other behavioural addictions, possibly to the point where it should not be considered an addiction at all, but an expression of some other underlying issue. The third is that the present study was not powerful enough to detect differences that do exist in the real world. Further research using a larger sample should be done to test this possibility. Researchers should ensure that future studies recruit a sample size that reaches a sufficient level of statistical power to avoid type II errors. Furthermore, there should be a focus on developing validated measures of PSMU or social media addiction that have well defined grouping cut offs, otherwise any differences between arbitrarily grouped high and low social media users should be interpreted cautiously. By using a pre-screening measure, future studies can group individuals who have a Z score of >1.96 on a validated measure of social media addiction (Field, 2013).

In summary, there are several theoretical reasons for the null effect. Firstly, the lack of eye-tracking in previous social media studies may have caused false effects to be found, where they were measuring biases in orienting or repeat retinal stimulation instead of biases in the maintenance of attention. Secondly, there may be no effect of attentional bias for social media addiction. There are very few published studies on this topic, but it is also possible that there have been studies that were never published because they did not find effects. A third reason is that processes of attentional bias and IOR (which is often reflected by reduced reaction time to previously attended stimuli) were competing against each other. Fourthly, social media may be maintained by other key factors such as personality, FOMO, or attentional deficits. Further research utilising eye-tracking to ensure participants complete tasks as instructed is required. It is also important that scales of social media addiction are further validated with clear distinctions between problematic and healthy social media use.

References

Akram, W., & Kumar, R. (2017). A study on positive and negative effects of social media on society. *International Journal of Computer Sciences and Engineering, 5*(10), 351-354.

Al-Menayes, J. J. (2015). Motivations for using social media: An exploratory factor analysis. *International Journal of Psychological Studies, 7*(1), 43. https://doi.org/10.5539/ijps.v7n1p43

American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., Text Revision). Washington, DC: Author.

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

American Society of Addiction Medicine (2019). *Definition of Addiction.* https://www.asam.org/Quality-Science/definition-of-addiction

Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of Addictive Behaviors, 30*(2), 252–262. https://doi.org/10.1037/adb0000160

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110,* 501–517. https://doi.org/10.2466/02.09.18.pr0.110.2.501-517

Balas, B., Cox, D., & Conwel, E. (2007). The effect of real-world personal familiarity on the speed of face information processing. *PloS one, 2.* https://doi.org/10.1371/journal.pone.0001223

Banyai, F., Zsila, A., Kiraly, O., Maraz, A., Elekes, Z., Griffiths, M. D., Andreassen, C. S., & Demetrovics, Z. (2017). Problematic social media use: Results from a large-scale nationally representative adolescent sample. *PLoS One*, *12*(1). https://doi.org/10.1371%2Fjournal.pone.0169839

Bhargava, V. R., & Velasquez, M. (2021). Ethics of the attention economy: The problem of social media addiction. *Business Ethics Quarterly, 31*(3), 321-359. https://doi.org/10.1017/beq.2020.32

Blackwell, D., Leaman, C., Tramposch, R., Osborne, C., & Liss, M. (2017). Extraversion, neuroticism, attachment style and fear of missing out as predictors of social media use and addiction. *Personality and Individual Differences*, *116*, 69-72. https://doi.org/10.1016/j.paid.2017.04.039

Bompas, A., Hedge, C., & Sumner, P. (2017). Speeded saccadic and manual visuo-motor decisions: Distinct processes but same principles. *Cognitive Psychology, 94*, 26-52. https://doi.org/10.1016%2Fj.cogpsych.2017.02.002

Bortfeld, H., Shaw, K., & Depowski, N. (2013). Disentangling the influence of salience and familiarity on infant word learning: methodological advances. *Frontiers in psychology*, *4*, 175. https://doi.org/10.3389%2Ffpsyg.2013.00175

Botvin, G. J., & Griffin, K. W. (2016). Prevention of substance abuse. In J. C. Norcross, G. R. VandenBos, D. K. Freedheim, & R. Krishnamurthy (Eds.), APA handbook of clinical psychology: Applications and methods (pp. 485–509). American Psychological Association. https://doi.org/10.1037/14861-026

Breen, M. (2021). How policy reform can solve the problem of gambling in Australia. *In the Black.* https://www.intheblack.com/magazines/2021-06-june

Brevers, D., Cleeremans, A., Bechara, A., Laloyaux, C., Kornreich, C., Verbanck, P., & Noel, X. (2011). Time course of attentional bias for gambling information in problem gambling. *Psychology of Addictive Behaviors*, *25*(4), 675–682. https://doi.org/10.1037/a0024201

Casteau, S. & Smith, D. T. (2019). Associations and dissociations between oculomotor readiness and covert attention. *Vision, 3*(17). https://doi.org/10.3390/vision3020017

Conrod, P. J., Pihl, R. O., Stewart, S. H., & Dongier, M. (2000). Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors for substance abuse. Psychology of addictive behaviors, 14(3), 243. https://psycnet.apa.org/doi/10.1037/0893-164X.14.3.243

Cox, A. E., Ullrich-French, S., & French B. F. (2016) validity evidence for the state mindfulness scale for physical activity, *Measurement in Physical Education and Exercise Science, 20*, 38-49, https://doi.org/10.1080/1091367X.2015.1089404

Cox, W. M., Fadardi, J. S., Intriligator, J. M., & Klinger, E. (2014). Attentional bias modification for addictive behaviors: clinical implications. *CNS Spectrums, 19*(3), 215-224. https://doi/org/10.1017/S1092852914000091

Craig, R. J. (1995). The role of personality in understanding substance abuse. Al*coholism Treatment Quarterly, 13*(1), 17-27. https://doi.org/10.1300/J020V13N01_02

Dalvi-Esfahani, M., Niknafs, A., Kuss, D. J., Nilashi, M., & Afrough, S. (2019). Social media addiction: Applying the DEMATEL approach. *Telematics and Informatics*, *43*, 101250. https://doi.org/10.1016/j.tele.2019.101250

