IMPLICIT VERSUS EXPLICIT MEASURES OF EMOTION PROCESSING IN PEOPLE WITH AGGRESSIVE TENDENCIES AND THOSE WHO USE PORNOGRAPHY

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Declaration

Originality

I hereby certify that to the best of my knowledge and belief this thesis is my own work, conducted under normal supervision and contains no material previously published or written by another person except where due references and acknowledgements are made. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

Thesis by Publication

I hereby certify that this thesis is in the form of a series of four papers. I have included as part of the thesis a written statement from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers. (*Refer to clause 39.2 of the Rules Governing Research Higher Degrees for acceptable papers).

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List of Publications


**Paper 3:** Kunaharan, S., Halpin, S., Sitharthan, T., & Walla, P. (Unpublished Manuscript) Does EEG and Startle Reflex Modulation vary with self-reported aggression?

**Paper 4:** Kunaharan, S., Halpin, S., Sitharthan, T., & Walla, P. (Unpublished Manuscript) Does varying levels of exposure to pornography and violence have an effect on our non-conscious emotion?

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**Journal Articles**


**Conference Abstracts**


Abstract

Traditional clinical practice and research in the behavioural sciences has long relied on surveys and questionnaires to gather insight into an individual’s inner state of affect. Although this subjective data was once thought to provide a comprehensive understanding of an individual’s thoughts, feelings and emotions, recent research has shown that many mental processes and behaviours occur without conscious appraisal. The current project aimed to shed light on the literature surrounding findings of differences between non-conscious and conscious emotion-related processes by specifically looking at individuals in the normal population who self-report having varying amounts of aggressive tendencies and those who self-report as viewing varying amounts of pornography. The current project also aimed to determine whether controlled exposure of these groups to violent and pornographic images differently modulated conscious and non-conscious affective processes. To test this, we utilised the simultaneous collection of electroencephalography (EEG), electromyography (EMG) by way of Startle Reflex Modulation (SRM) and self-report data whilst participants were presented with emotion-inducing images acquired via the International Affective Picture System database (IAPS) across three recording sessions. Conscious explicit responses were determined via valence and arousal ratings to each of the images presented. Collectively, the results obtained presented a picture of differently modulated EEG activity predominantly across frontal and parietal electrode sites which varied between high and low aggression and pornography groups at baseline and was independent of conscious explicit responses and SRM. Furthermore, we were able to mimic the ERP physiological effects of high pornography use by the controlled exposure of violent and pornographic images to infrequent pornography users across sessions. Despite the ERP
profiles showing variations across recording sessions, explicit responses remained constant. In sum, the findings of the current thesis provide insight into the confounds of simply relying on conscious subjective methods to understand emotional affect. Taken together the findings of the current thesis provide evidence to suggest clinicians and researchers may need to incorporate objective measures along with previously established subjective criteria to adequately determine a complete understanding of emotional affect in individuals.
Thesis Summary

In layperson’s terms, the following thesis aims to serve several purposes. The introduction of the thesis aims to initially present issues in modern society pertaining to access and viewership of pornographic and violent material. From there, traditional methods of measuring aberrant behaviour with regards to viewing excessive pornography and violence by researchers and clinicians is critiqued. That is to say, questionnaire and face-to-face interviews when determining emotional content is susceptible to cognitive influence. In contrast, the idea that methods utilising physiological measurements may provide additional information on a more non-conscious level which may tell a different story to consciously acquired information is visited. Therefore, the purpose of the thesis at large was to determine whether there are in fact distinct differences between non-conscious implicit and conscious explicit evaluations of experimentally controlled emotional content in a normal population who reports viewing varying amounts of pornographic material and who self-reported as being aggressive.

Due to the new triangulation approach in this field, chapter one, a perspective article, is meant to firstly highlight the issue of increased access and therefore exposure of pornography and violent material to the population at large. Secondly it aimed to investigate whether alternative methods of acquiring emotional information may provide different results to the tried and tested conventional methods incorporating self-report questionnaires and face-to-face interviews. This article makes a case for utilising neuroimaging techniques such as Electroencephalography (EEG) and Startle Reflex Modulation (SRM), which have the ability to determine non-conscious affective reactions to be used in conjunction with and not to the exclusion of already existing methods in
order to make more robust diagnoses of clinical disorders caused or perpetuated by excessive pornography use and aggressive behaviour. It has been published in an open access peer-reviewed science journal.

