Examining Attentional Bias to Unsolicited Sexual Stimuli and its Potential Association with Internet Pornography Use

By

Duncan Veneziani

A dissertation presented to the Faculty for Social Wellbeing and

the Faculty for Medicine and Surgery for the degree of MSc in Addiction

studies

May, 2022

Acknowledgements

Before anything else, I wish to glorify and appreciate God, who bestowed upon me copious blessings, knowledge, and perseverance to realize this dissertation. Without you, none of this would have been possible. A debt of gratitude is also owed to Dr Olga Bogolyubova, and Mr Matthew Bartolo whom with their constant supervision and expertise guided me throughout the completion of this project. I also wish to thank my parents for their continuous love and encouragement, without whom this scholastic achievement wouldn't have been possible. I am very much thankful to my fiancé Charlene for her love, understanding, care, and support throughout this research work. Last but not least, I would like to extend my appreciation to those who could not be mentioned here but have well played their role to make me believe in my capabilities.

Abstract

Attentional bias towards addiction-related cues has been a subject of extensive research in substance-use disorders (SUDs). Although this mechanism was primarily researched for psychostimulant drugs, there is now evidence that the same incentive-motivational properties can be used in reference to problematic Internet pornography use (IPU). This study aimed to contribute to existing research on the effects of IPU, by experimentally testing the effects of exposure to sexual content on a specific subconscious cognitive process: the allocation of attention (i.e., attentional bias). More specifically, this study aimed to compare attentional bias to sexual cues between participants with different frequencies of Internet pornography use. This study also addressed the effects of abstinence from pornography use on attentional bias. A total of 23 adult heterosexual males aged between 18 and 52 years (M_{age} = 32.52; SD = 9.317) were recruited to participate in a two-component study. The first component consisted of a Visual Probe Task followed by a set of self-report measures, and the second component was a re-examination of the Visual Probe Task, following one week of abstinence from pornography use. Results found no significant differences in reaction times between sexual and neutral cues. However, statistical significance was reported with frequency of Internet pornography use and mood modification, and age of first pornography use and saliency. Findings concerning frequency of use and mood modification, support the observation that using Internet pornography as a coping mechanism for depressing moods or stress can be considered a risk factor in developing problematic pornography use.

Keywords: attentional bias, incentive sensitization, Internet pornography, frequency, abstinence

Table of contents

Introduction

Over the past decades, Internet technologies brought forth a wealth of information for those who have access to the Internet. Aside from allowing access to an endless supply of knowledge and entertainment, the Internet also provided different means of communication among users (i.e., forums, video calls, and so forth). Furthermore, the Internet provided the possibility of finding any given service within any desired location, enabled access to bank accounts, provided the option of paying bills electronically, provided the ability to work from home, facilitated online shopping, and much more.

With increased access to the Internet, numerous concerns started to emerge in relation to how excessive use may negatively impact our lives. A study presented to The European Parliament Research Service (EPRS) reported that negative aspects of excessive Internet use include: information overload, addictive and problematic Internet use, impaired social relationships and communities, blurred boundaries between public/private settings, and adverse consequences on cognitive development (Quaglio & Millar, 2020). Activities commonly associated with Internet addiction and problematic Internet use include online social networking (Müller, 2016), gambling (Kuss & Griffiths, 2012), gaming (Lemmens, 2015), and Internet pornography (Giordano, 2017).

Because the Internet is not subject to regulations, pornographic material was easily made available for circulation, and distribution for consumption within one's own home (Kunaharan et al., 2017; Kühn & Gallinat, 2014). Additionally, technological advances such as speed high-speed Internet, smartphones, art phones, tablets, 4G, and Wi-Fi, provided more access, affordability, and anonymity to endless streams of sexual content (Cooper, 2013).

In a pornography consumption study, Price et al. (2015) found that Internet pornography use tripled, compared to previous years. In 2019, one of the biggest porn sites, Pornhub.com, reported an exponential growth of 115 million visitors per day or 80,032 every

minute (Silver, 2019), and in 2020, 130 million visitors per day or 90,470 per minute (Parkman, 2021). It is to be noted that these figures are only addressing a single porn site, and not the other 42 million pornography websites available on the web (Ward, 2021). To place its social popularity into perspective, the total revenue of the porn industry exceeded those of Apple, Google, Amazon, Yahoo, and Microsoft combined (Shukla, 2019).

Given the rapid growth and availability of pornographic material, it is important to understand its potential psychological effects on its users. While problematic consumption of Internet pornography use has received considerable scientific attention (Grubbs et al., 2019), experimental investigations on the cognitive aspects of pornography users are limited (Zimmer & Imhoff, 2020).

Pornography Use and When It Becomes Problematic

Findings in relation to neuropsychological evidence suggest some kind of indirect or direct adverse consequences in executive function (Leppink et al., 2016), possibly due to prefrontal cortex alterations (Kamaruddin et al., 2018). As a result, this may in turn influence the development, maintenance, and escalation of problematic pornography use (Laier et al., 2013a). Some of the negative effects in relation to executive functioning include impulsivity (Cheng & Chiou, 2018), difficulty in shifting attention (Messina et al., 2017; Seok et al., 2018), poor judgment and decision making (Sirianni & Vishwanath, 2016), impaired working memory (Laier et al., 2013a), loss of emotional regulation (Laier et al., 2013b), and inability to abstain or reduce pornography use (Chen & Jiang, 2020).

When it comes to neurobiological evidence, several studies reported similar findings across substance addiction and pornography use. These include sensitization or unconscious memory of pleasure, capable of triggering powerful cravings (Klucken et al., 2016); desensitization or a numbed response to pleasure (Kühn, S., & Gallinat, 2014; Banca et al., 2016; Albery et al., 2017); dysfunctional prefrontal circuits being manifested as weakened

inhibition combined with hyper-reactivity to sexual cues (Kunaharan et al., 2017; Laier et al., 2013b); and malfunctioning stress system mostly manifested as amplified cravings under minimal stressors, inability to control urges, and a myriad of withdrawal symptoms such as anxiety, depression, mood swings (Chatzittofis et al., 2016; Jokinen et al., 2017).

Attentional Bias as a Core Cognitive Process

Sexual stimuli (i.e., pornography) may become a conditioned signal or cue in our environment, which may significantly influence our behaviour. This is because cues primarily target visual perception, eliciting various physiological, psychological and cognitive responses (Van der laan et al., 2011).

As described by Robinson and Berridge (1993, 2001), the theory of incentive sensitization proposes that, through classical conditioning, stimuli related to addictive substances become associated with the incentive motivation of substances eliciting a conditioned response. These responses indicate an intensive want or craving influencing the incentive state of an individual (Berridge et al., 2009). This experience has been thoroughly documented in research and explained using the theory of attentional bias, one of the main cognitive biases extensively researched in substance disorders (Hakamata et al., 2014).

Attentional bias involves immediate and unconscious attention/identification of some stimuli (i.e., salient stimuli) whilst ignoring others simultaneously.

Although this mechanism was primarily researched for psychostimulant drugs, there is now evidence that the same incentive-motivational properties may provide an explanation for the cycle of behavioural addictions, such as gambling (Brevers et al., 2011), shopping addiction (Jiang & Li, 2017), and also to Internet pornography (Banca et al., 2016; Mechelmans et al., 2014; Pekal et al., 2018).

Just like in substance dependence, compulsive porn users also display attentional biases for addiction cues. While nudes catch the eye in most people (Jiang et al., 2006),

individuals with Internet-pornography-use disorder (IPD) display an even stronger attentional bias toward sexually explicit content (Pekal et al., 2018). The same attentional biases for addiction cues were also found in individuals who were dependent on alcohol, nicotine, heroin, and cannabis (Field & Cox, 2008).

Focus of Study

Some pornography users report experiencing an array of negative outcomes as a result of excessive, and persistent engagement in pornography use (i.e., Problematic Pornography Use, PPU). Although recent theoretical models have relied upon various cognitive processes (e.g., decision making, attentional bias, and inhibitory control) to explain the development and maintenance of PPU, empirical evidence derived from experimental studies is still limited. In this context, this study aimed to compile more evidence in relation to existing research about the effects of problematic Internet pornography use, by experimentally testing the effects of exposure to such content on a specific cognitive process (i.e., attentional bias). More specifically, this study aimed to compare attentional bias to unsolicited sexual cues amongst users with different frequencies of Internet pornography use. This study also aimed to assess if abstinence from pornography use has any effect on attentional bias.

In order to realize the overall aim of the study, attentional bias for sexual cues was measured using a Visual Probe Task, and frequency of pornography use was assessed via the Weekly Internet Pornography Use Scale; adapted from the Pornography Craving Questionnaire by Kraus & Rosenberg (2014). Those who accepted to participate in the second part of the study (i.e., to assess abstinence in relation to attentional bias) were asked to do one-week abstinence from Internet pornography use until re-examination (i.e., repeat the Visual Probe Task). Results attained from both Visual Probe Tasks were compared to one another (i.e., before and after abstinence) to see if there was any difference in reaction time.

Due to the theoretical assumptions of the incentive sensitization theory, three hypotheses were presented. First, it was hypothesised that higher attentional biases (i.e., faster reaction times) toward unsolicited sexual stimuli would be associated with higher Internet pornography (IP) use (i.e., higher frequency). Secondly, it was also hypothesised that non-Internet pornography users and occasional IP users would show less attentional bias (i.e., slower reaction times) towards unsolicited sexual stimuli compared to current IP users and frequent IP users. Lastly, it was hypothesised that participants abstaining from using Internet pornography for one week would show a decrease in attentional bias (i.e., slower reaction times) when compared to first examination.

Seeing that the mechanism of attentional bias toward addiction-related cues is also being used to explain the cycle of behavioural addiction, this research can be of further contribute to our local understanding of Internet pornography use, and to the global debate on why compulsive Internet pornography viewing can be considered as a behavioural addiction.

Key Terms

terms	definitions	source
Attentional bias	Elevated attention towards stimuli with higher saliency or relevance for certain individuals or groups	(Drobes et al.,2019)
Incentive sensitization	When repeated exposure to "potentially addictive [behaviours] can, in susceptible individuals and under particular circumstances, change brain	(Robinson & Berridge, 2008, p.3137)

	cells and circuits that normally regulate the attribution of incentive salience to stimuli"	
Motivated attention	Greater attentional processing being directed to motivationally salient cues	(Bradley et al., 2003)
Pornography	"Sexually explicit materials intended to arouse"	(Mc Knee et al., 2019, p.6)
Seeking system	A system that drives both humans and animals to seek information for survival purposes	(Panksepp, 1988)
Supranormal stimulus	Artificial stimuli that elicit stronger responses over the natural (i.e., original) stimuli	(Tinbergen, 1951)

Overview of the Dissertation

The second chapter of this dissertation will look at the history of pornography, to provide a definition that takes into consideration cultural aspects. It will also delve into findings of previous literature in relation to its effects, and how attentional bias is influenced. The third chapter aims to give a clear explanation of the methodology adopted to gather the data and the methods with which data was analysed. The results of this analysis are then presented, and their implications and consistency with previous literature will then be discussed in the following

chapter. The final chapter will highlight the importance of this study whilst giving a thorough account of its limitations, along with recommendations for future research on the topic.

Literature Review

Defining Pornography

Recent work in evolutionary psychology suggests that our definitions may have been constrained by our biology as well as our logic, causing flaws in the dominant definitions of pornography (Andrews, 2012). The central problem with these dominant definitions is that they fail to cover porn's diversity, even though, pornography has always been more varied than they imply. Most often, these definitions assert that porn is explicit material; material intended to arouse; and/or material dependent on sexual representation (Rea, 2001).

Not only are the parameters of such definitions nebulous, they also narrow down the idea that explicitness can vary according to contextual factors. For example, how "explicit" must the material be for it to be explicit? An R-rated erotic romance movie put out by a major studio can be inexplicit in its depictions compared to a hard-core movie, yet it can be explicit compared to other studio movies. and, if some viewers found this R-rated movie's sex scene explicit and arousing, is their reaction enough to conclude that the scene in question is pornographic?

Similarly, is a picture of a woman in a skimpy bikini explicit, or must she be fully unclothed? and if a young male gets aroused by her bikini, does that make her photo pornographic?

These questions suggest that 'pornography' is a protean term, as 'pornographic' material is subjective according to circumstances of production, distribution, and/or reception (Asthon et al., 2019). Given what this reveals of the inevitable influence of culture on meaning, it is important to think very clearly and very historically about pornography so as to devise a definition that caters and reflects its contextual complexity.

Back to the Future: From the Palaeolithic Era to Pornhub

The start of what constitutes pornography today is believed to have its origins in the Venus of Willendorf; dating back to 28,000 thousand years ago. For the people of that time, this voluptuous sculpture of a naked woman was believed to incite fertility rites. In fact, historians believe that such rites, started at the time when the Venus of Willendorf and other similar artefact were presented (Duncan, 2019).

The first illustration of anal sex dates back to the Babylonian era, 2000-1600 BC. This illustration shows a woman bent down whilst sliding backwards into a man's genitalia.

For the Babylonians, anal sex was a means of contraception, one of many at the time. In the Babylonian religion, chastity was a sin, and temple prostitutes served the public at large to win the favour of the gods (Duncan, 2019). These temples were not places of sex in exchange for money but a place of communal ritualistic practices to thank and praise the gods of ancient Babylon. Despite their sexual promiscuity and uninhibited practices, ancient Babylonians looked at sexual illustrations as a religious experience (Duncan, 2019).

The ancient Greeks famous for their exceptional talents in poetry, literature, music, philosophy, and other human sciences, were also famed for their vivid illustrations of sexual acts on their ceramics (Ettinger, 2017). The earliest evidence for ancient Greek sexuality comes from the Minoans (3650 to 1400 BC). According to existing descriptions by ancient historians, and archaeological findings, women occupied an important if not dominant role within the practice of Minoan religion and city activities (Grammatikakis, 2010). In Minoic civilisation, male artists used luscious figures of women to express female gender, status, and femininity rather than idealising female sexuality as a means to satisfy their own delectation. (Chrystal, 2016).

The Romans also had their overt depictions of sexual illustrations; mostly those depicted on the walls of Pompeii and Herculaneum more than 2,000 years ago (Clarke, 1998).

The sexually explicit frescoes found all over Pompeii, were considered to be an asset to have around your house, or else, you would have been regarded as tasteless and ignorant in understanding your societal values (Crouch, 2016).

Hundreds of years later, another culture had its own unique subset of erotic pottery, known as sex pots. The Moche of Peru (A.D. 100 to A.D. 800) had erotic pottery characterised by depictions of human figures engaged in various sexual acts. At first glance, one assumes that these sex pots were designed to titillate eroticism. However, scholars believe that these pots were used by the Moche as educational tools about sex and reproduction (Nash, 2016).

In the Middle Ages and at the beginning of the Early Modern period, sex and sexuality were subject to strong regulation from Catholic clergy, civic authorities, and family members. Although anti-erotic discourse had been part of the lives of monks, nuns, and other clergies, official and ideologically imposed indoctrination was not always adhered to by either laypeople or clergy. In fact, sexual material was regularly consumed via erotic novels and visual arts (Phillips, 2020).

The word ‘pornography’ was a term coined by Victorian science. Seeing that this era regulated and controlled any sexual material (Weeks, 1989), pornography offered an alternative solution to such restriction and repression (O’Neil & Bouce 1984), by illustrating sexual fantasies and desires (Joudrey, 2015). At this point, pornography was used for sexual arousal, and this conceptualization intensified throughout the years, especially in the 1920s, were pornographic movies started to film threesomes, orgies, and girl-on-girl scenes.

The 1960s sexual revolution drew an even larger eruption in the adult industry; especially in the 1970s and 1980s when porn production used technological advancements to reach a much wider audience (Crouch, 2016).

With the explosion of the readily available internet from the 1990s to the early 2000s, consumers were given prodigious access for pornographic material from any part of the globe at any given time. With a simple click of a button, a plethora of sexual genres would be immediately available for one's sexual pleasure.

Defining Pornography: Results from a Global Delphi Panel

As shown in the previous section, sexual representations (e.g. novels, frescoes, statues, and so forth) were subjectively interpreted according to their historical period. Thus, imagery that might have been considered religious in one society may have been condemned as profane (i.e., pornographic) in another.

Seeing that the future of research is becoming increasingly interdisciplinary (Bridle et al., 2013), researchers have tried to reach a consensus on how to define 'pornography' for academic research (Willoughby & Busby, 2016). In their attempt to define 'pornography', Ashton et al. (2019) thematically analysed recent and dominant definitions of pornography in research publications and scholarly articles. As a result, Asthon et al. (2019) concluded that pornography is any "material deemed sexual, given the context, that has the primary intention of sexually arousing the consumer and is produced and distributed with the consent of all persons involved" (p.144).