Delaney, D., Stein L. A. R., & Russell Gruber, R. (2018) Facebook addiction and impulsive decision-making. *Addiction Research & Theory, 26*(6), 478-486. https://doi.org/10.1080/16066359.2017.1406482

Dell, L. J., Ruzicka, M. F., & Palisi, A. T. (1981). Personality and other factors associated with the gambling addiction. *International Journal of the Addictions, 16*(1), 149-156. https://doi.org/10.3109/10826088109038817

Dolan, S. L., Bechara, A., & Nathan, P. E. (2008). Executive dysfunction as a risk marker for substance abuse: the role of impulsive personality traits. *Behavioral sciences & the law, 26*(6), 799-822. https://doi.org/10.1002/bsl.845

Donk, M., & Soesman, L. (2010). Salience is only briefly represented: Evidence from probe-detection performance. *Journal of Experimental Psychology: Human Perception and Performance, 36*(2), 286–302. https://doi.org/10.1037/a0017605

Durak, Y. & Seferoğlu, S. S. (2019). Modeling of variables related to problematic social media usage: Social desirability tendency example. *Scandinavian Journal of Psychology, 60*(3), 277-288. https://doi.org/10.1111/sjop.12530

Ehrman, R. N., Robbins, S. J., Bromwell, M. A., Lankford, M. E., Monterosso, J. R., & O'Brien, C. P. (2002). Comparing attentional bias to smoking cues in current smokers, former smokers, and non-smokers using a dot-probe task. *Drug and alcohol dependence*, *67(*2), 185-191. https://doi.org/10.1016/S0376-8716(02)00065-0

Emery, N. N., & Simons, J. S. (2015). Mood & alcohol-related attentional biases: New considerations for gender differences and reliability of the visual-probe task. *Addictive behaviors*, *50*, 1-5. https://doi.org/10.1016/j.addbeh.2015.06.007

Field, A. (2013). *Discovering statistics using IBM SPSS statistics.* Sage.

Field, M. & & Cox, W. M. (2008). Attentional bias in addictive behaviors: a review of its development, causes, and consequences. Drug and Alcohol Dependence, *97*(1-2), 1-20. https://doi.org/10.1016/j.drugalcdep.2008.03.030

Field, M., Duka, T., Eastwood, B., Child, R., Santarcangelo, M., & Gayton, M. (2007). Experimental manipulation of attentional biases in heavy drinkers: do the effects generalise?. *Psychopharmacology 192***,** 593–608. https://doi.org/10.1007/s00213-007-0760-9

Field, M., Marhe, R., & Franken, I. H. A. (2013b). The clinical relevance of attentional bias in substance use disorders. *CNS Spectrums, 19*(3), 225-230. https://doi.org/10.1017/S1092852913000321

Field, M., Mogg, K., Zetteler, J., & Bradley, B. P. (2004). Attentional biases for alcohol cues in heavy and light social drinkers: the roles of initial orienting and maintained attention. *Psychopharmacology*, *176*(1), 88-93. https://doi.org/10.1007/s00213-004-1855-1

Field, M., Mogg, K., Mann, B., Bennett, G. A., & Bradley, B. P. (2013a). Attentional biases in abstinent alcoholics and their association with craving. *Psychology of Addictive Behaviors, 27*(1), 71–80. https://doi.org/10.1037/a0029626

Field, M., Mufano, M. R., & Franken, I. H. (2009). A meta-analytic investigation of the relationship between attentional bias and subjective craving in substance abuse. Psychology Bullitin, 135(4), 589-607. https://doi.org/10.1037/a0015843

Fisher, L. A., Elias, J. W., & Ritz, K. (1998). Predicting relapse to substance abuse as a function of personality dimensions. *Alcoholism: Clinical and Experimental Research, 22*(5), 1041-1047. https://doi.org/10.1111/j.1530-0277.1998.tb03696.x

Franchina, V., Vanden Abeele, M., Van Rooij, A. J., Lo Coco, G., & De Marez, L. (2018). Fear of missing out as a predictor of problematic social media use and phubbing behavior among Flemish adolescents. *International journal of environmental research and public health, 15*(10), 2319. https://doi.org/10.3390/ijerph15102319

Francis, G. (2012) Publication bias and the failure of replication in experimental psychology. *Psychonomic Bulletin & Review 19*, 975–991. https://doi.org/10.3758/s13423-012-0322-y

Franken, I. H. (2003). Drug craving and addiction: integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology* *and Biological Psychiatry, 27*(4), 563-579. https://doi.org/10.1016/S0278-5846(03)00081-2

Freijy, T., Mullan, B., & Sharpe, L. (2014). Food-related attentional bias: Word versus pictorial stimuli and the importance of stimuli calorific value in the dot probe task. *Appetite, 83*, 202-208. https://doi.org/10.1016/j.appet.2014.08.037

Geirdal, A. Ø., Ruffolo, M., Leung, J., Thygesen, H., Price, D., Bonsaksen, T., & Schoultz, M. (2021). Mental health, quality of life, wellbeing, loneliness and use of social media in a time of social distancing during the COVID-19 outbreak. A cross-country comparative study. *Journal of Mental Health, 30*(2), 148-155. https://doi.org/10.1080/09638237.2021.1875413

Goudriaan, A.E., de Ruiter, M. B., van den Brink, W., Oosterlaan,.J., & Veltman. D. J. (2010) Brain activation patterns associated with cue reactivity and craving in abstinent problem gamblers, heavy smokers and healthy controls: an fMRI study. *Addict. Biol., 15*(4), 491-503.