Chapter 2 follows on from the perspective piece and provides a general introduction and review into the area of study. Previous research is presented in relation to the two groups identified with regards to EEG and SRM studies as well as further critiquing the sole use of traditional self-report methods by researchers and clinicians when attempting to determine emotional affect by highlighting several studies which have found this discrepancy. This chapter closes by highlighting key terms which will be utilised throughout the thesis and providing operational definitions of these terms to guide the reader.

In chapter 3, a paper published in a peer-reviewed science journal with a focus on applied sciences. Baseline data was collected via both traditional methods encompassing conscious deliberate responses (e.g. online survey, conscious evaluation of emotional images) and electrophysiological methods, which are sensitive to non-conscious reactions to affective content (e.g. EEG, SRM) to determine if frequency of pornography use has any relationship with conscious and/or non-conscious emotional states. Participants were divided into three groups (low, medium and high) based on their responses to the frequency they said they viewed pornography (via the online survey) and results were compared. Results obtained showed significant differences in explicit responses for the way groups rated the valence of ‘Pleasant’ and ‘Erotic’ images. No significant findings were found for SRM, although effects showed a trend towards statistical significance. ERP analyses however, showed very clear changes between the groups at later time periods between their responses to ‘Unpleasant’ and ‘Violent’ emotion categories. These
results indicated to us that increased self-reported pornography use appears to influence the brain’s non-conscious responses to emotion-inducing stimuli which was not able to be determined purely by self-reported data.

In chapter 4 baseline data was again used with traditional responses (online survey, conscious evaluation of emotional images) together with electrophysiological methods (EEG, SRM) with the aim to determine if differences in affective states occur in groups with low and high self-reported aggression. Participants in this instance were divided into two groups (low and high aggression/hostility) based on their self-reported hostility as obtained by a modified version of the Buss-Durkee Hostility Inventory (BDHI). Again, as per the previous paper, subjective and objective data was collected and analysed and results were compared. Results indicated that there was no significant differences between the groups for conscious explicit responses and for SRM. ERP analyses however, demonstrated significant group differences between the ‘Pleasant’ and ‘Violent’ emotion conditions in frontal, central and parietal regions across both hemispheres. Although participants in this study were divided based on different criteria to the previous paper (self-reported hostility instead of self-reported pornography), it is again evident that non-conscious affective states can differ as shown by EEG, in particular ERPs, which is not seen when purely relying on conscious self-report measures.

Chapter 5 extends from previous chapters whereby we introduced an exposure component across several recording sessions in order to mimic exposure to violent and pornographic material under experimentally controlled conditions. Participants all completed an additional 2 recording sessions proceeding the baseline session whereby they were exposed to varying amounts of pornographic and violent images at each session. A single round of 50 pornographic and 50 violent images was presented to each
participant at session 2 and a further 9 rounds of the same 100 images were presented at session 3. Once the images were presented, participants rated all 150 IAPS images as they had at baseline. The purpose of this study was to determine if controlled short-term exposure has similar effects (be it priming or desensitization effects) on conscious subjective self-report and objective physiological recordings when compared to varying self-reported actual individual pornography use. In order to avoid any ceiling effects only participants who initially self-reported as being “low” pornography consumers were taken into account and respective data analysed further in this study. Results of ERP analysis confirmed changes in the frontal lobe of the brain between ‘Violent’ and ‘Unpleasant’ emotion conditions. Most crucially, it indeed was found that the ERP profiles of the “low” pornography use group at the conclusion of the 3 sessions appeared to be similar to the “high” pornography use group investigated at baseline in paper 2. What had been inadvertently done was we had been indeed able to artificially mimic the ERP effects of high pornography use in the laboratory by simply exposing “low” users to a combination of pornography and violence. Startle reflex modulation did not show any effects of exposure across sessions and as expected, conscious self-report did not show notable changes between the above two emotion conditions investigated further illustrating the disadvantages of relying on self-report measures in studies of affect.