In another study by Mc Knee et al. (2019), 38 leading pornography researchers from various disciplines, were invited to participate in an international Delphi panel in an attempt to define 'pornography'. Results indicated that the majority of participants used the term 'explicit'; e.g.: "the explicit representation of sexual activity, broadly defined, in images and words" (p.3), and 'intention to arouse' in their definitions; e.g.: "explicit sexual representation for the purpose of arousal" (p.3). The remaining participants used neither 'explicitness' nor 'intent to arouse' in their definition of pornography and opted to cite Kendrick's history of pornography to assert that pornography is an "argument or a process,

not a thing" (p.4). This means that what defines 'pornography' today can, "change over time and the decision about who gets to decide what counts as pornographic […] is tied up with social and cultural relations" (p.4).

On the basis of these responses, two distinct definitions were presented. The first being "sexually explicit materials intended to arouse" (p.6), and the second was more culturally bound "we can use this definition…so long as we always bear in mind that this definition is always provisional, will change over time" (p.6). The lack of agreement in finding a single definition replicated the same findings of other studies (Andrews, 2012; Rose, 2012). In light of their conclusion, Mc Knee et al. (2019) presented a rather pragmatic approach in their definition. Rather than opting to choose either definition, the researcher is given the possibility to choose according to the project presented.

For the purpose of this study, pornography will be defined as "sexually explicit materials intended to arouse" (Mc Knee et al., 2019, p.6).

I Seek, Therefore I Am

"Humans have a complicated and ambivalent relationship to pleasure, which we spend an enormous amount of time and resources pursuing" (Linden, 2012, p.2). According to Linden, pleasure is such a key motivator of our lives, that we are compelled to seek it from a wide variety of experiences; either from a natural phenomenon to an induced (i.e., artificial) one. Regardless of what our pleasurable experiences may be, they all activate an anatomically and biochemically defined pleasure circuit in the brain. In summary, we are hardwired to catch a pleasure buzz from a vast array of experiences by exploring our environment.

Jakk Panksepp (1998), discovered what he termed the 'seeking' system, a system that drives both humans and animals to seek information for survival purposes. Metaphorically speaking, this system can be seen as the motivational engine that gets you out of your bed, to

venture into the world. However, in order for this engine to get moving, it must be fuelled with dopamine.

Dopamine stimulates this mesolimbic seeking system to encourage exploration, investigation, expectancy, foraging, curiosity, and craving. In other words, seeking is so stimulating, that dopamine fires each time we explore our environment.

Drawing from the works of Panksepp, one can argue that addiction can therefore be seen as an excessive (i.e., frequency) form of seeking. Whether one is seeking a hit from heroine, or a porn search, "dopamine is firing, keeping the [seeker] in a constant state of alert expectation" (Aiken, 2016, p.53). If you think about it, Internet pornography is like outer space – in terms of its infinite seeking (i.e., rewarding) opportunity.

With an evolutionary memory augmented towards environmental seeking, cybersex (i.e., Internet pornography) presents itself as the perfect rewarding experience. Overwhelming evidence suggests that due to its combination of unlimited exploration, anonymity, accessibility, affordability, intermittent rewards, fast delivery, and novel content, for some individuals, Internet pornography is totally irresistible (Aiken, 2016).

Supranormal Stimulus

Throughout history, pornography has been expressed through radically different forms and mediums. However, the advent of the Internet has dramatically altered the way pornography is consumed (Kohut et al., 2019). Today's cornucopia of free, streamed, high-definition pornography videos run the gamut from erotic to extreme; making today's Internet pornography *sui generis*, with a unique propensity of fusing novel learning with a powerful pleasure incentive drive (Wilson, 2016).

Today's Internet pornography is illustrative of Tinbergen's concept of 'supranormal stimulus' (Tinbergen, 1951); nowadays, often referred to as 'supernormal stimuli'. Tinbergen

discovered that artificial stimuli can elicit stronger, and often preferential, responses in animals over the natural (i.e., original) stimuli (i.e., eggs or mates).

Much of Tinbergen's work is perfectly reconceptualised in a book by Harvard psychologist Deirdre Barret titled "*Supernormal stimuli: How primal urges overran their evolutionary purpose"*. Just like Tinbergen's findings of abnormal stimulation to animals, technological advancements (i.e., Internet pornography) have created a similar 'laboratory' setting for humans (Barret, 2010). Today's Internet pornography's plastic surgery-enhanced breasts, exaggerated grunts of desire, and other artificial scenarios profuse the same purpose as Tinbergen's artificially enhanced female butterfly dummies; the males of each species prefer the artificial over the naturally evolved (Tinbergen, 1951).

In light of this biological phenomenon, Wolf (2003), argues that "For the first time in human history, [erotic] images' power and allure have supplanted that of real naked women. Today real naked women are just bad porn" (para. 6). Metaphorically speaking, just like Tinbergen's 'butterfly porn', Internet pornography has been successful in competing for the attention of males at the expense of real females. In their findings, Malcolm & Naufal (2014) determined that Internet pornography consumption (i.e., substitute for marital sexual gratification), correlated to (I) a decline in marriage formation, and (ii) contributed to such a trend. This study shows that once pornography becomes a means for sexual gratification, then it undercuts the need for marriage (i.e., real-life partner) to serve that function.

Attwood (2006) and Kinnick (2007) attest that nowadays, both the media and mainstream culture are moulded into 'pornographication' implying that pornography and associated messages have become more prevalent and influential in our culture.

Gail Dines (2010), argues that it is antithetical to assume that Internet pornography has no influence on the individual when at the same time advertisements have such an impact on our choices. Dines argues that if we accept that the food industry shapes what people eat,

and the clothing industry shapes how people dress, then it would be highly contradictory to assume that the porn industry has no effect on the individual.

The Promise of Pleasure

Internet pornography can pose unique risks beyond supernormal stimulation, due to what Cooper (2013) calls the 'Triple-A' engine: accessibility, affordability, and anonymity. Ease of accessibility paves the way to a limitless supply of artificial partners at any given space and time; anonymity helps to unsnarl gargantuan sexual fantasies without getting exposed, and affordability guarantees cheap and/or free access to sex tubes.

Increased access to Internet pornography gave rise to numerous concerns in relation to excessive or compulsive use (Diomidous et al., 2016); mainly because excessive use, can be regarded as a manifestation of addictive behaviour (Bostwick & Bucci, 2008). In fact, excessive Internet pornography users display tolerance for erotic stimuli (Prause et al., 2015), and frequency of use is correlated with sensation seeking (Peter & Valkenburg, 2016). Other traits that show the telltale signs of substance addiction include impulsivity (Carroll et al., 2008) and low self-control (Holt et al., 2012).

To Be or Not to Be: Is Pornography Addictive?

There is a great deal of controversy about whether pornography is addictive or not (George et al., 2019). Although several studies showed that pornography addiction might be related to socio-functional, psychological impairments, and neural changes similar to substance dependence (Darshan et al., 2014), others view such findings as reflective of cultural/sub-cultural values, not clinical ones.

A study by Grubbs et al. (2020) found that people's cultural, moral, or religious beliefs may lead them to believe that they are addicted to pornography, not pornography per se. In other words, what people refer to as porn addiction is essentially a conflict of values that leads the person to think they are addicted.

Similarly, Ley et al. (2014) argue that such studies are mostly cross-sectional, and they simply describe how certain groups of people act, without showing any real cause and effect. According to Ley et al. (2014) results attained from these studies, are subject to many forms of bias, and cannot reflect larger populations. In fact, even though there are various terminologies affiliated with problematic pornography use, such as hypersexuality, impulsive viewing, and compulsive viewing (Duffy & Dawson, 2016), pornography addiction is not recognised by the American Psychological Association (APA) for insufficient evidence and empirical research. Researchers believe that even if pornography addiction becomes recognised in a future edition of the DSM, it runs the possibility of being subcategorised under "Internet Addiction Disorders" rather than being recognised as a disorder of its own (George et al., 2019). So far, studies in relation to online sexual behaviour reported the presence of online dissociation both mentally and emotionally (Chaney & Dew, 2003). Seeing that similar finds have also been found in relation to other online activities (Schimmenti & Caretti, 2010), further supports the notion that problematic Internet pornography use could be related to Internet addiction (Griffiths, 2012). Notwithstanding, researchers, argue that the Internet gave rise to the possibility of various sexual interactions (e.g., casual sex websites), and not just pornography. Thus, whether Internet use represents a conduit for repetitive behaviour (e.g., pornography use) or a conduit for its own right is still debatable (Grant & Chamberlain, 2016).

Something to bear in mind is that the DSM is constantly debated, changed and revised. However, a number of professionals are still baffled as to why certain behavioural addictions have been recognized (i.e., gambling) whilst others are not (i.e., sex and porn addiction). Many leading experts believe that it is only a matter of time before the DSM recognizes that pornography can lead to both addiction and harmful effects (Donovan, 2019).

Contrary to the DSM, the latest version of the ICD did recognize compulsive sexual behaviour disorder, in the impulsive control disorders chapter (Powers, 2019). This inclusion proved to be the first step towards the need to acknowledge this issue whilst expanding on it; one key point being Internet pornography use (De Alarcón et al., 2019). Individuals who report problematic pornography use are indicating behaviours similar to substance dependence. Drugs manipulate the brain to activate its natural neural pathways associated with reinforcement and pleasure. Similarly, to drugs, Internet pornography 'tricks' the brain into thinking it is getting sex – and just like a drug, the forced high can become a powerful drive (Fradd, 2017).

Dopamine is the primary neurotransmitter (i.e., brain drug) that amps up the reward circuitry of the brain. Thus the bigger the squirt of dopamine, the more you want or crave for that something. Seeing that dopamine serves as a barometer to deduce the potential value of any experience, it will not only influence what to approach or avoid, and where to put your attention, but it will also tell you what to remember by rewiring your brain via new or stronger nerve connections (Wilson, 2017). As a result, following an initial rewarding experience with Internet pornography, the user's urge may become more frequent and powerful; consequently, leading these connections to become so enticing that simply sitting down at a computer may elicit a sexual response. Similar to drug addiction, Internet pornography can lead a person to use the substance more and more. By analogy, an Internet pornography user may need to watch more porn or escalate to hard-core porn, to get the same high he could get with smaller doses (Seto et al., 2001).

Although dopamine is often portrayed as the pleasure molecule, it can be argued that it is more about "seeing and searching for pleasure, not pleasure itself. Thus dopamine rises with anticipation" (Wilson, 2017, p. 67). An Internet pornography user can edge (masturbate without climaxing) to porn without triggering satiation, or aversion; encouraging a constant

prophetic anticipatory promise of pleasure (i.e., reward) just around the corner (i.e., the next scroll or tap).

Can’t Take My Eyes Off You or Can I

An fMRI study by Voon et al. (2014) found that Internet pornography users exhibited similar neural responses to pornographic cues as drug users displayed towards drug cues. Moreover, when participants were not viewing any pornographic content, they craved to view such content, but when they actually did, they didn't enjoy it. Such a discrepancy between 'liking' and 'wanting' fell in line with incentive motivation theories used in addiction studies (Robinson & Berridge, 1993).

Cravings for incentives (e.g., alcohol, drugs or Internet pornography) are linked with the mediation of the mesolimbic dopaminergic system (Berridge & Robinson, 1998). This theory connotes that dopamine alters the attribution of incentive salience towards relevant cues, triggering a motivational magnet of wanting. In light of this understanding, Berridge and Robinson (1998) proposed two distinctive characteristics related to the incentive salience theory. They argued that cue rewards could trigger a momentary peak of temptation strong enough to motivate someone to seek the unconditioned reward and (ii) that the cue itself becomes so powerful that the person would find it very difficult to avoid.

Along with incentive salience, activation of reward systems give rise to various subjective responses in both behaviour and cognition, including attention toward sexual cues (Strahlet et al., 2019). Studies have recognised that aside from involuntary attention (bottom-up approach), involuntary attention (bottom-up approach) can also alter the perception of visual stimuli processing captured by visual cues (Schupp et al., 2003). A concept which can be useful in understanding how sexual cues can affect perception and attention is ‘motivated attention’.

Motivated Attention

Visual attention may be guided by a person's free will towards a given object, facilitating goal-oriented behaviours. However, it is also possible that motivationally significant cues can capture attention involuntarily. These cues may be salient if they have an effective association ascribed to them (Ferrari et al., 2008). In line with this understanding, individuals with problematic pornography use, tend to bring stronger approach-motivated positive effects and stronger attention towards sexually explicit content (Mechelmans et al., 2014; Kagerer et al., 2014).

The majority of research vis-à-vis motivated attention focused on the role of salient stimuli in picture-viewing paradigms using reaction time tasks to evaluate participant's performance (Bradley et al., 2006). It is to be noted that these studies found that the processing speed of visual cues is almost instantaneous. In fact, Thorpe et al. (1996) observed that humans have the ability to detect complex scenes in a very short timeframe (i.e., 0.15 sec). This rapid detection not only supports the role of early visual information processing and neural network communication; but also questions how attention impacts rapid visual processing (Li et al., 2002).

Findings from neuroimaging studies report that in comparison to neutral images, images of motivational relevance provoke enhanced activation within the visual cortex (Balconi & Mazza, 2009; Bradley et al., 2003). Also, event-related potential changes in the early stages of visual processing were reported in studies using electrophysiological testing with Rapid Serial Visual Presentation (RSVP) (Junghöfer et al., 2001). These studies may indicate that early visual information processing strengthens motivationally salient stimuli. Although this approach has managed to consider various aspects of information processing, it disregarded the role of selective attention.

Attentional Bias

Kagerer et al. (2014) refer to attentional bias as "the tendency for some stimuli to be preferentially processed, therefore capturing attention" (p. 1). Seeing that this process is based on selective attention (MacLeod et al., 2002), explains our inclination towards immediate and unconscious identification of salient stimuli. Although there is a natural biological predisposition for attentional bias (Yorzinski et al., 2014), individual differences can influence the allocation of attention amongst competing stimuli; especially in substance use disorders (SUDs) (Field et al., 2014). Studies demonstrate that individuals with SUDs "notice and attend to substance-related stimuli more readily than non-substance users and that addiction-related cues [prevail] over other stimuli" (Castro-Calvo et al., 2021, p.4).

Lately, attentional bias towards addiction-related stimuli has also been applied to various behavioural addictions, such as problematic Internet gaming (Jeromin et al., 2016), gambling (Hønsi et al., 2013), or problematic use of social networking sites (Nikolaidou et al., 2019).

A common theory used to explain the underlying process of attentional bias towards addiction-related cues is the incentive sensitization theory (Robinson & Berridge, 1993). Based on this theory, classical conditioning processes (i.e., learning via association) delineate how addiction-related cues elicit an attentional bias. In summary, repeated pairings of certain addictive cues in conjunction with the effects derived from a specific consumption lead to an increased salience of certain stimuli; thus 'grabbing' attention and becoming attractive and 'wanted'.

The Visual Probe Task is a well-known paradigm used in assessing preconscious attentional biases (Van Rooijen et al., 2017). This task simultaneously presents two stimuli (i.e., generally presented as images) for a short duration (generally, 500msec / 0,5sec) on either side of a screen. One stimulus is emotionally neutral (e.g., books), whilst another

presumably elicits an attentional bias (e.g., drug paraphernalia in a drug-related Visual Probe Task). Once both stimuli disappear and a probe (e.g., dot) appears on either side of the screen, participants are to press a response key. This response measures attentional bias; since it indicates the time needed for a participant to perceive the probe in question (i.e., reaction time). The idea is that participants respond quicker when the probe appears instead of the stimuli being attended for (i.e., the stimuli grabbing attention at a preconscious level).

To this date, four studies have used a Visual Probe Task to assess attentional bias in problematic pornography use (PPU) (Castro-Calvo et al.,2021). Two studies opted for a similar experimental design (i.e., using a duration of 500msec to present a neutral versus sexual stimuli) (Doornwaard et al., 2014; Kagerer et al., 2014); whilst the remaining two used a more elaborate design (i.e., presentation of three stimuli for a total duration of 150ms) (Banca et al., 2016; Mechelmans et al., 2014). Stimuli in question consisted of three categories (i.e., neutral, erotic, and explicit).

It should be noted that some studies used more than a single task to examine additional characteristics related to attentional bias. In fact, Doornwaard et al. (2014) measured selective attention via a Word Search Task, and Kagerer et al. (2014) measured stimuli categorization via a Line Orientation Task.

The above-mentioned studies found that certain participants are more likely to present an attentional bias when reporting (i) problematic pornography use (PPU), high frequency of pornography use, or (iii) traits similar to problematic pornography use.

Kagerer et al. (2014) observed that sexual sensation seekers responded much faster when the dot appeared next to a sex picture than their neutral counterparts. Similarly, Doornwaard et al. (2014) found that frequency of pornography use (i.e., moderate and high) correlated to quicker responses during Visual Probe Task. Another interesting study was that of Mechelmans et al. (2014), who examined attentional bias amongst individuals with PPU.