Grant, J. E., Potenza, M., N., Weinstein, A., & Gorelick, D. A. (2010). Introduction to behavioural addictions. *American Journal of Drug and Alcohol Abuse, 36*(5), 233-241. https://doi.org/10.3109%2F00952990.2010.491884

Griffiths, M. D. (2018). Adolescent social networking: How do social media operators facilitate habitual use? *Education and Health, 36*(3), 66-69. https://sheu.org.uk/content/page/education-and-health-archive

Griffiths, M. D., & Delfabbro, P. (2001). The biopsychosocial approach to gambling: Contextual factors in research and clinical interventions. *Journal of Gambling Issues (JGI), 5,* 1-34. http://www.camh.net/egambling/issue5/feature/index.html

Healthdirect (2020). *Substance abuse.* https://www.healthdirect.gov.au/substance-abuse

Hester, R., Dixon, V., & Garavan, H. (2006). A consistent attentional bias for drug-related material in active cocaine users across word and picture versions of the emotional Stroop task. *Drug and Alcohol Dependence, 81*(3), 251-257. https://doi.org/10.1016/j.drugalcdep.2005.07.002

Heuer, A., Mennig, M., Schubö, A., & Barke, A. (2021). Impaired disengagement of attention from computer-related stimuli in Internet Gaming Disorder: Behavioral and electrophysiological evidence, *Journal of Behavioral Addictions, 10*. https://doi.org/10.1556/2006.2020.00100

Hill, P. L., Allemand, M., & Roberts, B. W. (2013). Examining the pathways between gratitude and self-rated physical health across adulthood. *Personality and individual differences, 54*, 92-96. https://doi.org/10.1016/j.paid.2012.08.011

Hønsi, A., Mentzoni, R. A., Molde, H., & Pallesen, S. (2013). Attentional bias in problem gambling: A systematic review. *Journal of Gambling Studies*, *29*(3), 359-375. https://doi.org/ 10.1007/s10899-012-9315-z

Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Lorch, E. P., & Donohew, R. L. (2002). Reliability and validity of a brief measure of sensation seeking. *Personality and individual differences, 32*(3), 401-414. https://doi.org/10.1016/S0191-8869(01)00032-0

Hunt, M. G., Marx, R., Lipson, C., & Young, J. (2018). No more FOMO: Limiting social media decreases loneliness and depression. Journal of Social and Clinical Psychology, 37(10), 751-768. https://doi.org/10.1521/jscp.2018.37.10.751

Ioannidis, K., Hook, R., Wickham, K., Grant, J. E., & Chamberlain, S. R. (2019). Impulsivity in Gambling Disorder and problem gambling: A meta-analysis. *Neuropsychopharmacology*, *44***,** 1354–1361. https://doi.org/10.1038/s41386-019-0393-9

Jasinska, A. J., Stein, E. A., Kaiser, J., & Naumer, M. J., & Yalachkov, Y. (2014). Factors modulating neural reactivity to drug cues in addiction: a survey of human neuroimaging studies. *Neurosci. Biobehav. Rev., 38,* 1-16.

Jeromin, F., Nyenhuis, N., & Barke, A. (2016). Attentional bias in excessive internet gamers: Experimental investigations using an addiction Stroop and visual probe. *Journal of Behavioural Addictions, 5,* 32-40. https://doi.org/10.1556/2006.5.2016.012

Jiang, Z., Zhao, X., & Li, C. (2017). Self-control predicts attentional bias assessed by online shopping-related Stroop in high online shopping addiction tendency college students. *Comprehensive Psychiatry, 75*, 14-21. https://doi.org/10.1016/j.comppsych.2017.02.007

Jin, X., Jin, Y., Zhou, S., Yang, S., Chang,. S., & Li, H. (2018). Attentional biases toward body images in males at high risk of muscle dysmorphia. *Peer J, 6.* https://doi.org/10.7717/peerj.4273

Kalivas, P. W. & Volkow, N. D. (2005). The neural basis of addiction: a pathology of motivation and choice. *American Journal of Psychiatry*, *162*(8), 1403-1413

Kemp, S. (2021a). *Digital 2021: Australia*. Data Reportal. https://datareportal.com/reports/digital-2021-australia

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E. V. A., ... & Walters, E. E. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. *Psychological medicine, 35*(2), 245-256. https://doi/org/10.1017/S0033291704002892

Kim, J., Kim, H., & Kang, E. (2017). Impaired feedback processing for symbolic reward in individuals with internet game overuse. *Frontiers in Psychiatry, 8*(195). 1-13. https://doi.org/10.3389/fpsyt.2017.00195

Kim, S. N., Kim, M., Lee, T. H., Lee, J. Y., Park, S., Park, M., ... & Choi, J. S. (2018). Increased attentional bias toward visual cues in Internet gaming disorder and obsessive-compulsive disorder: An event-related potential study. *Frontiers in Psychiatry, 9*, 315. https://doi.org/10.3389/fpsyt.2018.00315

King, D. L., Russell, A., & Hing, N. (2020). Adolescent land-based and internet gambling: Australian and international prevalence rates and measurement issues. *Current Addiction reports, 7,* 137-148. https://doi.org/10.1007/s40429-020-00311-1

Kirik, A., Arslan, A., Çetinkaya, A., & Mehmet, G. Ü. L. (2015). A quantitative research on the level of social media addiction among young people in Turkey. *International Journal of Sport Culture and Science, 3*(3), 108-122. https://doi.org/10.14486/IntJSCS444

Klein, R. M. (2000). Inhibition of return. *Trends in Cognitive Sciences, 4*(4), 138-147. https://doi.org/10.1016/S1364-6613(00)01452-2

Laskowski C. S., Dorchak D. L., Ward K. M., Christensen D. R., & Euston D. R (2019). Can slot-machine reward schedules induce gambling addiction in rats? *J Gambl Stud, 35*(3), 887-914. https://doi.org/10.1007/s10899-019-09852-1

Lubman, D. I., Allen, N. B., Peters, L. A., & Deakin, J. W. (2008). Electrophysiological evidence that drug cues have greater salience than other affective stimuli in opiate addiction. *Journal of psychopharmacology*, *22*(8), 836-842. https://doi.org/10.1177%2F0269881107083846

Lubman, D. I., Peters, L. A., Mogg, K., Bradley, B. P., & Deakin, J. F. W. (2000). Attentional bias for drug cues in opiate dependence. *Psychol. Med., 30*. 169-175. https://doi.org/10.1017/S0033291799001269

Manning, M, Smith, C & Mazerolle, P. (2013). *The societal costs of alcohol misuse in Australia: Trends & issues in crime and criminal justice* (No. 454). Australian Institute of Criminology. https://www.aic.gov.au/publications/tandi/tandi454

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396. https://doi.org/10.1037/h0054346

McLeod, S. (2007). Maslow's hierarchy of needs. Simply psychology, 1(1-18).