Finally, chapter 6 concludes by providing a summary of the results obtained in the papers included in this thesis and provides a discussion on the overall results presented. Data obtained from EEG, SRM and self-report measures across all papers are discussed further highlighting the discrepancies obtained between self-report and physiological measures. Implications of said research as well as directions for future investigations in this area are offered, primarily by the suggestion of implementing multiple measures in
emotion research as well as within a clinical setting which are sensitive to the varying levels of emotion processing.

Overall, the contents of the current thesis provides important information regarding the utilisation of various measures to determine emotional affect. It also sheds a light on systematic problem areas currently at play in emotion research and in clinical settings especially when considering issues which may be regarded as taboo in general society. The main objective of this thesis is to state that due to the complex nature of emotion, a multidimensional approach incorporating measures designed to determine implicit and explicit emotion responses is required in future research which may hopefully be integrated into a clinical setting and may aid in diagnostic practices in the future.
Chapter 1

CLINICAL NEUROSCIENCE – TOWARDS A BETTER UNDERSTANDING OF NON-CONSCIOUS VERSUS CONSCIOUS PROCESSES INVOLVED IN IMPULSIVE AGGRESSIVE BEHAVIOURS AND PORNOGRAPHY VIEWERSHIP

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Abstract

Assuming that the human mind indeed consists of a non-conscious and a conscious part it makes sense to believe that consciousness at times may struggle to get access to non-conscious content, which seems rather logical. At the same time most of us are aware that affective processing underlying our emotions happens non-consciously due to limbic activity that is mostly sub-cortical. Thus, any explicit response to a question about one’s state of affect is inevitably prone to be inaccurate if not wrong. Therefore, any therapy, biological and/or psychological that is based on explicit responses is potentially misleading. With this opinion article we aim to generate awareness about potential discrepancies between self-reported versus objectively measured emotion-related states. There is more to emotion than just subjective feeling and we should start taking non-conscious emotion-related processes into account.
1.1 Introduction

Little has been made mention over the years of diagnostic practices currently employed in the behavioural sciences and the apparent drawbacks they may have. Current protocols in the diagnosis and subsequent treatment of behavioural disorders by clinicians largely stem from structured interviews whereby the clinician will follow guidelines for diagnosis and classification outlined in the Diagnostic and Statistical Manual IV (DSM IV-TR) (APA, 2000) and/or International Classification of Diseases 10 (ICD 10) (WHO, 2004). This process usually involves an interview session followed by questionnaires, which are filled out by the patient aiming to aid the clinician in diagnosis. Objective evaluation is usually only used if the clinician believes that the behavioural problem is a symptom of an underlying medical issue in which case the patient will be referred to a medical practitioner. Researchers in recent years have recognised that this current framework supplied by the DSM-IV and the ICD-10 has serious shortcomings regarding its validity due to several factors in particular: comorbidities among certain diagnoses and an over-specification of specific categories. Additionally, many categories were created, whilst techniques to measure objective physiological processes such as Electroencephalography (EEG) and Startle Reflex Modulation (SRM) (both discussed later) were still in their infancy and hence these measures lacked a biological basis in their diagnostic criteria (Insel & Cuthbert, 2009; Robbins et al., 2012). As a result, it seems that the following question should be asked: why shouldn’t objective measures also be used in the interpretation and diagnosis of the human psyche when they are ubiquitously used to aid the diagnosis and treatment of most other medical conditions? Given this question, we need to formulate methods in order to firstly, ascertain whether physiological measures—which are more adept at revealing our non-conscious thoughts and feelings—are a more accurate representation of how a person feels, and secondly,
whether this information once gathered will be useful in aiding clinicians in the diagnosis and treatment of behavioural disorders.

1.2 What measures can we use?

Human behaviour can be thought of as a combination of processes involving both cognitive and affective components (Walla et al., 2014). Investigations using self-reporting techniques only allow us to measure the cognitive aspect of human behaviour whilst the lesser understood affective processing which is largely non-conscious is not considered (Walla & Panksepp, 2013). Self-reporting provides the clinician with “conscious” or “explicit” feedback from the patient, which is assumed to be an accurate representation of their innermost attitudes and feelings. Till now, this has been the method most widely used to provide the clinician with the most effective diagnosis and treatment options within the behavioural sciences. If these inaccurate self-reporting measures are being used to determine treatment options, then these treatment options aren’t able to uncover the underlying behavioural issue of these individuals. The consequences of solely utilising the aforementioned methods to understand one aspect of this behavioural dichotomy may be deleterious. The lack of recognition of these underlying behavioural issues and consequently the providing of ineffective treatment may not adequately modify problem behaviours and may show an increase in behaviours which can lead to negative consequences (e.g. violent crime, sexual assault etc.) in the society that they live in.