Findings indicated that even though explicit sexual stimuli marked the highest when scoring attentional bias, stimuli with either low (i.e., erotic) or no explicit content (i.e., neutral) recorded no attentional bias. Banca et al. (2016) contradicted such findings and remarked that irrespective of sexual explicitness, participants with PPU still display an enhanced attentional bias towards sexual stimuli; meaning that "attentional bias toward sexual stimuli was associated with a greater preference for cues conditioned to sexual images, but not with novelty preference" (Castro-Calvo et al. 2021, p.12). The study by Banca et al. (2016) had a remarkable resonance with the incentive sensitization theory (Robinson & Berridge, 1993), for it proposed that attentional bias towards a specific stimulus is a result of classical conditioning.

Another study that established a relationship between PPU and attentional bias; when presented with sexual stimuli was that of Pekal et al. (2018). It is to be noted that attentional bias towards such stimuli was related to craving and cue reactivity, both mediated by subjective sexual arousal and craving.

Purpose of Study

One cannot ignore sexual cues by simply avoiding them; especially when taking into consideration how we are constantly exposed to erotic stimuli on a daily basis (e.g., billboards, online adverts, videogames and so forth). These stimuli are not always presented through explicit content, but rather through unsolicited means (i.e., e.g., material that has the potential to elicit sexual arousal).

The reality is that porn’s widespread acceptance and accessibility have evolved much faster than our public awareness of it. Thus, it took many years for pornography to be considered innocuous, and as such, it will take time and effort to debate otherwise. According to Fradd (2017), this happened because for many years, pornography has been overlooked in public health or public policy discussions, due to its affiliation to moral or religious domains.

However, over the last decade, research has focused much more attention on the effects of exposure to pornography on the behaviours and cognitions of its consumers (Snagowski & Brand, 2015; Doornwaard et al., 2014). To date, various studies reported that some pornography users find it difficult to control their pornography use, causing significant psychological distress (Grubbs et al., 2015). Similar reports have been reported by clinicians seeing a rise in the number of clients seeking treatment for pornography-related problems (Park et al., 2016; Fradd, 2017; Wilson, 2017). With an increase in public knowledge, interest, and awareness in the field of behavioural addictions, Internet pornography gained more consideration in the Maltese society (Bonello, 2014; Borg, 2014; Darmanin, 2011; Falzon, 2016; Ministry of Health, 2012); especially when taking into consideration that pornographic websites are the most sought websites amongst the Maltese population, with some even reporting that their use has become addictive (Agius, 2018).

Methodology

This chapter will give an overview of the: (I) hypotheses being tested, (II) variables used in this study, (III) study design and research tools, (IV) procedure by which data was gathered, alongside sample's demographic characteristics, and (VI) an account of the data analysis procedure.

Theoretical Background

Given that problematic Internet pornography use (PIPU) may share common cognitive processes underlying substance use disorders (SUDs), It is useful to apply an addiction framework when studying psychological mechanisms potentially associated with PIPU (Kagerer et al., 2014).

Attentional bias towards addiction-related cues has been a subject of extensive research in substance-use disorders (SUDs) (Field et al., 2014; van Hemel-Ruiter et al., 2015). Robinson & Berridge (1993) suggest that substance-related cues acquire incentive-motivational properties, altering the perception of cues. Through classical conditioning, a substance-related cue acquires incentive-motivational properties, and as a result, it: "grabs attention, becomes attractive and 'wanted', and thus guides behaviour to the incentive" (p.26).

Although the initial assumption upon which this theory was construed pertained to psychostimulant drugs, there is now evidence that the same process can be used in the context of the development and maintenance of PIPU (Pekal et al., 2018).

A variety of paradigms have been used to measure attentional bias for sexual cues, including direct (e.g., Visual Probe Task) and indirect measures (e.g., Addiction-Stroop Task). Typically, a Visual Probe Task (MacLeod et al., 1986), involves a simultaneous and brief presentation of two stimuli (i.e., usually pictures or words): one stimulus of interest (e.g. a sexual image) and an emotional neutral stimulus. Immediately after the disappearance of

these images, a visual probe (e.g., cross) appears in the location where one of the stimuli previously occupied. Seeing that participants generally respond faster to probes appearing within regions of a visual display to which they are attending rather than regions to which they are not (Posner et al., 1985), an attentional bias for sexual-related cues is inferred when participants respond faster to probes that replace sexual-related stimuli than those that replace control stimuli (e.g., neutral stimuli).

Generally, substance users show an attentional bias for substance-related cues, but non-users do not (Field & Cox 2008). Similarly, studies that explored attentional bias amongst problematic Internet pornography users, found that they are more likely to present attentional bias toward sexual stimuli compared to non-users (Banca et al., 2016; Doornwaard et al., 2014; Mechelmans et al., 2014; Kagerer et al., 2014; Pekal et al., 2018). To my knowledge, this would be the first local study to investigate attentional bias as a potential measure of addictive behaviour in compulsive Internet pornography viewing.

Seeing that this experimental study intends to make assumptions to the entirety of the group being studied based on the sample data collected, a quantitative methodology was chosen. This is because, quantitative methodologies are defined by their ability to maximize objectivity, replicability, and generalizability of statistical data across the population at hand (Harwell, 2011; Field, 2018).

Aim, Objectives, and Hypotheses

Aim. The present study aimed to contribute to existing research about the effects of problematic Internet pornography use on its users, by experimentally testing the effects of exposure to such content on a specific implicit, subconscious cognitive process: the allocation of attention (i.e., attentional bias). More specifically, this study aimed to compare attentional bias to unsolicited sexual cues between current Internet pornography users [IP] (i.e., amongst different frequencies of IP use), and non-Internet pornography users.

Objectives. In order to realize the overall aim of the study, the following objectives were set: The current study followed the definition of pornography provided by Mc Knee et al. (2019) "sexually explicit materials intended to arouse" (p.6). Frequency of pornography use was assessed by the Weekly Internet Pornography Use Scale, adapted from the Pornography Craving Questionnaire (Kraus & Rosenberg, 2014). Attentional bias in relation to Internet pornography use was measured using the Visual Probe Task paradigm.

Hypotheses. Due to the theoretical assumptions of the incentive sensitization theory, it was hypothesised that: Hypothesis 1: Higher attentional biases (i.e., faster reaction times) toward unsolicited sexual stimuli will be associated with higher Internet pornography (IP) use. Hypothesis 2: Non-Internet pornography users and occasional IP users will show less attentional bias (i.e., slower reaction times) towards unsolicited sexual stimuli compared to current IP users and frequent IP use. Hypothesis 3: In participants abstaining from using Internet pornography for one week, a decrease in attentional bias (i.e., slower reaction times) will be observed, when compared to the first examination.

Participants and Procedure

Participants. A total of 29 adult male heterosexual aged between 18 and 52 years accepted to take part in the study. Of 29 participants, six were not eligible to partake in the study. Thus, 23 participants took part in the first stage of the study, and 21 participants accepted to continue for the second stage of the study.

Procedure. Seeing the sensitive nature of the topic in question, prospective participants were asked to provide a pseudonym (i.e., a fictitious name) as instructed in the information letter, alongside a phone number for contact purposes. As to safeguard from having prospective participants using the same/similar pseudonyms, each individual participant was given a unique number (i.e., code) prior to commencement of study. An online free access number generator was used to provide each participant with a unique

number: (https://numbergenerator.org), Unique numbers were generated by choosing ‘unique’ from the website interface to safeguard from possible duplications. Participants drew their own auto-generated number by clicking on ‘Roll’. Each generated number consisted of 2 random numbers between 1 and 10000 (e.g. 2797 5565).

Each participant was instructed to input their respective: (I) pseudonym, (II) code, and (III) session number, before starting the Visual Probe Task and to write their respective: (I) pseudonym, and (II) code on each paper of their self-report measure (i.e., top side).

A master sheet was used to link codes with pseudonyms and contact information. This sheet was kept separate from any other data to assure confidentiality and anonymity throughout the whole study, and only my supervisors and myself had access to it. For future research and/or publication purposes, anonymized data ought to be retained for a maximum of 10 years. However, all identifiable information was destroyed immediately upon study completion.

Sampling

A convenience sample was used to recruit participants from the University of Malta Registrar’s mailing list, and via Internet-based advertisements. University students received an email containing a detailed account of what the research entails, and how to participate, whilst participants from Internet-based advertisements (i.e., Facebook), were instructed to fill out a google form. The form in question requested participants to input a pseudonym and a contact number.

Eligibility

Given the nature of the cues, this study called for a cohort of adult heterosexual males. Also, seeing that all questionnaires (i.e., measures used in this study) retained their original format (i.e., English version) to ensure validity and reliability; participants had to be fluent in English.

Study Design and Research Tools

The study had two components. The first component consisted of a Visual Probe Task followed by a set of self-report measures, and the second component was a re-examination of the Visual Probe Task, following one-week abstinence from Internet pornography use.

The following self-report measures were used during the first component:(1) Standard demographic questionnaire; (2) Weekly Internet Pornography Use Scale; (3) Problematic Pornography Consumption Scale (Bőthe et al.,2017); and the (4) 13-Item Compulsive Sexual Disorder Inventory (Miner et al.,2017).

All self-report measures were completed after the experimental task to avoid the chance of affecting results.

Prior to the second stage of the study, those who scored high (i.e., 35 and over) in their 13-Item Compulsive Sexual Disorder Inventory (CSBI-13) did not partake in the second experiment. The main objective of this study was to assess whether or not attentional bias was related to the frequency of Internet pornography use, and not to compulsive sexual behaviour disorder (CSBD). Thus, having data from participants scoring high in CSBI-13 could have skewed the validity of results.

Those participants who accepted to continue for the second part of the study were asked to abstain from Internet pornography use until re-examination (i.e., in a week's time).

The first stage of the study (i.e., Visual Probe Task and questionnaires) lasted approximately 10-25 minutes, and the second stage the of study (i.e., re-examination via Visual Probe Task) lasted for approximately 5-10 minutes.

Visual Probe Task

A computational version of the Visual Probe Task (MacLeod et al., 1986) was used. Participants were instructed to place their right index fingers next to the upward and downward arrowheads of the keyboard (situated on the bottom right side)

Each test began with a fixation cross ("+") presented at the centre of a laptop screen for a duration of 1,000 msec. Afterwards, two images (i.e., stimuli) were shown on either side of the previous fixation cross for a total of 500 msec. Once both images disappeared, a target probe (i.e., upward or downward arrowhead) appeared on either side of the vacated images to allow for a button response or for a total of 1,500 msec. At this point, participants were required to respond quickly and accurately by pressing a response key (i.e., either an upward arrow or down arrow found on the keyboard). For each test, the designated arrow would remain on-screen until a response is given or for a total of 1500msec if no response was given. In either response or lack of response, the next test would begin after 2,000ms.

The two sets of images consisted of 16 unsolicited sexual stimuli [USS] (non-explicit images that have the potential to elicit sexual arousal) and 16 neutral stimuli [NS] (images being exclusively free from any sexual connotation). Seeing that certain parameters such as image complexity (Miller & Fillmore, 2010), as well as image size and colourfulness (Egeth & Yantis, 1997), could potentially confound the findings by introducing biases unrelated to higher-level processes under investigation (i.e., overriding attentional bias towards USS), all images were equally resized (961 x 768 pixels [13.35 x 10.67 mm]) and filtered into a greyscale version by using PhotoPad Photo Editor Software (free version).

Images that have the potential to elicit sexual arousal have been based on a study by Wierzba et al. (2015). This study provides a standardized set of sexual stimuli for use in experimental research and complements the Nencki Affective Picture System (NAPS) used as stimulus material in their Laboratory of Brain Imaging (LOBI) experiment research.

Prior to the commencement of the experimental task, participants did a practice trial designed to help them get accustomed to the keys and to understand the context of the task. This practice trial was not included in the data analyses.

Following the completion of 16 practice trials, participants went through 128 experimental tests. To prevent habitual effects (Doornwaard et al., 2014), the same pairing and target-probe location did not appear more than five times in a row. In fact, pairs were presented in random order and the target probe appeared randomly where the left and right images had been previously presented.

The 128 experimental tests (paired images of USS and NS), consisted of 16 different pairings with 8 possible combinations for each pair:

(1) USS- image and target probe [upward arrow head] both on left,

(2) USS- image and target probe – [upward arrow head] both on right,

(3) USS- image and target probe – [downward arrow head] both on left,

(4) USS- image and target probe – [downward arrow head] both on right,

(5) Natural – image and target probe – [upward arrow head] both on left

(6) Natural – image and target probe – [upward arrow head] both on right

(7) Natural – image and target probe – [downward arrow head] both on left

(8) Natural – image and target probe – [downward arrow head] both on right

In light on the above, each pair could be randomly selected to appear for eight times (i.e., not in a row), and to appear for four times on either side of the laptop screen (i.e., not in a row).

Software and Hardware

The Visual Probe Task was programmed and presented using Psychopy v2021.2.3 (Peirce et al., 2019). The task was presented on HP EliteBook 850 laptop running Windows 10 Home Operating System with an Intel Core i5-5200U processor, 2.20 GHz, and 4 GB RAM. The laptop had a 15,6-inch screen, 1,920 × 1080 resolution, 60.052-Hz refresh rate, and set at 65% brightness level. An external keyboard (i.e., Fujitsu Keyboard KB410) was used for key response.

Self-Report Measures

Following the Visual Probe Task, participants were required to fill a set of self-report measures. All self-report measures were divided in three sections: Section 1 consisted of a demographic questionnaire to assess: (1) age, (2) if participant is a University student, and (3) age of first pornography use.

Section 2 was designed to assess: (1) frequency, and (2) problematic consumption of Internet pornography (IP) use. The following measures were included in this section:

Weekly Internet Pornography Use Scale. Although there are no established ways of measuring frequency of pornography use (Malki et al., 2021; Short et al., 2012), Miller et al. (2020) suggest that frequency of use, should be calculated in terms of weekly consumption. In line with this understanding, frequency of Internet pornography use was assessed via the Weekly Internet Pornography Use Scale adapted from the Pornography Craving Questionnaire (Kraus & Rosenberg, 2014). Participants were asked to think back to the past 6 months and indicate on a 4-point Likert scale (0 ‘0 times’, 1 ‘1-2 times’, 2 ‘3-5 times’, 3 ‘6-10 times’, and 4 ‘11+ times’) their typical weekly IP use.

The Problematic Pornography Consumption Scale (PPCS). Problematic consumption of Internet pornography (IP) use, was assessed via PPCS (Bőthe et al.,2017). Participants were asked to think back to the past 6 months and indicate on a 7-point Likert

scale (1=" never"; 7= "all the time") to what extent did the 18 statements apply to them. A score of 76 or higher indicated the possibility of problematic pornography use.

Because this scale is based on Griffiths's components model of addiction (2005), each of the 18 statements is categorized under a specific factor related to the addictive properties of problematic pornography use: "salience, tolerance, mood modification, withdrawal, relapse, and conflict" (Bőthe et al.,2017, p.6).

Although there are other scales intended to assess problematic Internet pornography use, Chen & Jiang (2020), connote that the PPCS is the most accurate measure for such assessments. Furthermore, the PPCS yields "strong internal consistency and a valid factorial structure, which has been supported by the results of confirmatory factor analysis (CFA)" (p.3).

The Compulsive Sexual Behaviour Inventory – 13 (CSBI-13). Section 3 was intended to assess sexual behaviour. This was assessed via the Compulsive Sexual Behaviour Inventory – 13 (CSBI-13) (Miner et al., 2017). Here, participants were asked to rate each of the 13 items on a 5-point Likert scale (1=" never", and 5=" very frequently"). A score of 35 or more indicated a high probability of compulsive sexual behaviour. According to Dickenson et al. (2018), "The CSBI-13 has shown to have adequate reliability, criterion validity, and discriminant and convergent validity" (p.5).

Data Analysis

The data was analysed through statistical tests in IBM SPSS statistics 28. Normality testing was performed using the Shapiro-Wilk test. Test determined whether score distribution for reaction times was normal or skewed (non-normal). Three of the conducted Shapiro Wilk tests' p-values were less than the 0.05 level of significance, indicating that three of the four score distributions violated normality. Hence, non-parametric tests were used to analyse this data further (i.e., The Kruskal Wallis test and Wilcoxon signed ranks test).

In light if the above, tests used for the purpose of analysing data for this study were the: Kruskal Wallis test, and the Wilcoxon Signed Ranks test.

H1 and H2 were tested using the Kruskal Wallis test. The test was used to compare mean neutral/unsolicited sexual reaction times between different frequencies of weekly Internet pornography use.

H3 was tested using the Wilcoxon Signed Ranks test. The test was used to compare mean neutral/unsolicited sexual reaction times between experiment one and two following abstinence.

The Kruskal Wallis test was used to compare the PPCS between two independent variables (i.e., weekly pornography use, and age of first pornography use).

Ethics

All participants were made aware that study was anonymous, and that their participation was voluntary. Also, participants were informed that they could withdrawal at any point in time. The study was approved by the Faculty Research Ethics Committee (FREC).