Mechelmans, D. J., Irvine, M., Banca, P., Porter, L., Mitchell, S., Mole, T. B., Lapa, T. R., Harrison, N. A., Potenza, M. N., & Voon, V. (2014). Enhanced attentional bias towards sexually explicit cues in individuals with and without compulsive sexual behaviours. *PLOS ONE, 9*(8). https://doi.org/10.1371/journal.pone.0105476

Meng, Y. J., Deng, W., Wang, H. Y., Guo, W. J., Li, T., Lam, C., & Lin, X. (2014). Reward pathway dysfunction in gambling disorder: a meta-analysis of functional magnetic resonance imaging studies. *Behav. Brain. Res.,* 243-251.

Messinis, G. (1999). Habit formation and the theory of addiction. *Journal of Economic Surveys, 13*(4), 417-442. https://doi.org/10.1111/1467-6419.00089

Montag C, Schivinski B, Sariyska R, Kannen C, Demetrovics Z, Pontes HM. Psychopathological symptoms and gaming motives in disordered gaming—A psychometric comparison between the who and APA diagnostic frameworks. *Journal of Clinical Medicine, 8(*10), 1691. https://doi.org/10.3390/jcm8101691

Moqbel, M. & Kock, N. (2018). Unveiling the dark side of social networking sites: Personal and work-related consequences of social networking site addiction. *Information and management*, *55*, 109-119. https://doi.org/10.1016/j.im.2017.05.001

Nestler, E. J. (2005). Is there a common molecular pathway for addiction? *Nature neuroscience, 8(*11), 1445-1449. https://doi.org/10.1038/nn1578

Nikolaidou, M., Fraser, D. S., & Hinvest, N. (2019). Attentional bias in internet users with problematic use of social networking sites. *Journal of Behavioral Addictions, 8(*4), 733-742. https://doi.org/10.1556/2006.8.2019.60

Noel, X., Colmant, M., Van Der Linden, M., Bechara, A., Bullens, Q., Hanak, C., & Verbananck, P. (2006). Time course of attention for alcohol cues in abstinent alcoholic patients: the role of initial orienting. *Alcohol Clinical Experimental Research, 30,* 1871-1877.

Ortiz-Ospina, E. (2019). *The rise of social media.* Our World in Data. https://ourworldindata.org/rise-of-social-media

Oshri, A., Kogan, S. M., Kwon, J. A., Wickrama, K. A. S., Vanderbroek, L., Palmer, A. A., & MacKillop, J. (2018). Impulsivity as a mechanism linking child abuse and neglect with substance use in adolescence and adulthood. *Development and Psychopathology*, *30*(2), 417-435. https://doi/org/10.1017/S0954579417000943

Pan, Y. C., Chiu, Y. C., & Lin, Y. H. (2020). Systematic review and meta-analysis of epidemiology of internet addiction. *Neuroscience & Biobehavioral Reviews, 118,* 612-622. https://doi.org/10.1016/j.neubiorev.2020.08.013

Parekh, R. (2018). *Internet Gaming.* American Psychiatric Association. https://www.psychiatry.org/patients-families/internet-gaming

Parr, T., & Friston, K. J. (2019). Attention or salience?. *Current opinion in psychology, 29*, 1-5. https://doi.org/10.1016/j.copsyc.2018.10.006

Petrova, K., Wentura, D., & Bermeitinger, C. (2013). What happens during the stimulus onset asynchrony in the dot-probe task? Exploring the role of eye movements in the assessment of attentional biases. *PLoS One*, *8*(10). https://doi.org/10.1371/journal.pone.0076335

Petry, N. M., Zajac, K., & Ginley, M. K. (2018). Behavioural addictions as mental disorders: To be or not to be? *Annual Review of Clinical Psychology, 14,* 399-423. https://doi.org/10.1146/annurev-clinpsy-032816-045120

Pinna, F., Dell'Osso, B., Di Nicola, M., Janiri, L., Altamura, A. C., Carpiniello, B., & Hollander, E. (2015). Behavioural addictions and the transition from DSM-IV-TR to DSM-5. *Journal of Psychopathology, 21*(4), 380-389.

Priyadarshini, C., Dubey, R. K., Kumar, Y. L. N., & Jha, R. R. (2020). Impact of a social media addiction on employees' wellbeing and work productivity. *The Qualitative Report, 25*(1), 181-196.