As there are consequences in the use of self-report questionnaires to measure “non-conscious” or “implicit” behaviours, certain methods employed in neuroscience will be suggested in order to add weight to its use as a reliable measure of implicit or non-conscious behaviours. We acknowledge however that not all neuroscientific methods may
be suitable for this purpose. Commonly used techniques to study brain processing such as fMRI (Functional Magnetic Resonance Imaging) for example, although widely used in the neurosciences is quite costly and limited in its temporal resolution and this delay in data acquisition doesn’t allow it to be suitable for capturing fast and short implicit neural activity. Studies however, incorporating the use of Electroencephalography (EEG) have recorded participant neural activity reflecting implicit attitudes in real-time (Bosshard & Walla, 2013). This is more than adequate in recording neural impulses, which occur below conscious awareness and thus may be the most reliable instrument we can use to measure implicit neural activity. Another measure which has been long used to measure non-conscious processing is Startle Reflex Modulation (SRM). SRM has been used in several studies to selectively measure the valence of neural processing by measuring the intensity of eye blinks when presented with a startle probe (Bradeley et al., Grahl et al., 2012; Mavratzakis et al., 2013). The non-conscious behavioural effect occurs as people are usually more startled and hence, deliver a more intense blink when viewing something they innately find disruptive or disturbing and not so much when they view something they find pleasurable.

1.3 Targeted research groups

Due to the significant role our non-conscious plays in our behaviours, it is of course redundant to mention that several behavioural disorders could make use of further knowledge and understanding of its components. However, a closer look at specific questions relating to conscious vs non-conscious mechanisms is important as it allows for the focus of specific behavioural characteristics to be explored. This allows for more
streamlined research in this area of study, driving the search more specifically to particular groups.

Prior studies have aimed to investigate whether conscious exposure to violent or sexual behaviour (be it via movies, television, video games, magazines, internet etc.) has any effect on an individual’s behaviour or thought processes with regards to aberrant sexual and/or aggressive behaviours (Engelhardt et al., 2011; Anderson et al., 2010; Krahé & Möller, 2011; Willoughby et al., 2014; Svedin & Priebe, 2011). Research in this area is incredibly important as it is taking place at a time where society is exploding with continual technological advances, in particular increased access to a myriad of online content. This in turn, has allowed an ever increasing availability of sexually explicit and violent material available to anyone who wishes to access it. An observable issue with many of the aforementioned studies is the reliance of self-report measures in acquiring data on individual attitudes. It is necessary to take a close look at the implications of the inherent biases encountered during self-reporting. In particular, as this research is predominantly focusing on matters involving aggression and sex, the taboo nature of such topics gives rise to an individual subjectively tailoring his/her responses to the more socially/and or culturally appropriate response. This leaves us with results that don’t accurately reflect the demographics’ tendencies.

Further to this, aggression has historically been seen as a homogeneous construct where despite its multi-faceted nature, researchers have rarely differentiated between its differing forms. Venturing deeper to look at aggression as a behavioural characteristic, it is often a component of clinical disorders that is associated with abnormal brain functioning (Siegel & Victoroff, 2009). A sub-class of aggression known as impulsive aggression should be focused on as it may be more relevant than premeditated aggression.
(the other sub-class of aggression) when studying individuals who view pornographic material as many pornography users often compulsively view this material and impulsive and compulsive behaviours have been shown to be somewhat related (Robbins et al., 2012a; Robbins et al., 2012b; Fineberg et al., 2014). As mentioned previously, it makes more sense to streamline research into particular areas such as this as it allows more useful and therefore usable data to be collected.