Results

While the previous chapter displayed the methodology used to assess attentional bias as a potential measure of addictive behaviour in Internet pornography users, the aim of this chapter is to present the findings carried out on the three hypotheses previously presented. The process by which each hypothesis was tested, and the results obtained are presented below.

Sample Characteristics

A total of 29 adult heterosexual men were screened to be enrolled in this study. Data from six participants were excluded from the analyses because of a high score in the Compulsive Sexual Behaviour Inventory – 13 (CSBI – 13) (n=6) leaving a total of 23 participants. The average age of this sample was 32.521 (SD =9.317), ranging from 18 and 52 years. The majority of participants were non-university students (n=20), and were all recruited from an online platform (i.e., Facebook). Of these participants, two did not attend for the follow up study in a week's time (n=2), leaving 21 participants in all. Average age of first pornography use of this sample was 13.53 (SD=3.033), ranging from 10 and 20 years. These were categorized as 13 years or less (n=12), and 13 years and over (n=11).

Characteristics of Pornography Use in the Study Sample.

Weekly Internet Pornography Use Scale. This scale assessed how often participants made use of Internet pornography during the week on a 4-point scale ranging from 0 = "0 times" to 4 = "11+ times". Because of sample size (n=23) and score distribution, frequency of weekly pornography use was grouped as: none (n=5), low (1-2 times) (n=11), and moderate/high (3 times or more) (n=7).

Problematic Pornography Consumption Scale (PPCS). The cut-off point of this scale was 76 or more, and average score was that of 37.87 (SD=14.024). None of the participants scored higher than the cut-off point.

Compulsive Sexual Behavior Inventory – 13 (CSBI – 13). The cut-off point of this scale was 35 or more, and average score was that of 23.13 (SD=6.115). Out of 29 participants six scored high (i.e., 35 or more) in this scale.

Attentional Bias in Relation to Weekly Internet Pornography Use

The Kruskal Wallis test was used to compare mean neutral/sexual reaction time between weekly Internet pornography use. Additional information can be found in Table 1. The alternative hypothesis specifies that the mean reaction times vary significantly between weekly pornography use and is accepted if the p-value is less than the 0.05 criterion.

Table 1*: Comparison of Neutral / Unsolicited Sexual Reaction Time to Weekly Internet Pornography Use.*

	weekly Internet pornography use	N	Mean	Std. Dev	P-value
Neutral Stimuli (N.S.) Reaction Time (Test 1)	None	5	.607	.095	0.101
	1-2 times	11	.543	.058	
	3 times or more	7	.642	.108	
Neutral Stimuli (N.S.) Reaction Time (Test 2)	None	5	.632	.112	0.066
	1-2 times	10	.528	.050	
	3 times or more	6	.573	.088	
Unsolicited Sexual Stimuli (U.S.S.) Reaction Time (Test 1)	None	5	.632	.112	0.053
	1-2 times	11	.480	.166	
	3 times or more	7	.491	.231	
Unsolicited Sexual Stimuli (U.S.S.) Reaction Time (Test 2)	None	5	.617	.068	0.076
	1-2 times	10	.527	.051	
	3 times or more	6	.554	.093	

Notwithstanding the lack of statistical significance, one may still observe that the mean reaction scores for both stimuli differ according to weekly pornography use. This difference was mostly observed amongst non-pornography users.

In Test 1, those with a weekly pornography use of one to two times had a mean score of <0.543 for neutral stimuli, and a mean score of <0.480 msec for sexual stimuli. In Test 2, the mean score was that of <0.528 for neutral stimuli, and <0.527 for sexual stimuli. Those with higher frequency of weekly pornography use (i.e., 3 times or more) had similar results in both tests. In Test 1, the mean score for neutral stimuli was <0.642, whilst the mean score for sexual stimuli was <0.491. Similarly, in Test 2, the mean scores for neutral stimuli was <0.573, and for sexual stimuli was <0.554.

In comparison, non-pornography users had similar mean scores for both neutral (Test 1 <0.607 / Test 2 <0.618), and sexual stimuli (Test 1 <0.632 / Test 2 <0.617), but higher mean scores compared to the mean scores of sexual stimuli amongst pornography users. This means that non-pornography users had slower reaction times when presented with sexual stimuli compared to pornography users. Also, it is interesting to note that the mean score for sexual stimuli amongst non-users, was similar to the mean score for neutral stimuli amongst pornography users.

Although the above observation shows that pornography users responded faster than non-users, no difference was observed between different frequencies of weekly pornography use.

Comparison of Reaction Times Before and After Abstinence

The Wilcoxon Signed Ranks test was used to compare the mean neutral/sexual reaction between test 1 and test 2. Additional information can be found in Table 2. The alternative hypothesis specifies that the mean reaction time varies significantly between test 1 and test 2 and is accepted if the p-value is less than the 0.05 criterion.

Table 2: *Reaction times before and after abstinence*

	Mean	Sample size	Std. Deviation	P-value
REAC/TS for N.S. in Test 1	0.579	21	0.090	0.192
REAC/TS for N.S. in Test 2	0.566	21	0.086	
REAC/TS for U.S.S. in Test 1	0.575	21	0.095	0.140
REAC/TS for U.S.S. in Test 2	0.556	21	0.075	

There was a reduction in the mean reaction time between test 1 and test 2 both for the neutral and sexual groups. However, the reductions were not significant since the p-values (0.192 and 0.140) exceed the 0.05 level of significance.

Problematic Pornography Consumption Scale (PPCS) in Relation to Weekly Internet Pornography Use

The Kruskal Wallis test was used to compare the mean rating scores provided to each statement related to the PPCS, in relation to weekly Internet pornography use. The mean rating scores ranged from 1 to 7, where 1 corresponded to ‘never’ and 7 corresponded to ‘all the time’. Additional information can be found in Table 3. The alternative hypothesis specifies that the mean rating scores provided to the statement vary significantly between the groups, and is accepted if the p-value is less than the 0.05 criterion.

Table 3: *PPCS statements in relation to weekly Internet pornography use*

PPCS statements	Weekly Internet Pornography Use	N	Mean	Std. Dev.	P-value
I felt that porn is an important part of my life	None	5	1.20	.447	0.104
	1-2 times	11	2.09	1.136	
	3 times or more	7	3.00	1.915	
I used porn to restore the tranquillity of my feelings	None	5	1.20	.447	0.013
	1-2 times	11	3.18	1.328	
	3 times or more	7	3.57	1.618	
I felt porn caused problems in my sexual life	None	5	2.20	2.168	0.676
	1-2 times	11	2.27	1.104	
	3 times or more	7	2.14	1.676	
I felt that I had to watch more and more porn for satisfaction	None	5	1.40	.894	0.490
	1-2 times	11	1.91	1.136	
	3 times or more	7	2.00	1.155	
I unsuccessfully tried to reduce the amount of porn I watch	None	5	1.00	.000	0.206
	1-2 times	11	2.55	1.916	
	3 times or more	7	2.14	1.676	
I became stressed when something prevented me from watching porn	None	5	1.60	.894	0.924
	1-2 times	11	1.45	.688	
	3 times or more	7	1.86	1.464	
I thought about how good it would be to watch porn	None	5	2.80	1.643	0.667
	1-2 times	11	2.36	1.433	
	3 times or more	7	2.86	1.345	
Watching porn got rid of my negative feelings	None	5	1.20	.447	0.004
	1-2 times	11	2.73	1.009	
	3 times or more	7	3.71	1.113	
Watching porn prevented me from bringing out the best in me	None	5	2.40	2.191	0.926
	1-2 times	11	2.00	1.342	
	3 times or more	7	2.29	1.380	
I felt that I needed more and more porn in order to satisfy my needs	None	5	1.80	.837	0.741
	1-2 times	11	1.45	.522	
	3 times or more	7	2.00	1.528	
When I vowed not to watch porn anymore, I could only do it for a short period of time	None	5	2.00	1.225	0.684
	1-2 times	11	2.45	1.440	
	3 times or more	7	1.86	.900	

I became agitated when I was unable to watch porn	None	5	1.00	.000	0.263
	1-2 times	11	1.45	.934	
	3 times or more	7	1.71	.951	
I continually planned when to watch porn	None	5	1.20	.447	0.388
	1-2 times	11	2.00	1.183	
	3 times or more	7	1.86	1.464	
I released my tension by watching porn	None	5	1.20	.447	0.013
	1-2 times	11	3.91	1.640	
	3 times or more	7	3.71	1.799	
I neglected other leisure activities as a result of watching porn	None	5	1.40	.548	0.707
	1-2 times	11	1.73	1.618	
	3 times or more	7	1.29	.756	
I gradually watched more “extreme” porn, because the porn I watched before was less satisfying	None	5	1.00	.000	0.115
	1-2 times	11	1.91	.944	
	3 times or more	7	1.86	1.069	
I resisted watching porn for only a little while before I relapsed	None	5	1.80	1.304	0.105
	1-2 times	11	2.45	.934	
	3 times or more	7	1.57	.787	
I missed porn greatly when I didn’t watch it for a while	None	5	1.40	.548	0.739
	1-2 times	11	1.91	1.044	
	3 times or more	7	2.57	2.440	

Since the p-value of certain statements was less than the 0.05 criterion, statistical significance was established between the following statements and weekly Internet pornography use: ‘Watching porn got rid of my negative feelings’ (0.004), ‘I used porn to restore the tranquillity of my feelings’ (0.013) and ‘I released my tension by watching porn’ (0.013).

Problematic Pornography Consumption Scale (PPCS) in Relation to Age of First Pornography Use

The Kruskal Wallis test was used to compare the mean rating scores provided to each statement related to the PPCS in relation to age of first pornography use. The mean rating scores ranged from 1 to 7, where 1 corresponded to ‘never’ and 7 corresponded to ‘all the time’. Additional information can be found in Table 4. The alternative hypothesis specifies that the mean

rating scores provided to the statement vary significantly between the groups, and is accepted if the p-value is less than the 0.05 criterion.

Table 4: *PPCS statements in relation to age of first pornography use*

PPCS statements	Age of First Pornography Use	N	Mean	Std. Dev.	P-Value
I felt that porn is an important part of my life	13 years or less	12	2.75	1.603	0.035
	More than 13 years	11	1.55	.934	
I used porn to restore the tranquillity of my feelings	13 years or less	12	3.17	1.403	0.312
	More than 13 years	11	2.55	1.695	
I felt porn caused problems in my sexual life	13 years or less	12	2.50	1.679	0.347
	More than 13 years	11	1.91	1.221	
I felt that I had to watch more and more porn for satisfaction	13 years or less	12	1.92	1.165	0.737
	More than 13 years	11	1.73	1.009	
I unsuccessfully tried to reduce the amount of porn I watch	13 years or less	12	2.50	1.834	0.157
	More than 13 years	11	1.64	1.433	
I became stressed when something prevented me from watching porn	13 years or less	12	1.75	1.138	0.416
	More than 13 years	11	1.45	.820	
I thought about how good it would be to watch porn	13 years or less	12	2.67	1.614	0.975
	More than 13 years	11	2.55	1.214	
Watching porn got rid of my negative feelings	13 years or less	12	2.92	1.165	0.545
	More than 13 years	11	2.45	1.440	
Watching porn prevented me from bringing out the best in me	13 years or less	12	2.67	1.723	0.108
	More than 13 years	11	1.64	1.027	
I felt that I needed more and more porn in order to satisfy my needs	13 years or less	12	1.92	1.240	0.475
	More than 13 years	11	1.45	.522	
When I vowed not to watch porn anymore, I could only do it for a short period of time	13 years or less	12	2.42	1.165	0.186
	More than 13 years	11	1.91	1.300	
I became agitated when I was unable to watch porn	13 years or less	12	1.75	1.055	0.066
	More than 13 years	11	1.09	.302	

I continually planned when to watch porn	13 years or less	12	2.08	1.311	0.140
	More than 13 years	11	1.45	.934	
I released my tension by watching porn	13 years or less	12	3.83	1.528	0.096
	More than 13 years	11	2.64	2.014	
I neglected other leisure activities as a result of watching porn	13 years or less	12	1.42	1.165	0.550
	More than 13 years	11	1.64	1.286	
I gradually watched more "extreme" porn, because the porn I watched before was less satisfying	13 years or less	12	2.00	1.044	0.107
	More than 13 years	11	1.36	.674	
I resisted watching porn for only a little while before I relapsed	13 years or less	12	2.33	.985	0.104
	More than 13 years	11	1.73	1.009	
I missed porn greatly when I didn't watch it for a while	13 years or less	12	2.50	1.834	0.060
	More than 13 years	11	1.45	.934	

Since the p-value of one statement was less than the 0.05 criterion, statistical significance was established between the following statement and age of first pornography use: 'I felt that porn is an important part of my life' (0.035). Notwithstanding the lack of statistical significance in relation to other statements, one may still observe that the mean reaction scores for all statements marked significantly higher for those who started pornography at the age of 13 or less.

Conclusion

Although all research hypotheses were rejected, statistical significance was found between the Problematic Pornography Consumption Scale (PPCS), and both (i) weekly pornography use, and (ii) age of first pornography use. The findings will be explored in more detail in the next section.

Discussion

Following the display of results, this chapter looks into the implications of such findings while comparing them with findings from previous literature.

In contrast to past research using a Visual Probe Task for sexual stimuli, the main findings of this study indicated no biases in favour of such stimuli. The difference in reaction times between sexual and neutral stimuli was simply not large enough to achieve statistical or practical relevance.

The Possibility of Having Multiple Shifts in Attention as a Result of a Prolonged SOA.

Addiction studies have shown that different duration of stimuli presentation (i.e., the stimulus onset asynchrony, or SOA) assess different aspects of attentional bias (Van Rooijen et al., 2017). This is because, different cognitive mechanisms are thought to underlie the initial shifting of attention, as well as the subsequent maintenance or disengagement of attention (Field & Cox, 2008). In light of this understanding, a short SOA (e.g., 50-150 msec) is used to assess automatic bias (i.e., initial orienting) in attention, whilst prolonged SOA (e.g., 500-1000 msec) is usually indicative of a bias in disengagement (i.e., increased attentional engagement,), and maintenance of attention.

Duncan et al. (1994) argue that generally speaking, participants are able to shift their attention toward a pleasant or interesting cue in around 50 msec. However, when it comes to disengaging attention from one cue to redirect it to another, it only takes 150 msec (Theeuwes, 2005). It is thought that shorter SOAs can limit any participant from shifting attention between stimuli, implying that a possible attentional bias is more reflective of a bias in the initial orienting of attention. On the other hand, longer SOAs, provide participants with an ability to make multiple shifts in their attention between stimuli; therefore, the attentional index is more likely to be reflective of a delayed disengagement and maintenance of attention; although not all studies have shown this (Mechelmans et al., 2014).

Although there were numerous studies that used an SOA of 500 msec when using a Visual Probe Task to assess attentional bias amongst substance users, the interpretation being given to attentional bias indices (gathered from reaction times) was flawed with inconsistencies. For one, Bradley et al. (2003) interpreted a 500 msec SOA as indicative of initial orienting, whilst Koster et al. (2005) interpreted such an SOA as indicative of delayed disengagement. Although this discrepancy, was also observed in studies that assessed attentional bias in problematic pornography use (PPU), studies using an SOA of 500 msec for a bias in initial orienting found that it was more related to a bias in delayed disengagement and maintenance of attention (Kagerer et al., 2014). On the other hand, studies using a short SOA (e.g., 150-200 msec) did confirm a bias in early orienting mechanisms (Doornwood et al., 2014; Mechelmans et al., 2014; Pekal et al., 2018).

When taking into consideration the above findings, as well as those of Duncan et al. (1994), and Theeuwes et al. (2005), it seems plausible to assume that by using an SOA of 500 msec, multiple shifts of attention between the two stimuli presented during the Visual Probe Task, influenced the main results of this study. Thus, it would have been better if a shorter SOA (i.e., 150 msec) was used, seeing that study intended to assess automatic shifting of attention (i.e., initial orienting). On the other hand, if one had to use the same argument, then it could also be assumed that this lack of attentional bias in initial orienting of attention could have been attributed to an attentional bias in delayed disengagement and maintenance of attention (i.e., difficulty in directing their attention away from an unsolicited sexual picture). Therefore, lack of attentional bias could have been more related to problems in disengaging from unsolicited sexual pictures rather than to an enhanced orienting towards unsolicited sexual pictures.

Differences in the Intensity of Stimuli Presented.

"Evolutionary models of emotion and attention postulate that the visual-attention system is biologically programmed to attend with increased priority to stimuli of biological significance" (Kagerer et al., 2014, p.1). Notwithstanding the fact that sex is already a salient biological stimulus

in human life, and repeated exposure to sexual material (e.g., pornography) is postulated to lead to an even stronger attentional bias for sexual content, especially in a cognitive task performance (e.g., Visual Probe Task) (Imran et al., 2014; Strahler et al., 2019), this study reports no attentional bias towards sexual stimuli. A partly similar finding was that of Prause et al. (2008), who reported a faster response to neutral stimuli than sexual stimuli. These results contradicted other findings showing faster responses (i.e., attentional bias) to sexual stimuli (e.g., Albery et al., 2017; Banca et al., 2016).