Rodríguez-Cintas, L., Daigre, C., Grau-López, L., Barral, C., Pérez-Pazos, J., Voltes, N., ... & Roncero, C. (2016). Impulsivity and addiction severity in cocaine and opioid dependent patients. *Addictive behaviors, 58*, 104-109. https://doi.org/10.1016/j.addbeh.2016.02.029

Satel, J., Wilson, N. R., & Klein, R. M. (2019). What neuroscientific studies tell us about inhibition of return. *Vision, 3*(4), 58. https://doi.org/10.3390/vision3040058

Saura, J. R., Palacios-Marqués, D., & Iturricha-Fernández, A. (2021). Ethical design in social media: Assessing the main performance measurements of user online behavior modification. *Journal of Business Research, 129,* 271-281. https://doi.org/10.1016/j.jbusres.2021.03.001

Sciberras, E., Patel, P., Stokes, M. A., Coghill, D., Middeldorp, C. M., Bellgrove, M. A., ... & Westrupp, E. (2020). Physical health, media use, and mental health in children and adolescents with ADHD during the COVID-19 pandemic in Australia. *Journal of attention disorders.* https://doi.org/10.1177%2F1087054720978549

Siddiqui, S., & Singh, T. (2016). Social media: Its impact with positive and negative aspects. *International Journal of Computer Applications Technology and Research, 5*(2), 71-75.

Sinclair, J. M., Garner, M., Pasche, S. C., Wood, T. B., & Baldwin, D. S. (2016). Attentional biases in patients with alcohol dependence: influence of coexisting psychopathology. *Human Psychopharmacology: Clinical and Experimental*, *31*(6), 395-401. https://doi.org/10.1002/hup.2549

Sindermann, C., Elhai, J. D., & Montag, C. (2020). Predicting tendencies towards the disordered use of Facebook's social media platforms: On the role of personality, impulsivity, and social anxiety. *Psychiatry Research*, *285*. https://doi.org/10.1016/j.psychres.2020.112793.

Steinberg, L., Sharp, C., Stanford, M. S., & Tharp, A. T. (2013). New tricks for an old measure: The development of the Barratt Impulsiveness Scale–Brief (BIS-Brief). *Psychological Assessment, 25*(1), 216–226. https://doi.org/10.1037/a0030550

Sümen, A., & Evgin, D. (2021). Social Media Addiction in High School Students: A Cross-Sectional Study Examining Its Relationship with Sleep Quality and Psychological Problems. *Child Indicators Research*, *14*, 2265-2283. https://doi.org/10.1007/s12187-021-09838-9

Tabitha M. Powledge, T. M. (1999). Addiction and the brain: The dopamine pathway is helping researchers find their way through the addiction maze, *BioScience 49*(7), 513–519. https://doi.org/10.2307/1313471

Thomson, K., Hunter, S. C., Butler, S. H., & Robertson, D. J. (2021). Social media 'addiction': the absence of an attentional bias to social media stimuli. *Journal of Behavioural Addictions*, 1-37.

Valyear, M. D., Villaruel, F. R., & Chaudhri, N. (2017). Alcohol-seeking and relapse: a focus on incentive salience and contextual conditioning. *Behavioural processes, 141*, 26-32. https://doi.org/10.1016/j.beproc.2017.04.019

Verplanken, B., Verplanken, B., & Ryan. (2018). *Psychology of habit*. Cham, Switzerland: Springer.

Weinreich, H., Obendorf, H., Herder, E., & Mayer, M. (2008). Not quite the average: An empirical study of web use. *ACM Transactions on the Web,* 2(1), 1-31.

Whetton, S, Tait, R, Chrzanowka, A, Donnelly. N, McEntee, A., Muhktar, A. Zahra, E., Campbell, G., Degenhardt, L., Dey, T., Halim, S. A., Hall, W., Makate, M., Norman, R., Peacock, A., Roche, A., & Allsop, S. (2020b). *Quantifying the social costs of cannabis use to Australia in 2015/16.* National Drug Research Institute. https://ndri.curtin.edu.au/ndri/media/documents/publications/T287.pdf

Whetton, S., Shanahan, M., Cartwright, K., Duraisingam, V., Ferrante, A., Gray, D., Kaye, S., Kostadinov, V., McKetin, R., Pidd, K., Roche, A., Tait, R. J., & Allsop, S. (2016). *The social costs of methamphetamine in Australia 2013/14.* National Drug Research Institute. https://ndri.curtin.edu.au/ndri/media/documents/publications/T246.pdf

Whetton, S., Tait, R., Chrzanowka, A., Donnelly, N., McEntee, A., Muhktar, A., Zahra, E., Campbell, G., Degenhardt, L., Dey, T., Halim, S. A., Hall, W., Makate, M., Norman, R., Peacock, A., Roche, A., & Allsop, S. (2020*). Quantifying the social costs of pharmaceutical opioid misuse & illicit opioid use to Australia in 2015/16.* National Drug Research Institute.
https://ndri.curtin.edu.au/ndri/media/documents/publications/T277.pdf

Whetton, S., Tait, R., Scollo, M., Banks, E., Chapman, J., Dey, T., Halim, S. A., Makate, M., McEntee, A., Muhktar, A., Norman, R., Pidd, K., Roche, A., & Allsop, S. (2019). *Identifying the social costs of tobacco use to Australia in 2015/16.* National Drug

Research Institute. https://ndri.curtin.edu.au/NDRI/media/documents/publications/T273.pdf

Zakon, A. (2020). Optimized for addiction: Extending product liability concepts to defectively designed social media algorithms and overcoming the communications decency act. *Wisconsin Law Review, 2020*(5), 1107-1146. https://heinonline.org/HOL/P?h=hein.journals/wlr2020&i=1135

Zhang, M., Fung, D. S. S., & Smith, H. (2019). Variations in the visual probe paradigms for attention bias modification for substance use disorders. *International Journal of Environmental Research and Public Health, 16,* 1-13. https://doi.org/10.3390/ijerph16183389

Appendix 1

Table 5

List of Words Included in Experiment

Social media	Control
Comments	Backpack
Facebook	Book
Finsta	Clipboard
Hashtag	Eraser
Insta	Folder
Instagram	Glue
Likes	Highlighter
Message	Holepunch
Posted	Marker
Reacted	Notebook
Replied	Paint
Retweet	Paintbrush
Share	Paper
Snapchat	Paperclip
Social	Pencil
Story	Pens
Tagged	Ruler
Tiktok	Scissors
Tweet	Sharpener
Twitter	Stapler

Appendix 2. Survey

Honours Project 2021

Start of Block: Default Question Block

PIS

Investigating neural mechanisms of visual attention with eye tracking technology

Information Sheet:

Invitation

You are invited to participate in a research study looking at how the brain implements mechanisms of visual attention. This study is being conducted by Dr. Jason Satel, (University of Tasmania, Australia) in collaboration with Dr. Halley Pontes (Birkbeck, University of London, United Kingdom).