1.4 Take home message

The main take home message of this opinion piece is to drive home the notion that there is a lot more processing going on in the non-conscious mind than we care to think about and the use of surveys doesn’t allow us to take this information into consideration. Self-reported data or face to face interviews largely only give us the conscious or explicit aspect of an individual’s behaviour and doesn’t at all reflect the individual’s non-conscious or implicit viewpoint. The main focal point of this research looks at impulsive aggressive individuals and people who view pornography. Both behaviours (aggression and sex) targeted by these groups are evolutionally incredibly important and are largely driven by instinct with little or no higher cognitive resources involved. As it is so, it makes more sense to measure and categorise these behaviours using implicit physiological measures rather than what is currently being used, which allows responses to be deliberate evaluations made cognitively after careful reasoning and evaluation of consequences.
1.5 Conclusion

It may be necessary to educate further and inform clinicians with what needs to be growing research into how they may better categorise, diagnose and finally treat their patients’ behavioural disorders. By only targeting one aspect of human behaviour they are not seeing the full picture of exactly what a behavioural characteristic entails and are therefore not in the best position to understand and treat them. The more we know about the non-conscious processes that drive human behaviour, the more clinicians may be able to better form treatment options for certain behavioural problems. Methods employed in the neurosciences, most specifically EEG and SRM may serve us best as instruments used to ascertain these non-conscious processes whereby physiological markers specific to certain behaviours may be present, which can be used to aid in diagnosis. This opinion article hopes to provide insight in order to possibly advance existing knowledge to clinicians and also provide a guideline from which future amendments may be made by the American Psychological Association and The World Health Organisation to their respective diagnostic manuals.
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Chapter 2

GENERAL INTRODUCTION
2.1 Overview

Modern research techniques encompassing the use of physiological recordings allow for unprecedented insight into human behavioural processes. There exists a requirement to incorporate this information into current clinical and research practices (Kunaharan & Walla, 2014; Kunaharan, Halpin, Bosshard, Sitharthan & Walla, 2017; Krueger, Hopwood, Wright & Markon, 2014, Krueger & Markon, 2014). Current clinical practice and behavioural research often rely heavily on subjectively acquired information to form conclusions pertaining to emotion. The current thesis aimed to provide evidence that merely utilising subjective conscious appraisal of emotion content does not provide a complete story. Rather, a combination of subjective and objective measures is required to provide a fuller understanding of emotional affect. The current research studied specific samples within the normal population, those who reported viewing varying amounts of pornographic material and who also reported having varying degrees of aggressive behaviours. The objective was to determine whether individuals within these groups differ in their conscious and non-conscious emotion behaviours and whether these behaviours are differently modulated after exposure to pornography and violence. In considering this issue, it is important to describe the model of emotion used within this work.

2.2 What is emotion? Determining the various levels of emotion processing and affect

It is understood that emotion processing is a multilevel process encompassing both conscious and non-conscious processing utilities (Walla, 2011). But what actually
constitutes an emotion? It is important to note that no consensus exists with regards to
how emotion should be defined. Debate may arise over what the phenomena of emotion
include, and even the word itself is usually defined with reference to particular emotions
(e.g. anger, fear, joy, disgust, sadness, surprise; Cabanac, 2002). The ambiguousness
pertains to the emphasis placed upon a range of facets such as cognition, feeling states,
physiology, behaviour and neural activity (Walla & Panksepp, 2013; Scherer & Ekman,
that there are two sources of disagreement when trying to define emotion. The first source
of disagreement is the debate between a reductionist view, which states a decry of
biological mechanisms due to the belief that determining underlying physiological
underpinnings will not assist in determining psychological laws, and the converse belief,
which states that psychological phenomena cannot be understood without knowledge of
underlying physiological processes. The second point of disagreement suggests that there
are those who believe that the important aspects of emotion physiology lies in the
autonomic nervous system (termed the peripheralists) and those who believe that the most
important emotion processes lie in the central nervous system, more specifically, the
cortical and limbic systems (termed the centralists). The authors go on to suggest that
both peripheral and central processes are necessary in studying emotion, with the most
important factor being the interaction between these structures.

Walla and Panksepp, (2013) suggested delineating between the terms ‘affect’ and
‘emotion’ when attempting to propose a new model of emotion. They suggested that the
root of emotion begins deep in the brain and generates “raw feelings” (p. 111) which they
labelled “affective processing” (p. 95). Here, affect was referred to as the “raw valenced
aspect of emotional arousal” (p. 95). They also went on to suggest that lower levels of
processing are influenced by higher-order brain functions and that emotions as a
behavioural characteristic originate on a non-conscious level. Similarly, Shouse (2005) suggested that affect should be best described as a non-conscious experience and emotion can best be described as a conscious or outward display. Together, a picture is presented of a working definition of emotional affect having roots deep in sub-cortical brain structures and the resultant emotion may be characterized by the conscious experience or display of said affect.