According to Kagerer et al. (2014) and Pekal et al. (2018), differences in findings are probably attributed to different explicitness of sexual stimuli (i.e., nuanced and highly explicit) used during studies. This is further accentuated by Mechelmans et al. (2014), who reported that only explicit sexual stimuli marked an attentional bias, as stimuli with either low (i.e., erotic) or no explicit content (i.e., neutral) recorded no such bias. Furthermore, research on the processing of sexual stimuli on cognitive processes often includes depictions of sexual intercourse or interactions, as well as male and female nudes to obtain stronger attention amongst participants (Stoléru et al., 2012).

Although the images used for this study were based on the erotic subset of the Nencki Affective Picture System (NAPS ERO), explicit images (i.e., pornographic) could not be used. This is because, in Malta, it is illegal to demonstrate pornographic images even in the context of research.

Aside from providing erotic images, the NAPS ERO dataset also provides the mean rating scores for the valence and arousal of each stimulus. Thus, valence and arousal ratings can be treated as parameters that guide the selection of stimuli according to the requirements of a given experimental design (Wierzba et al., 2015). Although this study requested the use of erotic material to assess attentional bias amongst pornography users, images approved by the University board of studies fell far from short of being erotic. In fact, all images approved ranked the lowest in both valence and arousal amongst the entire NAPRS ERO dataset. It is to

be noted that the majority of participants did remark that the images presented were not enough enticing to grab their attention.

Repeated Exposure to Internet Pornographic Use

Although pornography users responded faster than non-pornography users, no difference was observed between different frequencies. This finding seems to contrast that of Doornwaard et al. (2014), who in their study, a positive correlation was found between regular consumption of pornography use (moderate and high vs. low pornography users) and greater attentional bias. A similar correlation has also been reported amongst studies of different substances; where substance-related attentional bias was directly proportional to the quantity and frequency of the substance used (Field et al., 2013)

Several processes may help explain these unexpected findings. Participants reporting regular pornographic consumption may experience greater habituation when presented with sexual stimuli. Habituation reflects a change in the effective properties of a stimulus via repeated presentation (Hall & Rodríguez, 2017). Hence, if pornography users are repeatedly exposed to a vast array of explicit content, any material perceived as less enticing may cause a decline in the vigour of the orienting response. This does not necessarily mean that participants attended less to sexual stimuli; instead, they may be more able to scan sexual stimuli more efficiently (i.e., quicker) when compared to those who considered such stimuli as being novel, leaving more time to reorient attention to the adjacent stimulus before the dot appears (Prause et al., 2008). This idea aligns with the findings of a study that investigated selective attention vis-à-vis alcohol-related stimuli. Here researchers observed that habitual drinkers displayed a lower attention bias after a dose of alcohol than participants who drank less regularly (Duka & Townshend, 2004; Heitmann & De Jong, 2021).

Alternatively, methodological reasons may explain why the findings of this study were contrary to expectations. Specifically, the way self-report pornography use was

categorized: one to two times per week (low use) versus three or more times per week (moderate/high use). One could argue that there isn't much of a difference between these groups, and three times of pornography use per week may not be enough to strengthen the sexual schemas that individuals draw upon when processing information (Doornwaard et al., 2014).

The Possible Implication of Attentional Avoidance Following Abstinence

While problematic consumption of Internet pornography has received considerable scientific attention (Grubbs et al., 2019), experimental investigations on cognitive tasks are rather limited (Zimmer & Imhoff, 2020).

To my knowledge, this is the first study to experimentally assess if abstinence from pornography use has an influence on attentional bias. Hence, little choice was left but to lean on substance-related studies to compare such findings.

Previous investigations using the Visual Probe Task to assess attentional bias amongst alcohol abusers in treatment suggest that participants are able to avoid attending to alcohol-related stimuli when conditions allow them to consciously control their attention (Field & Cox, 2008). In fact, Vollstadt-Klein et al. (2009) found that social drinkers and alcoholics abstaining for longer than two weeks exhibited an attentional bias for drug cues when presented with short SOAs (50 msec). However, when such cues were presented for longer durations (500 msec), they happened to avoid them completely. Similarly, a study by Noël et al. (2006) showed that alcohol abusers in treatment were able to avoid their attention from alcohol-related images when presented for 500 msec. Comparable results have also been found amongst former smokers, where avoidance of nicotine cues was mostly observed at greater magnitudes in longer exposure times (2,000 msec) (Peuker & Bizarro, 2014).

Together, these results show that prolonged stimuli presentation can allow participants to use avoidance strategies to eliminate or reverse attentional bias. Seeing that this study used

a 500 msec picture presentation following abstinence (i.e., long exposure), results attained may be interpreted as a possible effect of avoidance strategies.

According to a study by Field et al. (2013), avoidance strategies are correlated to subjective craving levels (i.e., higher avoidance as a result of low levels of craving). Thus, if results pertaining to abstinence were to be attributed to avoidance strategies, the use of a Pornography Craving Questionnaire (PCQ) (Kraus & Rosenberg, 2014) could have consolidated this possibility.

Notwithstanding the above, another aspect that may need further consideration when assessing attentional bias and abstinence is abstinence duration. In fact, a study by Peuker & Bizarro (2014), suggests that different periods of abstinence can influence the search for and selection of stimuli.

Mood Modification and Saliency

More often than not, pornography consumption may lead to little or no adverse effects. However, there are instances when such viewing may become problematic (Ford et al., 2012), especially among those individuals who use pornography to cope with depressive moods or stress (Brand et al., 2016b). Hence, a person's mood might influence the decision to use pornography, and as a result, this may reinforce the idea and expectancy that using pornography is helpful to cope with stress and other negative emotions (Laier & Brand, 2014).

Notwithstanding the fact that participants in this study indicated low scores in relation to problematic pornography consumption, the most common endorsed response referred to mood modification; being statistically significant in relation to frequency of pornography use.

This finding supports that of Laier & Brand, 2017, who observed that motivation to use Internet pornography was mainly attributed to the avoidance of negative feelings (e.g., sluggishness, and anxiety), and high levels of daily life stress. Furthermore, tendencies

toward addictive pornography habits were linked to a person's mood before and after watching Internet pornography, as well as an actual increase in a good and calm mood.

These findings support the observation that using Internet pornography as a coping mechanism for depressing moods or stress can be considered a risk factor for developing problematic pornography use. In fact, studies assessing brain correlates of perceived problems in controlling sexual behaviours showed that the activity of reward-related brain structures is correlated to the presentation of addiction-related sexual cues (Brand et al., 2016a, Voon et al., 2014).

Another statistical finding was associated between PPCS and age of first pornography use. Here, it was observed that the earlier the consumption (i.e., 13 years or less) the more salient pornography becomes (i.e., "I felt that porn is an important part of my life"). It could be argued that this salience may be a result of how pornography use elevates negative emotions, but it could also be attributed to other reasons not explored in this study.

Conclusion

The main findings were not consistent with the findings of previous literature. However, some unexpected findings have been reported between mood modification alongside saliency and problematic pornography use. The implications of these findings, together with limitations and recommendations are discussed in the following chapter.

Conclusion

The present study aimed to make a contribution to existing research on the effects of problematic Internet pornography use on its users, by experimentally testing the effects of exposure to such content on a specific implicit, subconscious cognitive process: the allocation of attention (i.e., attentional bias). More specifically, this study aims to compare attentional bias to unsolicited sexual cues between current Internet pornography (IP) users (i.e., amongst different frequencies of IP use), and non-Internet pornography users. This study also addressed an important lacuna in literature on the effects of attentional bias following abstinence from pornography use.

This study found a very small difference in reaction times between sex target and neutral target tests. Such difference was simply not large enough to reach either statistical or practical significance. Although main findings were not consistent with the findings of previous literature, some unexpected findings have been reported between mood modification and saliency in relation to problematic pornography use. In fact, a statistical significance was reported in relation to frequency of Internet pornography use (i.e., measured in weekly use) and mood modification, and age of first pornography use and saliency.

In the former, the most commonly endorsed response reflected a change in mood following pornography use, particularly amongst those who reported a weekly pornography use of three times or more, compared to participants reporting either once or twice per week, or not at all. vis-à-vis saliency, those who started pornography at a younger age (13 years or less), felt that pornography was an important part of their life.

Limitations of the study

The study had several limitations. First and foremost, limitations pertaining to sample population. It is to be noted that sample size for this study was that of 23 participants. Hence, it was very unlikely to get statistical significance when the sample size was this small (i.e., less than 50). It may be the case that if a different method of administration was used (e.g., online experiment) there may have been a higher response rate.

An additional limitation is the administration of self-report measures when collecting data in relation to participants': weekly pornography use; problematic use; and sexual behaviour. Such measures rely solely on participants' accuracy of their comprehension of the scale items, as well as their willingness and ability to be insightful and honest, However, when taking into consideration the sexually explicit nature of the study, participants may have felt compelled to give answers that they deemed socially acceptable. Hence, this may have tempered with inclusion criteria, especially if participants did not respond truthfully to the CSBI-13 scale.

Another potential limitation was the use of convenience sampling. Because this sampling technique relied on data collected from a population that was conveniently available to participate in the study, several forms of biases could have ultimately distorted research outcomes. In line with this understanding, participants in this study could have been an under-representation of the actual population of interest. It could be argued that only a subset of eligible pornography users may have agreed to participate in the study. Specifically, it is possible that only males who were interested in the topic of men's sexuality decided to read over the recruitment letter/advert and then agreed to participate. Similarly, some prospective participants may have declined to participate because they were not willing to open up about their pornography use due to feelings of guilt or shame. Prior research suggests that guilt-proneness, and shame-proneness occur in some individuals struggling with excessive

pornography use, because their behaviour may be incongruent with their personal or religious values (Gilliland et al., 2011). Consequently, it may be that individuals who choose to participate in this type of study may not represent the average consumer of pornography.

Other limitations include those in relation to the experimental task. The set of pictures used for sexual stimuli in the Visual Probe Task needed to be re-examined, and preferably tested in advance to ensure a better degree of valence (i.e., attractiveness) and arousal. Also, different presentation times (150 msec vs. 500 msec) could have been employed to properly assess attentional bias in relation to initial orienting or delayed disengagement. Thus, shorter presentation times could have investigated the influence of inhibition of return (Posner et al., 1985), an orienting phenomenon that slows down visual attention to a previously searched location.

The use of a single cognitive task to assess attentional bias was rather limiting. Other study (e.g., Kagerer et al., 2014), used multiple tasks to measure attention, with the most reliable being those that capture attention due to speeded up responses. Having a possible correlation between scores of two or more paradigms consolidates an individual response towards sex-related attentional bias.

To date, this was the first study to experimentally assess if abstinence from pornography use has an influence on attentional bias. Thus, it was difficult to situate findings in literature pertaining to pornography use. Notwithstanding this limitation, findings from substance-related studies argue that following abstinence, participants can avoid attending to stimuli when conditions allow them to consciously control their attention (Field & Cox, 2008). Hence, when stimuli are presented for a long duration, participants can use avoidance strategies to eliminate or even reverse attentional bias. Seeing that this study used a 500 msec picture presentation following abstinence (i.e., long exposure), results attained may be interpreted as a possible effect of avoidance strategies.

Finally, another important consideration to keep in mind when assessing attentional bias and abstinence is abstinence duration. A study by Peuker & Bizarro (2014) suggests that different abstinence times can affect the search for and selection of stimuli. Thus, it could have been interesting to assess this difference by, for example, comparing different abstinence durations.

Recommendations for future research

Seeing that this study solely addressed heterosexual males, future research should examine different sexualities and genders to assess differences in attentional bias and responses in relation to PPCS.

Also, seeing that this study investigated several hypotheses of clinical significance with a non-clinical sample, future investigations should try to recruit clinical samples to better evaluate the effects of attentional biases on symptoms of problematic pornography use.

As to examine the impact of attentional bias in more detail, the Visual Probe Task could be modified to replicate the one used for the study by Kagerer et al. (2014). Thus, the task in question should record reaction times for neutral/sexual cue pairings and neutral/neutral cue pairings. Using such conditions can help to understand if the presence of a sexual cue influences reaction scores.

Concluding remarks and usefulness of the study

This study was intended to enhance local research in the field of behavioural addictions, particularly regarding pornography. Although an attentional bias was not found amongst pornography users, this study still encourages further efforts to design and eventually test similar hypotheses following the above recommendations. These may contribute to other findings of neural reactivity to sexually explicit cues amongst pornography users in a network similar to that implicated in drug-cue-reactivity studies, to provide support for incentive motivation theories of addiction.

Additionally, following results attained from the PPCS scale, earlier exposure to Internet pornography may lead to a higher risk of problematic use due to salient attributions. Overall, as exposure to online pornographic content is almost unavoidable for young generations (Dwulit & Rzymski, 2019), the present study supports the notion that protection of children from too early exposure should be prioritized. Furthermore, findings in relation to frequency of use and mood modification, support the observation that using Internet-pornography to cope with depressive mood or stress might be considered as a risk factor for developing pornography addiction (Laier & Brand, 2017). It would be interesting to see if future studies could confirm this and provide a more detailed at-risk factor analysis.

Overall, Internet pornography is a rapidly growing and ever-changing phenomenon. This field of research warrants more critical engagement by scholars so that public debate and policymakers can become more well-informed. It is of utmost importance that different disciplines continue to contribute with more studies so that we can begin to understand pornography in multifaceted ways.

References

Agius, R. (2018, June 21). *The Maltese watch porn to learn from it*. TVMnews.mt. https://tvmnews.mt/en/news/the-maltese-watch-porn-to-learn-from-it/

Aiken, M. (2016). *The cyber effect: A pioneering Cyberpsychologist explains how human behaviour changes online*. Hachette UK.

Albery, I. P., Lowry, J., Frings, D., Johnson, H. L., Hogan, C., & Moss, A. C. (2017). Exploring the relationship between sexual Compulsivity and attentional bias to sex-related words in a cohort of sexually active individuals. *European Addiction Research*, *23*(1), 1-6. https://doi.org/10.1159/000448732

Andrews, D. (2012). Toward a more valid definition of "Pornography". *The Journal of Popular Culture*, *45*(3), 457-477. https://doi.org/10.1111/j.1540-5931.2012.00939.x

Ashton, S., McDonald, K., & Kirkman, M. (2019). What does 'pornography' mean in the digital age? Revisiting a definition for social science researchers. *Porn Studies*, *6*(2), 144-168. https://doi.org/10.1080/23268743.2018.1544096

Attwood, F. (2006). Sexed up: Theorizing the sexualisation of culture. *Sexualities, 9*(1), 77-94. https://doi:10.1177/1363460706053336

Balconi, M., & Mazza, G. (2009). Consciousness and emotion: ERP modulation and attentive vs. pre-attentive elaboration of emotional facial expressions by backward masking. *Motivation and Emotion*, *33*(2), 113-124. https://doi.org/10.1007/s11031-009-9122-8

Banca, P., Morris, L. S., Mitchell, S., Harrison, N. A., Potenza, M. N., & Voon, V. (2016). Novelty, conditioning and attentional bias to sexual rewards. *Journal of Psychiatric Research*, *72*, 91-101. https://doi.org/10.1016/j.jpsychires.2015.10.017

Barrett, D. (2010). *Supernormal stimuli: How primal urges overran their evolutionary purpose*. W. W. Norton & Company.

Berridge, K. C., & Robinson, T. E. (1998). What is the role of dopamine in reward: Hedonic impact, reward learning, or incentive salience? *Brain Research Reviews*, *28*(3), 309-369. https://doi.org/10.1016/s0165-0173(98)00019-8

Berridge, K. C., Robinson, T. E., & Aldridge, J. W. (2009). Dissecting components of reward: 'liking', 'wanting', and learning. Current opinion in pharmacology, 9(1), 65–73. https://doi.org/10.1016/j.coph.2008.12.014

Bonello, J. (2014). *University of malta students' attitudes towards pornography: A quantitative study*. (Unpublished bachelors dissertation). University of Malta, Malta.

Borg, J. (2014). *Young people's views on protected/unprotected sex.* (Unpublished bachelors dissertation). University of Malta, Malta.