What is the purpose of this study?

The aim of the proposed study is to investigate how different mechanisms in the brain interact when we are looking at a visual scene. For example, if there is a bright flash in front of you, you often can't help but look at it immediately. However, if the same object keeps flashing over and over, you will adapt and stop paying attention to it. We are interested in how these sorts of effects actually work in the brain?

Why have I been invited to participate?

You have been invited to participate on a pre-screening short survey that will last for approximately 10 minutes. This survey will determine your eligibility to participate in the follow-up laboratory study we will conduct. Participation in this pre-screening survey and in the follow-up laboratory study is entirely voluntary and confidential. There are no negative consequences either personally or academically if you do not wish to participate.

To be eligible for the follow-up laboratory study, you must be over the age of 18, have no existing uncorrected visual disabilities, and/or psychiatric/neurological disorders. Corrected vision through the use of glasses or contact lenses still makes you eligible to participate.

What will I be asked to do?

During this pre-screening online survey, you will be asked a series of confidential questions about yourself (e.g. age, gender) and about the way in which you use digital technology (social media and gaming). We will also ask general questions about your personality and your well-being.

If you are eligible to the follow-up laboratory study, you will be asked to conduct a series of eye movements and manual responses while completing a computerized task. Your eye movements will be tracked throughout the experiment and your brain activity and reaction times will be recorded. The experimental session should last around 60 minutes, and will take place in room O 008 at the Newnham campus in Launceston.

Are there any possible benefits from participation in this study?

There are no immediate or direct potential benefits to participants, the study aims to gather knowledge into neural mechanisms underlying visual attention. As compensation for participation, participants will be offered the choice of course credit (1 point/hour) or a dollar value for their time ($15/hour). The study may generate non-immediate and indirect benefits through your participation which may provide a contribution to science.

Are there any possible risks from participation in this study?

During the pre-screening survey, we do not anticipate any potential detrimental effects as you will not be asked any sensitive question.

In the follow-up laboratory study, you may experience mild fatigue over the time of the experiment. If this happens, you may inform the researcher of your discomfort and a break can be scheduled where possible.

What if I change my mind during or after the study?

You are free to withdraw at any time where there is no obligation to complete participation and no explanation is needed if you choose to withdraw.

What will happen to the information when this study is over?

All data collected during this study will be confidential and will be destroyed after 5 years.

How will the results of the study be published?

At the end of the study, the results may be published in scientific journals. You can access such articles through the UTAS academic websites.

What if I have questions about this study?

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H0016857. Dr. Jason Satel is the principal investigator of this study and he can be contacted via email at jason.satel@utas.edu.au.

Informed Consent **Please provide your consent to participate in the study by ticking all the boxes below**

- ☐ I agree to take part in the research study named above. (1)
- ☐ I have read and understood the Information Sheet for this study. (2)
- ☐ I confirm that I am at least 18 years old. (3)
- ☐ The nature and possible effects of the study have been explained to me. (4)
- ☐ I understand that the study involves paying attention and looking at or ignoring visual stimuli on a computer screen. (5)
- ☐ I understand that participation involves no foreseeable risks. (6)
- ☐ I understand that all research data will be securely stored on the University of Tasmania premises for five years from the publication of the study results, and will then be destroyed. (7)
- ☐ Any questions that I have asked have been answered to my satisfaction. (8)
- ☐ I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research. (9)
- ☐ I understand that the results of the study will be published so that I cannot be identified as a participant. (10)

☐ I understand that my participation is voluntary and that I may withdraw at any time without any effect. (11)

☐ I understand that I will not be able to withdraw my data after completing the experiment as it has been collected confidentially. (12)

---

*

Q32 If you would like to participate in the follow-up laboratory study in case you are eligible, please enter your email address below so that we can contact you. Note that if you don't provide an email address we will not be able to contact you for the follow-up laboratory study.

____

End of Block: Default Question Block

Start of Block: Pre-screening Survey Demographics

Q1 What is your gender?

○ Male (1)

○ Female (2)

○ Other (3)

Q2 Please enter your age below (in years)

____

Q3 Which of the following best describes your current relationship status?

- ◯ In a relationship (1)
- ◯ Not in a relationship (2)

Q4 What is your current employment status?

- ◯ Employed, working full-time (1)
- ◯ Employed, working part-time (2)
- ◯ Unemployed (3)
- ◯ Retired (4)
- ◯ Student (5)
- ◯ Other (6)

Q5 **Have you played any video games in the past 12 months?**

When answering this question please consider any gaming activity during the past year that involved online and/or offline gaming either from a desktop computer, laptop, console or any other mobile device such as a smartphone or tablet.

- ◯ Yes (1)
- ◯ No (2)

Q6 Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last 12 months?

- ◯ Yes (1)
- ◯ No (2)

End of Block: Pre-screening Survey Demographics

Start of Block: Pre-screening Survey Gaming

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

*

Q12 On average, how many hours you spend gaming on weekdays (Monday to Friday)?

Gaming means any gaming-related activity that has been played either from a computer/laptop or from a gaming console or any other kind of device (e.g., mobile phone, tablet, etc.) both online and/or offline.

____

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

*

Q13 **On average, how many hours you spend gaming on weekends (Saturday to Sunday)?**

Gaming means any gaming-related activity that has been played either from a computer/laptop or from a gaming console or any other kind of device (e.g., mobile phone, tablet, etc.) both online and/or offline.