Bostwick, J. M., & Bucci, J. A. (2008). Internet sex addiction treated with naltrexone. *Mayo Clinic proceedings*, *83*(2), 226–230. https://doi.org/10.4065/83.2.226

Bőthe, B., Tóth-Király, I., Zsila, Á., Griffiths, M. D., Demetrovics, Z., & Orosz, G. (2018). The development of the problematic pornography consumption scale (PPCS). *The Journal of Sex Research*, *55*(3), 395-406. https://doi.org/10.1080/00224499.2017.1291798

Bradley, B. P., Mogg, K., Wright, T., & Field, M. (2003). Attentional bias in drug dependence: Vigilance for cigarette-related cues in smokers. *Psychology of Addictive Behaviors*, *17*(1), 66-72. https://doi.org/10.1037/0893-164x.17.1.66

Bradley, M. M., Codispoti, M., & Lang, P. J. (2006). A multi-process account of startle modulation during affective perception. *Psychophysiology*, *43*(5), 486-497. https://doi.org/10.1111/j.1469-8986.2006.00412.x

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

Brand, M., Young, K. S., Laier, C., Wölfling, K., & Potenza, M. N. (2016b). Integrating psychological and neurobiological considerations regarding the development and maintenance of specific internet-use disorders: An interaction of person-affect-Cognition-Execution (I-PACE) model. *Neuroscience & Biobehavioral Reviews*, *71*, 252-266. https://doi.org/10.1016/j.neubiorev.2016.08.033

Brevers, D., Cleeremans, A., Bechara, A., Laloyaux, C., Kornreich, C., Verbanck, P., & Noël, 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

Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures*, *53*, 22-32. https://doi.org/10.1016/j.futures.2013.09.003

Carroll, J. S., Padilla-Walker, L. M., Nelson, L. J., Olson, C. D., McNamara Barry, C., & Madsen, S. D. (2008). Generation XXX. *Journal of Adolescent Research, 23*(1), 6-30. https://doi.org/10.1177/0743558407306348

Castro-Calvo, J., Cervigón-Carrasco, V., Ballester-Arnal, R., & Giménez-García, C. (2021). Cognitive processes related to problematic pornography use (PPU): A systematic review of experimental studies. *Addictive Behaviors Reports*, *13*, 100345. https://doi.org/10.1016/j.abrep.2021.100345

Chaney, M. P., & Dew, B. J. (2003). Online experiences of sexually compulsive men who have sex with men. *Sexual Addiction & Compulsivity, 10*(4), 259-274. https://doi.org/10.1080/713775414

Chatzittofis, A., Arver, S., Öberg, K., Hallberg, J., Nordström, P., & Jokinen, J. (2016). HPA axis dysregulation in men with hypersexual disorder. *Psychoneuroendocrinology, 63*, 247-253. https://doi.org/10.1016/j.psyneuen.2015.10.002

Chen, L., & Jiang, X. (2020). The assessment of problematic internet pornography use: A comparison of three scales with mixed methods. *International Journal of Environmental Research and Public Health, 17*(2), 488. https://doi.org/10.3390/ijerph17020488

Chen, L., Wang, X., Chen, S. M., Jiang, C. H., & Wang, J. X. (2018). Reliability and validity of the Problematic Internet Pornography Use Scale in Chinese college students. *Chinese Journal of Public Health*, *34*(7), 1032-1036. https://doi.org/10.11847/zgggws1115589

Cheng, W., & Chiou, W. (2018). Exposure to sexual stimuli induces greater discounting leading to increased involvement in cyber delinquency among men. *Cyberpsychology, Behavior, and Social Networking*, *21*(2), 99-104. https://doi.org/10.1089/cyber.2016.0582

Chrystal, P. (2016). *In bed with the ancient greeks*. Amberley Publishing.

Clarke, J. R. (1998). *Looking at lovemaking: Constructions of sexuality in Roman art, 100 B.C.-A.D. 250*. University of California Press.

Cooper, A. (2013). *Cybersex: The dark side of the force* (2nd ed.). Routledge.

Crouch, H. (2016, December 8). *Pompeii wall paints reveal the raunchy services offered in Roman brothels 2,000 years ago*. The

Sun. https://www.thesun.co.uk/news/2355219/pornographic-pompeii-wall-paints-reveal-the-raunchy-services-offered-in-ancient-roman-brothels-2000-years-ago/

Darmanin, P (2011). *Gender differences regarding young people's views of casual and meaningful sex.* (Unpublished bachelors dissertation). University of Malta. Malta.

Darshan, M., Sathyanarayana Rao, T., Manickam, S., Tandon, A., & Ram, D. (2014). A case report of pornography addiction with dhat syndrome. *Indian Journal of Psychiatry*, *56*(4), 385. https://doi.org/10.4103/0019-5545.146536

De Alarcón, R., De la Iglesia, J., Casado, N., & Montejo, A. (2019). Online porn addiction: What we know and what we don't—A systematic review. *Journal of Clinical Medicine*, *8*(1), 91. https://doi.org/10.3390/jcm8010091

Dickenson, J. A., Gleason, N., Coleman, E., & Miner, M. H. (2018). Prevalence of distress associated with difficulty controlling sexual urges, feelings, and behaviors in the United States. *JAMA Network Open*, *1*(7), e184468. https://doi.org/10.1001/jamanetworkopen.2018.4468

Dines, G. (2010). *Pornland: How porn has hijacked our sexuality*. Beacon Press.

Diomidous, M., Chardalias, K., Magita, A., Koutonias, P., Panagiotopoulou, P., & Mantas, J. (2016). Social and Psychological Effects of the Internet Use. *Acta informatica medica : AIM : journal of the Society for Medical Informatics of Bosnia & Herzegovina : casopis Drustva za medicinsku informatiku BiH*, *24*(1), 66–68. https://doi.org/10.5455/aim.2016.24.66-68

Donovan, J. (2019, March 21). *Pornography addiction: Why pornography is addictive?* WebMD. https://www.webmd.com/sex/porn-addiction-possible

Doornwaard, S. M., Van den Eijnden, R. J., Johnson, A., & Ter Bogt, T. F. (2014). Exposure to sexualized media content and selective attention for sexual cues: An experimental

study. *Computers in Human Behavior*, *41*, 357-364. https://doi.org/10.1016/j.chb.2014.10.037

Drobes, D. J., Oliver, J. A., Correa, J. B., & Evans, D. E. (2019). Attentional Bias and Smoking. In V. R. Preedy (Ed.), *Neuroscience of Nicotine Mechanisms and Treatment* (pp. 145-150). Academic Press.

Duffy, A., Dawson, D. L., & Das Nair, R. (2016). Pornography addiction in adults: A systematic review of definitions and reported impact. *The Journal of Sexual Medicine*, *13*(5), 760-777. https://doi.org/10.1016/j.jsxm.2016.03.002

Duka, T., & Townshend, J. M. (2004). The priming effect of alcohol pre-load on attentional bias to alcohol-related stimuli. *Psychopharmacology*, *176*(3-4), 353–361. https://doi.org/10.1007/s00213-004-1906-7

Duncan, J. (2019, March 18). *The complete history of anal sex: Part 1*. Medium. https://medium.com/moments-of-passion/the-complete-history-of-anal-sex-part-1-34b33ab1355

Duncan, J., Ward, R., & Shapiro, K. (1994). Direct measurement of attentional dwell time in human vision. *Nature*, *369*(6478), 313-315. https://doi.org/10.1038/369313a0

Dwulit, A. D., & Rzymski, P. (2019). Prevalence, patterns and self-perceived effects of pornography consumption in Polish University students: A cross-sectional study. *International Journal of Environmental Research and Public Health*, *16*(10), 1861. https://doi.org/10.3390/ijerph16101861

Egeth, H. E., & Yantis, S. (1997). VISUAL attention: Control, representation, and time course. *Annual Review of Psychology*, *48*(1), 269-297. https://doi.org/10.1146/annurev.psych.48.1.269

Ettinger, G. (2017, May 3). The Portrayal of Women In Ancient Greek Pottery. Retrieved from https://thepigeonpress.org/portrayal-women-ancient-greek-pottery/

Falzon, N. (2016). *University students' attitudes towards pornography; A comparative study*. (Unpublished bachelors dissertation). University of Malta. Malta.

Ferrari, V., Codispoti, M., Cardinale, R., & Bradley, M. M. (2008). Directed and motivated attention during processing of natural scenes. *Journal of cognitive neuroscience*, *20*(10), 1753–1761. https://doi.org/10.1162/jocn.2008.20121

Field, A. (2018). *Discovering statistics using IBM SPSS statistics*. SAGE Publications.

Field, M., & Cox, W. (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., Marhe, R., & Franken, I. H. (2013). The clinical relevance of attentional bias in substance use disorders. *CNS Spectrums*, *19*(3), 225-230. https://doi.org/10.1017/s1092852913000321

Field, M., Marhe, R., & Franken, I. H. (2014). The clinical relevance of attentional bias in substance use disorders. *CNS Spectrums*, *19*(3), 225-230. https://doi.org/10.1017/s1092852913000321

Ford, J. J., Durtschi, J. A., & Franklin, D. L. (2012). Structural therapy with a couple battling pornography addiction. *The American Journal of Family Therapy*, *40*(4), 336-348. https://doi.org/10.1080/01926187.2012.685003

Fradd, M. (2017). *The porn myth: Exposing the reality behind the fantasy of pornography*. Ignatius Press.

George, M., Maheshwari, S., Chandran, S., & Rao, T. S. (2019). Psychosocial aspects of pornography. *Journal of Psychosexual Health, 1*(1), 44-47. https://doi.org/10.1177/2631831818821535

Gilliland, R., South, M., Carpenter, B. N., & Hardy, S. M. (2011). The roles of shame and guilt in hypersexual behavior. *PsycEXTRA Dataset, 18*(1), 12-29. https://doi.org/10.1037/e741382011-288

Giordano, A. L., & Cashwell, C. S. (2017). Cybersex addiction among college students: A prevalence study. *Sexual Addiction & Compulsivity, 24*(1-2), 47-57. https://doi.org/10.1080/10720162.2017.1287612

Grammatikakis, I. E. (2010). The woman in Minoic Crete. *The Journal of Maternal-Fetal & Neonatal Medicine*, *24*(7), 968-972. https://doi.org/10.3109/14767058.2010.531328

Grant, J. E., & Chamberlain, S. R. (2016). Expanding the definition of addiction: DSM-5 vs. ICD-11. *CNS Spectrums*, *21*(4), 300-303. https://doi.org/10.1017/s1092852916000183

Griffiths, M. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use*, *10*(4), 191-197. https://doi.org/10.1080/14659890500114359

Griffiths, M. D. (2012). Internet sex addiction: A review of empirical research. *Addiction Research & Theory*, *20*(2), 111-124. https://doi.org/10.3109/16066359.2011.588351

Grubbs, J. B., Kraus, S. W., Perry, S. L., Lewczuk, K., & Gola, M. (2020). Moral incongruence and compulsive sexual behavior: Results from cross-sectional interactions and parallel growth curve analyses. *Journal of abnormal psychology*, *129*(3), 266–278. https://doi.org/10.1037/abn0000501

Grubbs, J. B., Stauner, N., Exline, J. J., Pargament, K. I., & Lindberg, M. J. (2015). Perceived addiction to Internet pornography and psychological distress: Examining relationships concurrently and over time. *Psychology of addictive behaviors : journal of the Society of Psychologists in Addictive Behaviors*, *29*(4), 1056–1067. https://doi.org/10.1037/adb0000114

Grubbs, J. B., Perry, S. L., Wilt, J. A., & Reid, R. C. (2019). Pornography problems due to moral incongruence: An integrative model with a systematic review and meta-analysis. *Archives of Sexual Behavior*, *48*(2), 397-415. https://doi.org/10.1007/s10508-018-1248-x

Hakamata, Y., Matsui, M., & Tagaya, H. (2014). Does neurocognitive function affect cognitive bias toward an emotional stimulus? Association between general attentional ability and attentional bias toward threat. *Frontiers in psychology*, *5*, 881. https://doi.org/10.3389/fpsyg.2014.00881

Hall, G., & Rodríguez, G. (2017). Habituation and conditioning: Salience change in associative learning. *Journal of Experimental Psychology: Animal Learning and Cognition*, *43*(1), 48-61. https://doi.org/10.1037/xan0000129

Harwell, M.R. (2011). Research Design in Qualitative/Quantitative/Mixed Methods. In Conrad, C.F. & Serlin, R.C. (Eds.), *The Sage Handbook for Research in Education.* (pg. 147-163). Sage Publications.

Heitmann, J., & de Jong, P. J. (2021). Attentional Bias in Alcohol and Cannabis Use Disorder Outpatients as Indexed by an Odd-One-Out Visual Search Task: Evidence for Speeded Detection of Substance Cues but Not for Heightened Distraction. *Frontiers in psychology*, *12*, 626326. https://doi.org/10.3389/fpsyg.2021.626326

Holt, T. J., Bossler, A. M., & May, D. C. (2012). Low self-control, deviant peer associations, and juvenile Cyberdeviance. *American Journal of Criminal Justice*, *37*(3), 378-395. https://doi.org/10.1007/s12103-011-9117-3

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

Imran, A., Sakaluk, J., & Gillath, O. (2014). Perception of sexual stimuli influences cognitive task performance. *PsycEXTRA Dataset*. https://doi.org/10.1037/e514472015-371

Jeromin, F., Nyenhuis, N., & Barke, A. (2016). Attentional bias in excessive internet gamers: Experimental investigations using an addiction Stroop and a visual probe. *Journal of Behavioral Addictions*, *5*(1), 32-40. https://doi.org/10.1556/2006.5.2016.012

Jiang, Y., Costello, P., Fang, F., Huang, M., & He, S. (2006). A gender- and sexual orientation-dependent spatial attentional effect of invisible images. *Proceedings of the National Academy of Sciences of the United States of America*, *103*(45), 17048–17052. https://doi.org/10.1073/pnas.0605678103

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

Jokinen, J. (2017). Methylation of the HPA axis related genes in men with hypersexual disorder. *European Psychiatry*, *41*(S1), s849-s850. https://doi.org/10.1016/j.eurpsy.2017.01.1684

Joudrey. (2015). Penetrating boundaries: An ethics of anti-perfectionism in Victorian pornography. *Victorian Studies, 57*(3), 423. https://doi.org/10.2979/victorianstudies.57.3.423

Junghöfer, M., Bradley, M. M., Elbert, T. R., & Lang, P. J. (2001). Fleeting images: a new look at early emotion discrimination. *Psychophysiology, 38*(2), 175–178.

Kagerer, S., Wehrum, S., Klucken, T., Walter, B., Vaitl, D., & Stark, R. (2014). Sex attracts: Investigating individual differences in attentional bias to sexual stimuli. *PLoS ONE*, *9*(9), e107795. https://doi.org/10.1371/journal.pone.0107795

Kamaruddin, N., Abdul Rahman, A. W., & Handiyani, D. (2018). Pornography addiction detection based on neurophysiological computational approach. *Indonesian Journal of Electrical Engineering and Computer Science*, *10*(1), 138-145. https://doi.org/10.11591/ijeecs.v10.i1.pp138-145

Kinnick, K. (2007). Pushing the envelope: The role of the mass media in the mainstreaming of Pornography. In A. Hall & M. Bishop (Eds.), *Pop porn: Pornography in american culture* (pp.7-26).

Klucken, T., Wehrum-Osinsky, S., Schweckendiek, J., Kruse, O., & Stark, R. (2016). Altered appetitive conditioning and neural connectivity in subjects with compulsive sexual behavior. *The Journal of Sexual Medicine, 13*(4), 627-636. https://doi.org/10.1016/j.jsxm.2016.01.013

Kohut, T., Balzarini, R. N., Fisher, W. A., Grubbs, J. B., Campbell, L., & Prause, N. (2019). Surveying pornography use: A shaky science resting on poor measurement foundations. *The Journal of Sex Research*, *57*(6), 722-742. https://doi.org/10.1080/00224499.2019.1695244

Koster, E. H., Verschuere, B., Crombez, G., & Van Damme, S. (2005). Time-course of attention for threatening pictures in high and low trait anxiety. *Behaviour Research and Therapy*, *43*(8), 1087-1098. https://doi.org/10.1016/j.brat.2004.08.004

Kraus, S., & Rosenberg, H. (2014). Pornography craving questionnaire. *PsycTESTS Dataset*. https://doi.org/10.1037/t72293-000

Kühn, S., & Gallinat, J. (2014). Brain structure and functional connectivity associated with pornography consumption. *JAMA Psychiatry*, *71*(7), 827. https://doi.org/10.1001/jamapsychiatry.2014.93

Kunaharan, S., Halpin, S., Sitharthan, T., Bosshard, S., & Walla, P. (2017). Conscious and non-conscious measures of emotion: Do they vary with frequency of pornography use? *Applied Sciences*, *7*(5), 493. https://doi.org/10.3390/app7050493

Kuss, D. J., & Griffiths, M. D. (2012). Internet and gaming addiction: a systematic literature review of neuroimaging studies. *Brain sciences*, *2*(3), 347–374. https://doi.org/10.3390/brainsci2030347

Laier, C., & Brand, M. (2014). Empirical evidence and theoretical considerations on factors contributing to cybersex addiction from a cognitive-behavioral view. *Sexual Addiction & Compulsivity*, *21*(4), 305-321. https://doi.org/10.1080/10720162.2014.970722

Laier, C., & Brand, M. (2017). Mood changes after watching pornography on the internet are linked to tendencies towards internet-pornography-viewing disorder. *Addictive Behaviors Reports*, *5*, 9-13. https://doi.org/10.1016/j.abrep.2016.11.003

Laier, C., Pawlikowski, M., Pekal, J., Schulte, F. P., & Brand, M. (2013b). Cybersex addiction: Experienced sexual arousal when watching pornography and not real-life

sexual contacts makes the difference. *Journal of Behavioral Addictions*, *2*(2), 100-107. https://doi.org/10.1556/jba.2.2013.002

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

Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015). Internet gaming disorder scale. *PsycTESTS Dataset*. https://doi.org/10.1037/t42759-000

Leppink, E. W., Chamberlain, S. R., Redden, S. A., & Grant, J. E. (2016). Problematic sexual behavior in young adults: Associations across clinical, behavioral, and neurocognitive variables. *Psychiatry Research*, *246*, 230-235. https://doi.org/10.1016/j.psychres.2016.09.044

Ley, D., Prause, N., & Finn, P. (2014). The emperor has no clothes: A review of the 'Pornography addiction' model. *Current Sexual Health Reports*, *6*(2), 94-105. https://doi.org/10.1007/s11930-014-0016-8

Li, F. F., VanRullen, R., Koch, C., & Perona, P. (2002). Rapid natural scene categorization in the near absence of attention. *Proceedings of the National Academy of Sciences*, *99*(14), 9596-9601. https://doi.org/10.1073/pnas.092277599

Linden, D. J. (2012). *The compass of pleasure: How our brains make fatty foods, orgasm, exercise, marijuana, generosity, vodka, learning, and gambling feel so good*. Penguin.

MacLeod C, Mathews A, Tata P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*(1), 15-20. https://doi.org/10.1037//0021-843x.95.1.15

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association

through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*(1), 107-123. https://doi.org/10.1037/0021-843x.111.1.107

Malcolm, M., & Naufal, G. S. (2014). Are pornography and marriage substitutes for young men? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2534707

Malki, K., Rahm, C., Öberg, K. G., & Ueda, P. (2021). Frequency of pornography use and sexual health outcomes in Sweden: Analysis of a national probability survey. *The Journal of Sexual Medicine, 18*(10), 1735-1751. https://doi.org/10.1016/j.jsxm.2021.08.003

Mc Knee, A., Byron, P., Litsou, K. (2019). An Interdisiplinary Definition of Pornography: Results from a Global Delphi Panel. https://doi.org/10.1007/s10508-019-01554-4

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), e105476. https://doi.org/10.1371/journal.pone.0105476

Messina, B., Fuentes, D., Tavares, H., Abdo, C. H., & Scanavino, M. D. (2017). Response and rebuttal to editorial comment on "Executive functioning of sexually compulsive and non-sexually compulsive men, before and after watching erotic video". *The Journal of Sexual Medicine, 14*(3), 347-354. https://doi.org/10.1016/j.jsxm.2016.12.240

Miller, D. J., Raggatt, P. T., & McBain, K. (2020). A literature review of studies into the prevalence and frequency of men's pornography use. *American Journal of Sexuality Education, 15*(4), 502-529. https://doi.org/10.1080/15546128.2020.1831676

Miller, M. A., & Fillmore, M. T. (2010). The effect of image complexity on attentional bias towards alcohol-related images in adult drinkers. *Addiction, 105*(5), 883-890. https://doi.org/10.1111/j.1360-0443.2009.02860.x

Miner, M. H., Raymond, N., Coleman, E., & Swinburne Romine, R. (2017). Investigating clinically and scientifically useful cut points on the compulsive sexual behavior inventory. *The Journal of Sexual Medicine, 14*(5), 715-720. https://doi.org/10.1016/j.jsxm.2017.03.255

Ministry of Health (2012). *Sexual Knowledge, attitudes and behaviour – national survey.* https://deputyprimeminister.gov.mt/en/dhir/Documents/sexual_health_survey_report_2012.pdf

Müller, K., Dreier, M., Beutel, M., Duven, E., Giralt, S., & Wölfling, K. (2016). A hidden type of internet addiction? Intense and addictive use of social networking sites in adolescents. *Computers in Human Behavior*, *55*, 172-177. https://doi.org/10.1016/j.chb.2015.09.007

Nash, S. E. (2016, March 31). *Skeleton sex pots*. SAPIENS. https://www.sapiens.org/column/curiosities/moche-skeleton-sex-pots/

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

Noël, X., Colmant, M., Van Der Linden, M., Bechara, A., Bullens, Q., Hanak, C., & Verbanck, P. (2006). Time course of attention for alcohol cues in abstinent alcoholic patients: The role of initial orienting. *Alcoholism: Clinical and Experimental Research, 30*(11), 1871-1877. https://doi.org/10.1111/j.1530-0277.2006.00224.x

O'Neill, J. H., & Bouce, P. (1984). Sexuality in eighteenth-century Britain. *Eighteenth-Century Studies*, *18*(2), 261. https://doi.org/10.2307/2738547

Panksepp, J. (1998). Affective Neuroscience: The Foundations of Human and Animal Emotions. Oxford University Press.

Park, B. Y., Wilson, G., Berger, J., Christman, M., Reina, B., Bishop, F., Klam, W. P., & Doan, A. P. (2016). Is Internet Pornography Causing Sexual Dysfunctions? A Review with Clinical Reports. *Behavioral sciences (Basel, Switzerland)*, *6*(3), 17. https://doi.org/10.3390/bs6030017

Parkman, D. (2021, April 9). *Pornhub insights releases stats for 2020 'Tech review'*. XBIZ. https://www.xbiz.com/news/258472/pornhub-insights-releases-stats-for-2020-tech-review

Peirce et al. (2019). *Psychopy*. Retrieved from https://www.psychopy.org

Pekal, J., Laier, C., Snagowski, J., Stark, R., & Brand, M. (2018). Tendencies toward internet-pornography-use disorder: Differences in men and women regarding attentional biases to pornographic stimuli. *Journal of Behavioral Addictions*, *7*(3), 574-583. https://doi.org/10.1556/2006.7.2018.70

Peter, J., & Valkenburg, P. M. (2016). Adolescents and pornography: A review of 20 years of research. *The Journal of Sex Research*, *53*(4-5), 509-531. https://doi.org/10.1080/00224499.2016.1143441

Peuker, A. C., & Bizarro, L. (2014). Attentional avoidance of smoking cues in former smokers. *Journal of Substance Abuse Treatment*, *46*(2), 183-188. https://doi.org/10.1016/j.jsat.2013.08.014

Phillips, K. M. (2020, December 29). *Sex and sexuality*. Oxford Bibliographies. Retrieved February 23, 2022,

from https://www.oxfordbibliographies.com/view/document/obo-9780195396584/obo-9780195396584-0109.xml

Posner, M. I., Rafal, R. D., Choate, L. S., & Vaughan, J. (1985). Inhibition of return: Neural basis and function. *Cognitive Neuropsychology, 2*(3), 211-228. https://doi.org/10.1080/02643298508252866

Powers, R. (2019, June 26). *World Health Organization confirms compulsive sexual behavior disorder to be in ICD-11*. NCOSE. https://endsexualexploitation.org/articles/world-health-organization-confirms-compulsive-sexual-behavior-disorder-to-be-in-icd-11/

Prause, N., Janssen, E., & Hetrick, W. P. (2008). Attention and emotional responses to sexual stimuli and their relationship to sexual desire. *Archives of Sexual Behavior, 37*(6), 934-949. https://doi.org/10.1007/s10508-007-9236-6

Prause, N., Steele, V. R., Staley, C., Sabatinelli, D., & Hajcak, G. (2015). Modulation of late positive potentials by sexual images in problem users and controls inconsistent with "porn addiction". *Biological Psychology, 109*, 192-199. https://doi.org/10.1016/j.biopsycho.2015.06.005

Price, J., Patterson, R., Regnerus, M., & Walley, J. (2015). How much more XXX is Generation X consuming? Evidence of changing attitudes and behaviors related to pornography since 1973. *The Journal of Sex Research, 53*(1), 12-20. https://doi.org/10.1080/00224499.2014.1003773

Quaglio, G., & Millar, S. (2020). *Potentially negative effects of internet use: In-depth analysis*. Scientific Foresight Unit (STOA). https://www.europarl.europa.eu/RegData/etudes/IDAN/2020/641540/EPRS_IDA(2020)641540_EN.pdf

Rea, M. C. (2001). What is pornography? *Nous*, *35*(1), 118-145. https://doi.org/10.1111/0029-4624.00290

Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: an incentive-sensitization theory of addiction. *Brain research. Brain research reviews*, *18*(3), 247–291. https://doi.org/10.1016/0165-0173(93)90013-p

Robinson, T. E., & Berridge, K. C. (2001). Incentive-sensitization and addiction. *Addiction*, *96*(1), 103-114. https://doi.org/10.1046/j.1360-0443.2001.9611038.x

Robinson, T. E., & Berridge, K. C. (2008). The incentive sensitization theory of addiction: Some current issues. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1507), 3137-3146. https://doi.org/10.1098/rstb.2008.0093

Rose, D.E. (2012). The definition of pornography and avoiding normative silliness: a commentary adjunct to Rea's definition. *Philosophy study*, *2*, 547-559.

Schimmenti, A., & Caretti, V. (2010). Psychic retreats or psychic pits?: Unbearable states of mind and technological addiction. *Psychoanalytic Psychology*, *27*(2), 115-132. https://doi.org/10.1037/a0019414

Schupp, H., Markus, J., & Hamm, A. (2003). Emotional facilitation of sensory processing in the visual cortex. *Psychological Science*, *14*(1), 7-13. https://doi.org/10.1111/1467-9280.01411

Seok, J., & Sohn, J. (2018). Gray matter deficits and altered resting-state connectivity in the superior temporal gyrus among individuals with problematic hypersexual behavior. *Brain Research*, *1684*, 30-39. https://doi.org/10.1016/j.brainres.2018.01.035

Seto, M. C., Maric, A., & Barbaree, H. E. (2001). The role of pornography in the etiology of sexual aggression. *Aggression and Violent Behavior, 6*(1), 35-53. https://doi.org/10.1016/s1359-1789(99)00007-5

Short, M. B., Black, L., Smith, A. H., Wetterneck, C. T., & Wells, D. E. (2012). A review of internet pornography use research: Methodology and content from the past 10 years. *Cyberpsychology, Behavior, and Social Networking*, *15*(1), 13-23. https://doi.org/10.1089/cyber.2010.0477

Shukla, A. (2019, February 21). *Porn is bigger than Amazon or Netflix and that's a cause for worry*. OpIndia. https://www.opindia.com/2019/07/porn-is-bigger-than-amazon-or-netflix-and-thats-a-cause-for-worry/

Silver, C. (2019, December 19). *Pornhub 2019 year in review report: More porn, more often*. Forbes. https://www.forbes.com/sites/curtissilver/2019/12/11/pornhub-2019-year-in-review-report-more-porn-more-often/?sh=519fc73f4671

Sirianni, J. M., & Vishwanath, A. (2016). Problematic online pornography use: A media attendance perspective. *The Journal of Sex Research*, *53*(1), 21-34. https://doi.org/10.1080/00224499.2014.980496

Snagowski, J., & Brand, M. (2015). Symptoms of cybersex addiction can be linked to both approaching and avoiding pornographic stimuli: Results from an analog sample of regular cybersex users. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00653

Stoléru, S., Fonteille, V., Cornélis, C., Joyal, C., & Moulier, V. (2012). Functional neuroimaging studies of sexual arousal and orgasm in healthy men and women: A review and meta-analysis. *Neuroscience & Biobehavioral Reviews, 36*(6), 1481-1509. https://doi.org/10.1016/j.neubiorev.2012.03.006

Strahler, J., Baranowski, A., Walter, B., Huebner, N., & Stark, R. (2019). Attentional bias toward and distractibility by sexual cues: A meta-analytic integration. *Neuroscience & Biobehavioral Reviews*, *105*, 276-287. https://doi.org/10.1016/j.neubiorev.2019.07.015

Theeuwes, J. (2005). Irrelevant singletons capture attention. *Neurobiology of Attention*, 418-424. https://doi.org/10.1016/b978-012375731-9/50073-2

Tinbergen, N. (1951) The Study of Instinct. Clarendon Press.

Thorpe, S., Fize, D., & Marlot, C. (1996). Speed of processing in the human visual system. *Nature*, *381*(6582), 520-522. https://doi.org/10.1038/381520a0

Van der Laan, L., De Ridder, D., Viergever, M., & Smeets, P. (2011). The first taste is always with the eyes: A meta-analysis on the neural correlates of processing visual food cues. *NeuroImage*, *55*(1), 296-303. https://doi.org/10.1016/j.neuroimage.2010.11.055

Van Hemel-Ruiter, M. E., De Jong, P. J., Ostafin, B. D., & Oldehinkel, A. J. (2015). Reward-related attentional bias and adolescent substance use: A prognostic relationship? *PLoS ONE*, *10*(3). https://doi.org/10.1371/journal.pone.0121058

Van Rooijen, R., Ploeger, A., & Kret, M. E. (2017). The dot-probe task to measure emotional attention: A suitable measure in comparative studies? *Psychonomic Bulletin & Review*, *24*(6), 1686-1717. https://doi.org/10.3758/s13423-016-1224-1

Vollstadt-Klein, S., Loeber, S., Von der Goltz, C., Mann, K., & Kiefer, F. (2009). Avoidance of alcohol-related stimuli increases during the early stage of abstinence in alcohol-dependent patients. *Alcohol and Alcoholism*, *44*(5), 458-463. https://doi.org/10.1093/alcalc/agp056

Voon, V., Mole, T. B., Banca, P., Porter, L., Morris, L., Mitchell, S., Lapa, T. R., Karr, J., Harrison, N. A., Potenza, M. N., & Irvine, M. (2014). Neural correlates of sexual cue reactivity in individuals with and without compulsive sexual behaviours. *PLoS ONE*, *9*(7), e102419. https://doi.org/10.1371/journal.pone.0102419

Ward, R. (2021, April 20). *7 ways the internet has changed the adult entertainment industry in 2022*. WEBSTA. https://websta.me/internet-changed-the-adult-industry/

Weeks, J. (1989). *Sex, politics, and society: The regulation of sexuality since 1800*. Longman Publishing Group.

Wierzba, M., Riegel, M., Pucz, A., Leśniewska, Z., Dragan, W. Ł., Gola, M., Jednoróg, K., & Marchewka, A. (2015). Erotic subset for the Nencki affective picture system (NAPS ERO): Cross-sexual comparison study. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.01336

Willoughby, B.J., & Busby, D.M. (2016). In the eye of the beholder: Exploring variations in perceptions of pornography. *Journal of Sex Research, 53*(6), 678-688. https://doi.org/10.1080/00224499.2015.1013601.

Wilson, G. (2016). Eliminate chronic internet pornography use to reveal its effects. *Addicta: The Turkish Journal on Addictions*, *3*(2). https://doi.org/10.15805/addicta.2016.3.0107

Wilson, G. (2017). *Your brain on porn: Internet pornography and the emerging science of addiction* (2nd ed.). Commonwealth Publishing.

Wolf, N. (2003, October 9). *The porn myth*. New York Magazine. Retrieved December 13, 2021, from https://nymag.com/nymetro/news/trends/n_9437/

Yorzinski, J. L., Penkunas, M. J., Platt, M. L., & Coss, R. G. (2014). Dangerous animals capture and maintain attention in humans. *Evolutionary Psychology*, *12*(3), 147470491401200. https://doi.org/10.1177/147470491401200304

Zimmer, F., & Imhoff, R. (2020). Abstinence from masturbation and Hypersexuality. *Archives of Sexual Behavior*, *49*(4), 1333-1343. https://doi.org/10.1007/s10508-019-01623-8

Appendix 1: Evidence of Ethical Clearance from FREC/UREC

Unique Form ID: 9654_06092021

Dear Duncan Veneziani,

Your ethics proposal with regards to your research titled *Examining attentional bias to unsolicited sexual stimuli and its potential association with Internet pornography use* has been **approved**.

Attached find a **copy of the feedback form** containing FREC's feedback and approval. Kindly check the sheet in case of any comments from FREC.

Faculty Research Ethics Committees are authorised to review and approve research ethics applications on behalf of the University of Malta, except in the case of sensitive personal data. In this regard, your ethics proposal **does not need to be sent to UREC-DP**. Hence, **you may now start your research**.

Regards,

L-Università ta' Malta

Faculty Research Ethics Committee

Faculty for Social Wellbeing
Room 113, Humanities A Building
+356 2340 2237

Appendix 2: Recruitment Letter to University Registrar and Internet Based Advertisements

Dear prospective participant

My name is Duncan Veneziani and I am a student at the University of Malta, presently reading for a Master's degree in Addiction Studies.