____

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

*

Q21 **On average, how many times a day do you engage in gaming?**

Gaming means any gaming-related activity that has been played either from a computer/laptop or from a gaming console or any other kind of device (e.g., mobile phone, tablet, etc.) both online and/or offline.

____

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

Q8 Have you played the game Scarioth's Legion in the past 12 months?

- Yes (1)
- No (2)

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

Q9 What type of gamer do you consider yourself to be?

◯ Extremely casual (1)

◯ Somewhat casual (2)

◯ Neither casual nor avid (3)

◯ Somewhat avid (4)

◯ Extremely avid (5)

Display This Question:

If Have you played any video games in the past 12 months?When answering this question please conside... = Yes

Q22 Have you ever experienced problems due to your gaming behavior?

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

Display This Question:

If Have you played any video games in the past 12 months? When answering this question please conside... = Yes

Q19 The questions below are about your gaming activity during the past year (i.e., last 12 months). Here, gaming activity means any gaming-related activity that has been played either from a computer/laptop or from a gaming console or any other kind of device (e.g., mobile phone, tablet, etc.) both online and/or offline.

Please indicate how often the following issues occurred on average over the past twelve months until today.

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Very Often (5)
I have had difficulties controlling my gaming activity. (1)	○	○	○	○	○
I have given increasing priority to gaming over other life interests and daily activities. (2)	○	○	○	○	○
I have continued gaming despite the occurrence of negative consequences. (3)	○	○	○	○	○

I have experienced significant problems in life (e.g., personal, family, social, education, occupational) due to the severity of my gaming behavior. (4)	○	○	○	○	○

End of Block: Pre-screening Survey Gaming

Start of Block: Pre-screening Survey Social Media

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

*

Q15 On average, how many times a day do you check your social media accounts?

____

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

Q16 Which social media platform do you use the most?

▼ Baidu Tieba (1) ... Other (22)

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

Q17 Which social media platform is your favorite?

▼ Baidu Tieba (1) ... Other (22)

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

Q18 What type of social media user do you consider yourself to be?

- ◯ Extremely casual (1)
- ◯ Somewhat casual (2)
- ◯ Neither casual nor avid (3)
- ◯ Somewhat avid (4)
- ◯ Extremely avid (5)

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

Q23 Have you ever experienced problems due to your social media use behavior?

- ◯ Never (1)
- ◯ Sometimes (2)
- ◯ About half the time (3)
- ◯ Most of the time (4)
- ◯ Always (5)

Display This Question:

If Have you used any type of social media (e.g., Twitter, Facebook, Instagram, Snapchat) in the last... = Yes

Q20 Below you will find some questions about how you engage with social media. Choose the response alternative for each question that best describes your behavior.

	Very rarely (1)	Rarely (2)	Sometimes (3)	Often (4)	Very often (5)
Spent a lot of time thinking about social media or planned use of social media? (7)	○	○	○	○	○
Felt an urge to use social media more and more? (8)	○	○	○	○	○
Used social media in order to forget about personal problems? (9)	○	○	○	○	○

Tried to cut down on the use of social media without success? (10)	○	○	○	○	○
Became restless or troubled if you have been prohibited from using social media? (11)	○	○	○	○	○
Used social media so much that it has had a negative impact on your job/studies? (12)	○	○	○	○	○

Please select the answer 'Very Often' (13)	o	o	o	o	o

End of Block: Pre-screening Survey Social Media

Start of Block: Pre-screening Additional Assessment

Q25 **The following questions relate to your personality and well-being. Please answer them as truthfully as possible.**

Q24 Please answer the following short statements by indicating the extent of your agreement using the following scale:

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
I have difficulty staying on task. (1)	○	○	○	○	○
I have difficulty paying attention. (2)	○	○	○	○	○
I often interrupt another person's work. (3)	○	○	○	○	○

Q26 Please answer the following short statements by indicating the extent of your agreement using the following scale:

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Very Often (5)
How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done? (1)	○	○	○	○	○
How often do you have difficulty getting things in order when you have to do a task that requires organization? (2)	○	○	○	○	○

How often do you have problems remembering appointments or obligations? (3)	○	○	○	○	○
When you have a task that requires a lot of thought, how often do you avoid or delay getting started? (4)	○	○	○	○	○

How often do you fidget or squirm with your hands or feet when you have to sit down for a long time? (5)	○	○	○	○	○
How often do you feel overly active and compelled to do things, like you were driven by a motor? (6)	○	○	○	○	○

Q27 Please answer the following short statements by indicating the extent of your agreement using the following scale:

	Strongly Disagree (1)	Disagree (2)	Neither disagree or agree (3)	Agree (4)	Strongly Agree (5)
I would like to explore strange places. (1)	○	○	○	○	○
I get restless when I spend too much time at home. (2)	○	○	○	○	○
I like to do frightening things. (3)	○	○	○	○	○
I like wild parties. (4)	○	○	○	○	○

I would like to take off on a trip with no pre-planned routes or timetables. (5)	○	○	○	○	○
I prefer friends who are excitingly unpredictable. (6)	○	○	○	○	○
I would like to try bungee jumping. (7)	○	○	○	○	○
I would love to have new and exciting experiences, even if they are illegal. (8)	○	○	○	○	○

Q28 Please answer the following short statements by indicating the extent of your agreement using the following scale:

	Strongly Disagree (1)	Disagree (2)	Neither disagree or agree (3)	Agree (4)	Strongly Agree (5)
I make sure to get healthy nutrition. (1)	○	○	○	○	○
To keep fit I try to stay in motion. (2)	○	○	○	○	○
To sustain mental well-being, I try to do something good for myself regularly. (3)	○	○	○	○	○
I regularly meet up with friends. (4)	○	○	○	○	○

I try to avoid negative influences on my health, such as alcohol consumption and/or the use of drugs. (5)	○	○	○	○	○

Q29 Please rate the extent to which you have experienced the events below during the course of the last seven days.

	Strongly Disagree (1)	Disagree (2)	Neither disagree or agree (3)	Agree (4)	Strongly Agree (5)
I was aware of different emotions that arose in me. (13)	○	○	○	○	○
I noticed pleasant and unpleasant emotions. (14)	○	○	○	○	○
I noticed pleasant and unpleasant thoughts. (15)	○	○	○	○	○
I noticed emotions come and go. (16)	○	○	○	○	○

I noticed thoughts come and go. (17)	○	○	○	○	○
It was interesting to see the patterns of my thinking. (18)	○	○	○	○	○
I focused on the movement of my body. (19)	○	○	○	○	○
I felt present in my body. (20)	○	○	○	○	○
I listened to what my body was telling me. (21)	○	○	○	○	○

I was aware of how my body felt. (22)	○	○	○	○	○
I noticed the sensations in my body. (23)	○	○	○	○	○
I was in tune with how hard my muscles were working. (24)	○	○	○	○	○
Please select the answer 'Strongly Disagree' (25)	○	○	○	○	○

Q30 Please answer the following short statements by indicating the extent of your agreement using the following scale:

	Strongly Disagree (1)	Disagree (2)	Neither disagree or agree (3)	Agree (4)	Strongly Agree (5)
I plan tasks carefully. (1)	○	○	○	○	○
I do things without thinking. (2)	○	○	○	○	○
I don't "pay attention." (3)	○	○	○	○	○
I am self-controlled. (4)	○	○	○	○	○
I concentrate easily. (5)	○	○	○	○	○
I am a careful thinker. (6)	○	○	○	○	○
I say things without thinking. (7)	○	○	○	○	○

I act on the spur of the moment. (8)	○	○	○	○	○

End of Block: Pre-screening Additional Assessment

Start of Block: End Block

Q31 Thank you for completing the pre-screening survey.

We will soon get in touch with by email in order to determine your eligibility.

In the meantime, if you have any question or feedback to provide, please contact the principal investigator of this study Dr. Jason Satel via email at jason.satel@utas.edu.au.

End of Block: End Block

Abstract 3. Ethics Approval

Research Integrity and Ethics Unit

UNIVERSITY of TASMANIA

Ethics Approval Letter

28/07/2021

To: Dr Satel

Project ID: 24184

Project Title: On the role of the oculomotor system in gaming and social media usage

The above named project has been approved by the University of Tasmania Human Research Ethics Committee on 28 July 2021.

Approval has been granted for the following documentation:

Submission Document Name	Submission Document File Name	Submission Document Type	Submission Document Date	Submission Document Version
ethics_24184_questionnaire	ethics_24184_questionnaire.pdf	QUESTIONNAIRE	12/05/2021	2
ethics_24184_protocol_v6	ethics_24184_protocol_v6.docx	PROTOCOL	26/07/2021	6
ethics_24184_info_v4	ethics_24184_info_v4.docx	PARTICIPANT INFORMATION AND CONSENT FORM	26/07/2021	4
ethics_24184_consent_v4	ethics_24184_consent_v4.docx	PARTICIPANT INFORMATION AND CONSENT FORM	26/07/2021	4
ethics_24184_response_v6	ethics_24184_response_v6.docx	OTHER PROJECT-RELATED DOCUMENTATION	26/07/2021	6

The University of Tasmania Human Research Ethics Committee has provided approval for the project to be conducted at the following sites:

- Newnham Campus

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project.

This approval constitutes ethical clearance by the University of Tasmania Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

In accordance with the National Statement on Ethical Conduct in Human Research, it is the responsibility of institutions and researchers to be aware of both general and specific legal requirements, wherever relevant. If researchers are uncertain they should seek legal advice to confirm that their proposed research is in compliant with the relevant laws. University of Tasmania researchers may seek legal advice from Legal Services at the University.

The University of Tasmania Human Research Ethics Committee (HREC) operates under and is required to comply with the National Statement on the Ethical Conduct in Human Research.

Therefore, the Chief Investigator's responsibility is to ensure that:

(1) All investigators are aware of the terms of approval, and that the research is conducted in compliance with the HREC approved protocol or project description.

(2) Modifications to the protocol do not proceed until **approval** is obtained in writing from the HREC. This includes, but is not limited to, amendments that:

(i) are proposed or undertaken in order to eliminate immediate risks to participants;
(ii) may increase the risks to participants;
(iii) significantly affect the conduct of the research; or
(iv) involve changes to investigator involvement with the project.

Please note that all requests for changes to approved documents must include a version number and date when submitted for review by the HREC.

(3) Reports are provided to the HREC on the progress of the research and any safety reports or monitoring requirements as indicated in NHMRC guidance.

Guidance for the appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located under the ERM "Help Tab" in "Templates". All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested.

(4) The HREC is informed as soon as possible of any new safety information, from other published or unpublished research, that may have an impact on the continued ethical acceptability of the research or that may indicate the need for modification of the project.

(5) All research participants must be provided with the current Participant Information Sheet and Consent Form, unless otherwise approved by the Committee.

(6) This study has approval for four years contingent upon annual review. A Progress Report is to be provided on the anniversary date of your approval. Your first report is due on the anniversary of your approval, and you will be sent a courtesy reminder closer to this due date. Ethical approval for this project will lapse if a Progress Report is not submitted in the time frame provided.

(7) A Final Report and a copy of the published material, either in full or abstract, must be provided at the end of the project.

(8) The HREC is advised of any complaints received or ethical issues that arise during the course of the project.
(9) The HREC is advised promptly of the emergence of circumstances where a court, law enforcement agency or regulator seeks to compel the release of findings or results. Researchers must develop a strategy for addressing this and seek advice from the HREC.

Kind regards,

Ethics Executive Officer

UNIVERSITY of TASMANIA