As part of my dissertation, I am conducting a study titled 'Examining attentional bias to unsolicited sexual stimuli and its potential association with Internet pornography use'.

The aim of my study is to assess attentional bias as a potential measure of addictive behaviour in a cohort of adult (18+) heterosexual male Internet pornography (IP) users and non-users. Seeing that all questionnaires will retain their original format, participants must be fluent in English.

Data collected during the study will be confidential and anonymized. Thus, should you choose to participate, make sure that when you fill out the hereby google form you provide a pseudonym (i.e., fictitious name), and a phone number for contact purposes.

https://docs.google.com/forms/d/e/1FAIpQLSfwZEubotbK1sJPVRYtH8oB-CWLsed2N9CNgNYROb5UWpSR6w/viewform?usp=sf_link

A more detailed explanation of the said study is found in the above link as well.

Investigating attentional bias and Internet pornography use has never been done locally. This means that you can be the first to take part in such a study. Also, aside from contributing towards local research, you can also contribute to the global debate on why Internet pornography use can be considered as a behavioural addiction.

Don’t let your false fear of being judged triumph over your participation. We are nothing but shades of the same colour.

Looking forward to meet you.

Appendix 3: Information Letter

Information letter

Dear prospective participant,

My name is Duncan Veneziani and I am a student at the University of Malta, presently reading for a Masters in Addiction Studies. I am presently conducting a research study for my dissertation titled Examining attentional bias to unsolicited sexual stimuli and its potential association with Internet pornography use; this is being supervised by Dr Olga Bogolyubova, and Mr Matthew Bartolo. This letter is an invitation to participate in this study. Below you will find information about the study and about what your involvement would entail, should you decide to take part.

The aim of my study is to assess attentional bias as a potential measure of addictive behavior in a cohort of adult heterosexual male Internet pornography (IP) users. Seeing that all questionnaires (i.e., measures used in this study) will retain their original format (i.e., English version) to ensure validity and reliability; participants must be fluent in English. Your participation in this study would help to increase our understanding of Internet pornography use. Any data collected from this research will be used solely for purposes of this study.

Should you choose to participate, you may be asked to participate in a two-component study. The first stage of the study, will consist of a Visual Probe Task and, a part of this task,non-explicit sexual images will be demonstrated. You will also be asked to complete a questionnaire including questions on demographics, internet pornography use and sexual behavior. First stage of the study (i.e., Visual Probe Task and questionnaires) will last for approximately 10-25 minutes.
You may be selected to participate for the second stage of the study in a week's time based on your questionnaire response. Should you accept to partake, you will be asked to abstain from Internet pornography use until re-examination. Second stage of study (i.e., re-examination via Visual Probe Task) will last for approximately 5-10minutes.

Data collected during the study will be kept confidential and anonymized. Thus, should the data be published it will not be identifiable as yours. In light of the above, shouldyou choose to accept participation, kindly provide a pseudonym (i.e., fictitious name), and a phone number for contact purposes. As to safeguard from having prospective participants using the same and/or similar pseudonyms, an online free access number generator will be used to provide each participant with a unique number prior to commencement of study. Thisnumber will only be connected with your pseudonym, and not with your real name or identity.

Participation in this study is entirely voluntary; in other words, you are free to accept or refuse to participate, without needing to give a reason. You are also free to withdraw from the study at any time, without needing to provide any explanation and without any negative repercussions for you. Should you choose to withdraw, any data collected from your interview may be deleted upon request.

If you choose to participate, please note that there are no direct benefits to you. However, do keep in mind that investigating attentional bias and Internet pornography use has never been done locally and you can be the first to take part in such a study. Not only can your

participation be of benefit to local research, but it can also contribute to the global debate on why Internet pornography can be considered as a behavioral addiction. Your participation does not entail any known or anticipated risks. However, should you self-perceive as having problematic Internet pornography use, and wish to speak out about this, you will be briefed on how to make contact with University counselling services (23402235) or Willingness Clinic(79291817).

Please note also that, as a participant, you have the right under the General Data Protection Regulation (GDPR) and national legislation to access, rectify and where applicable ask for the data concerning you to be erased. For future research and/or publication purposes, anonymized data will be retained for a maximum of 10 years. However, all identifiable information will be destroyed immediately upon study completion in 2022.

Based on the above information, agreement to participate in this study expresses informed consent. Also, a copy of this information sheet is being provided for you to keep and for future reference.

Thank you for your time and consideration. Should you have any questions or concerns, please do not hesitate to contact me by e-mail duncan.veneziani.07@um.edu.mt; you can also contact my supervisors via email: olga.bogolyubova@um.edu.mt & matthew.bartolo@gmail.com

Sincerely,

[Student]	[Principal supervisor]
[Mr Duncan Veneziani]	[Dr Olga Bogolyubova]
[Duncan.veneziani.07@um.edu.mt]	[olga.bogolyubova@um.edu.mt]

[Co-supervisor]

[Mr Matthew Bartolo]
Matthew.bartolo@gmail. com

Appendix 4: Protocol of the Experiment and Self-Report Measures

Experiment Protocol

Study consists of 2 components:

1) The first component consists of a Visual Probe Task and a set of questionnaires: demographics, Internet pornography use (i.e., frequency and consumption) and sexual behaviour.
2) The second component of the study will consist of another Visual Probe Task (i.e., same as the one shown in the first component of the study). Participants will be asked to abstain from Internet pornography use until re-examination in a weeks' time.

Protocol for Visual Probe Task

1.1 Visual Probe Task will be used to assess attention bias.

1.2 Seeing the sensitive nature of the topic in question, prospective participants must provide a pseudonym (i.e., a fictitious name) as instructed in the information letter, alongside a phone number for contact purposes. As to safeguard from having prospective participants using the same / similar pseudonyms, each individual participant will be given a unique number (i.e., code) prior to commencement of study.

1.3 Prior to commencement of experiment, each participant will be given a unique number (i.e., code)

1.3.1 An online free access number generator will be used to provide each participant with a unique number. Unique numbers are generated by choosing 'unique' in its interface. This would safeguard from possible duplications.

1.3.2 Participants must draw their own auto generated number by clicking on 'Roll'.

1.3.3 Each generated number will consist of 2 random numbers between 1 and 10000 (e.g. 2797 5565).

1.3.4 Number Generator can be accessed via: https://numbergenerator.org/randomnumbergenerator/1-2#!numbers=2&low=1&high=10000&unique=true&csv=&oddeven=&oddqty=0&sorted=false&addfilters=

1.3.5 Each participant must input: (i) chosen pseudonym, (ii) generated code, and (iii) session number before starting the Visual Probe Task.

1.4 Participants will be shown two images (i.e., visual stimuli): (1) unsolicited sexual images (i.e., non-explicit images that have the potential to illicit sexual arousal), and (2) neutral counterpart (i.e., images being exclusively free from any sexual connotation), followed by a probe.

1.5 Participants will be asked to indicate as quickly as possible the side in which the probe occurs. This probe will occur at the position of either a sexual or a neutral stimulus until participant's response.

1.6 Participants will be shown a central fixation cross (duration 1,500 msec), followed by two images randomized to either right or left of the fixation cross (duration 500msec). The images will disappear followed by a Probe (i.e., upward or downward arrowhead). Probe will appear to either the left or right side of the screen where the images were previously shown. Probe will remain on the screen until participant struck a response key or for a total of 1,500 msec if no key is struck. In either response or lack of response, the next trail would begin after 3,000 msec.

1.7 Main scores will be calculated by subtracting reaction times for the probe appearing after the unsolicited sexual stimuli from reaction times for the probe appearing after the neutral stimuli.
1.8 Positive score represents faster reaction times for probes appearing after an unsolicited sexual stimulus which indicate an attentional bias.
1.9 Images to be used for the Visual Probe Task:
1.9.1 Images that have the potential to illicit sexual arousal have been based on a study by Wierzba et al. (2015). This study complements the Nencki Affective Picture System (NAPS) that is used as stimulus material in their Laboratory of Brain Imaging (LOBI) experimental research. Thus images used for this study provide a standardized set of sexual stimuli for use in experimental research.
1.9.2 Neutral images (i.e., images being exclusively free from any sexual connotation) have also been taken from NAPS image database.
1.9.3 Permission to use NAPS image database was granted by the same author. Proof of permission can be accessed on: https://drive.google.com/drive/folders/126fLNV3Ea0WtwRPk_Q5DYiwpiKuuyX4u

Protocol for self-report measures

1.1 Each questionnaire is divided into 3 sections.
1.1.1 **Section 1** connotes a **demographic questionnaire** to assess: (1) age; (2) if participant is a University student, and (3) age of first pornography use.
1.1.2 **Section 2** is designed to assess: (1) **frequency**, and (2) **consumption of Internet pornography (IP) use**.
1.1.3 **Section 3** is intended to assess **sexual behaviour**.
1.2 Before commencement of questionnaire, the researcher will give an overview of what the questionnaire entails, and to point out that each participant can ask for further clarification if stuck or unsure on how to proceed.
1.3 Each participant must right down his unique number (i.e., code) (already drawn for his Visual Probe Task) on each paper of his questionnaire (i.e., top right corner).
1.4 Each questionnaire will have a unique set of instructions to explain how each questionnaire should be filled.
1.5 Each questionnaire has no right or wrong answer.
1.6 Each Participant is to indicate the answer that most applies to him.
1.7 Questionnaires that required permission of use: (1) Weekly Internet Pornography (IP) Use Scale – Adapted from the 'Pornography Craving Questionnaire' (Kraus & Rosenberg, 2014); (2) Problematic Pornography Consumption Scale (PPCS) (Bőthe et al., 2017); and Compulsive Sexual Behaviour Inventory – 13 (CSBI-13) (Miner et al., 2017), have been granted by each respective author via correspondence on ResearchGate – A European commercial social networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators. Proof of permission can be accessed on: https://drive.google.com/drive/folders/1kFZZld4dxd_FKM2YAcXB4zXgQgr-5fDX
1.8 Once the questionnaire is completed, participant is to drop it in a sealed box.
1.9 Sealed box will be opened once all participants have completed their questionnaires.

Pseudonym: _____ **Code: _____**

Part 2 – Self-Report Measures

Questionnaire is divided into **3 sections:**

- **Section 1** connotes a **demographic questionnaire** to assess: (1) age; (2) if participant is a University student, and (3) age of first pornography use.
- **Section 2** is designed to assess: (1) **frequency**, and (2) **consumption of Internet pornography (IP) use**.
- **Section 3** is intended to assess **sexual behaviour**.
- **Before you start filling this questionnaire, write your pseudonym and unique number (i.e., code) on the top right part of each page of this questionnaire.**

Section 1.
Demographic Questionnaire

Age: _____

University student: Yes ☐ No ☐

Age of first pornography use: _____

Pseudonym: _____ **Code: _____**

Section 2.
Internet Pornography Use

Internet pornography use is going to be assessing by: (1) Frequency (i.e., weekly Internet pornography use), and Consumption. The following scales will be used: (1) Weekly Internet pornography use scale (adapted from the 'Pornography Consumption Scale' by Kraus & Rosenberg, 2014) and the (2) Problematic Pornography Consumption Scale (PPCS) (Bőthe et al., 2017).

2.1 Weekly Internet Pornography Use Scale – Adapted from the Pornography Craving Questionnaire by Kraus & Rosenberg, (2014).

Reference:

Kraus, S., & Rosenberg, H. (2014). The pornography craving questionnaire: Psychometric properties. *Archives of Sexual Behavior*, *43*(3), 451-462. https://doi.org/10.1007/s10508-013-0229-3

Permission to use:
Permission to use was granted by the same author via correspondence on ResearchGate **–** A European commercial social networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators. Correspondence can be accessed on: https://drive.google.com/drive/folders/1ifwNBIa1s7D4bOPhObs7frTk1uQGYwzl

Instruction to participants:
Please think back to the past six months and indicate on the following 4-point scale typical weekly Internet pornography use from 0 (0 times) to 4 (11+ times). There is no right or wrong answer. Please indicate the answer that most applies to you.

Weekly Internet Pornography Use Scale.

0 = 0 times	☐
1 = 1-2 times	☐
2 = 3-5 times	☐
3 = 6-10 times	☐
4 = 11+ times	☐

Adapted from © Kraus & Rosenberg, (2004).

Pseudonym: _____ **Code: _____**

2.2 The Problematic Pornography Consumption Scale (PPCS)

Reference:

Bőthe, B., Tóth-Király, I., Zsila, Á., Griffiths, M. D., Demetrovics, Z., & Orosz, G. (2017). The development of the problematic pornography consumption scale (PPCS). *The Journal of Sex Research*, *55*(3), 395-406. https://doi.org/10.1080/00224499.2017.1291798

Permission to use:

Permission to use was granted by the same author via correspondence on ResearchGate – A European commercial social networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators. Correspondence can be accessed on: https://drive.google.com/drive/folders/1Bo6jMLRdq0QR-hC_1pPMcVl1CWu0RUDB

Instruction to participants:

Please think back to the past six months and indicate on the following 7-point scale how often or to what extent the statements apply to you. There is no right or wrong answer. Please indicate the answer that most applies to you.

The Problematic Pornography Consumption Scale (PPCS)

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	All the Time

	1	2	3	4	5	6	7
1. I felt that porn is an important part of my life	O	O	O	O	O	O	O
2. I used porn to restore the tranquillity of my feelings	O	O	O	O	O	O	O
3. I felt porn caused problems in my sexual life	O	O	O	O	O	O	O
4. I felt that I had to watch more and more porn for satisfaction	O	O	O	O	O	O	O
5. I unsuccessfully tried to reduce the amount of porn I watch	O	O	O	O	O	O	O
6. I became stressed when something prevented me from watching porn	O	O	O	O	O	O	O
7. I thought about how good it would be to watch porn	O	O	O	O	O	O	O
8. Watching porn got rid of my negative feelings	O	O	O	O	O	O	O
9. Watching porn prevented me from bringing out the best in me	O	O	O	O	O	O	O
10. I felt that I needed more and more porn in order to satisfy my needs	O	O	O	O	O	O	O
11. When I vowed not to watch porn anymore, I could only do it for a short period of time	O	O	O	O	O	O	O
12. I became agitated when I was unable to watch porn	O	O	O	O	O	O	O
13. I continually planned when to watch porn	O	O	O	O	O	O	O
14. I released my tension by watching porn	O	O	O	O	O	O	O
15. I neglected other leisure activities as a result of watching porn	O	O	O	O	O	O	O
16. I gradually watched more “extreme” porn, because the porn I watched before was less satisfying	O	O	O	O	O	O	O
17. I resisted watching porn for only a little while before I relapsed	O	O	O	O	O	O	O
18. I missed porn greatly when I didn’t watch it for a while	O	O	O	O	O	O	O

Pseudonym: _____ **Code: _____**

Section 3.
Sexual Behavior

Compulsive Sexual Behaviour Inventory – 13 (CSBI-13)

Reference:

Miner, M. H., Raymond, N., Coleman, E., & Swinburne Romine, R. (2017). Investigating clinically and scientifically useful cut points on the compulsive sexual behavior inventory. *The Journal of Sexual Medicine*, *14*(5), 715-720. https://doi.org/10.1016/j.jsxm.2017.03.255

Permission to use:

Permission to use was granted by the same author via correspondence on ResearchGate – A European commercial social networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators. Correspondence can be accessed on: https://drive.google.com/drive/folders/1DYSqaemrq-kQWf1TkHa15aMWy5Clin98

Instruction to participants:

Rate each of the 13 items on a 5-point Likert scale ranging from 1 (never) to 5 (very frequently). There is no right or wrong answer. Please indicate the answer that most applies to you.

Compulsive Sexual Behavior Inventory – 13 (CSBI-13)

Circle the answer that most accurately describes your response	Never	Rarely	Occasionally	Frequently	Very Frequently
1. How often have you had trouble controlling your sexual urges?	1	2	3	4	5
2. Have you felt unable to control your sexual behavior?	1	2	3	4	5
3. How often have you used sex to deal with worries or problems in your life?	1	2	3	4	5
4. How often have you felt guilty or shameful about aspects of your sexual behavior?	1	2	3	4	5
5. How often have you concealed or hidden your sexual behavior from others?	1	2	3	4	5
6. How often have you been unable to control your sexual feelings?	1	2	3	4	5
7. How often have you made pledges or promises to change or alter your sexual behavior?	1	2	3	4	5
8. How often have your sexual thoughts or behaviors interfered with the formation of friendships?	1	2	3	4	5
9. How often have you developed excuses and reasons to justify your sexual behavior?	1	2	3	4	5
10. How often have you missed opportunities for productive and enhancing activities because of your sexual activity?	1	2	3	4	5
11. How often have your sexual activities caused financial problems for you?	1	2	3	4	5
12. How often have you felt emotionally distant when you were engaging in sex with others?	1	2	3	4	5
13. How often have you had sex or masturbated more than you wanted to?	1	2	3	4	5