2.2.1 Conscious and non-conscious emotion

As mentioned previously, emotion and affect are linked and are suggested to be somewhat differentiated by the origin of the sensation termed emotional affect. Affective processing – which, according to Walla and Panksepp (2013) originates deep in the brain - pertains to non-conscious processing, and the resultant emotional experience is shaped by higher-order brain functions which relate to conscious experience or appraisal.

There is increasing evidence suggesting that a large part of our thought processes and subsequent behaviour occur beneath the level of conscious awareness (Walla, 2011; Winkielman & Berridge, 2004). The terms conscious and non-conscious are often used in experimental psychology to denote a perceptual state in which a subject may (conscious) or may not (non-conscious) be able to “report the presence of a particular stimulus or one of its attributes” (see Tamietto & De Gelder, 2010 p. 698). The authors of the aforementioned, indicate that similarly used terms include ‘implicit’ and ‘explicit’ to signify unintentional and intentional processing respectively. It has been shown that non-conscious regulation of emotion is possible (Mauss, Cook & Gross, 2007). According to Williams, Bargh, Nocera and Gray (2009), non-conscious processes can attain similar outcomes to conscious aspects of the same process and in some cases, provide even better outcomes than conscious processing. They state that non-conscious
processes are not constrained to the same limitations as conscious processes and so utilising non-conscious processes to assist in regulating emotion may be simpler to achieve.

2.3 The requirement for objective measures in clinical and research settings in the behavioural sciences

The current protocol employed for the diagnosis of problem behaviours by clinicians in the behavioural sciences rely heavily on structured interviews whereby the clinician will follow guidelines for diagnosis and classification outlined in the Diagnostic and Statistical Manual 5 (DSM 5; American Psychiatric Association, 2013) and/or International Classification of Diseases 10 (ICD 10; World Health Organisation, 1993), with the aim for the clinician to form a diagnosis and possible treatment options. The World Health Organization (WHO) and the International Union of Psychological Science (IUPsyS) conducted a multilingual survey questioning 2155 psychologists across 23 countries by investigating their use of the DSM and ICD found that 60% of psychologists routinely used a formal classification system, with the ICD-10 used by 51% and the DSM-IV by 44% (Evans et al, 2013). Even grant proposals for proposed research projects will often cite the DSM as evidence that the topic of their investigations is of a genuine public concern (Krueger et al, 2014). These manuals have historically been based on behavioural observation and interview rather than biological etiology (Hilton, 2013). In recent years, it has been recognised that this current framework suggested by these manuals has serious shortcomings regarding its validity (Saito et al., 2010). This is due to, among other reason, the inability to characterise patients due to patients not fitting neatly into single DSM categories and clinicians having to contend with vague constructions labelled as “Not
Otherwise Specified” in some areas (Krueger et al., 2014 p. 1). In addition, many of the categories in the DSM were created well before the neurosciences had achieved maturity and as a result, do not represent current knowledge regarding factors such as neural circuitry, neurotransmitters and genetics among others (Insel & Cuthbert, 2009). It is noteworthy at this point to state that it is not the purpose or the intention of the current thesis to group our test participants with the psychiatrically impaired based on whether they score highly against the measured criteria. The intention of bringing up the DSM and ICD was to bring focus to an underlying protocol utilised by researchers and clinicians which is systemically adhered to which places a great deal of emphasis on subjective criteria. It is clear that the DSM is a classification system which does not imply that patients with the same diagnosis have the same root cause of their illness, however, it has been suggested by Krueger et al. (2014) that incorporating and utilising objective methods grounded in human physiology such as genetics, neurobiology etc. may provide a deeper level of understanding of the root cause of behavioural issues and prove to be a more effective method in treating problem behaviours.

What is additionally noteworthy is that a vast majority of research studies in the behavioural sciences rely heavily, or at times, rely exclusively on the acquisition of information obtained from questionnaire-based research (Paulhus & Vazire, 2007). The aforementioned authors suggest that the main advantage of utilising self-reports is that they are efficient and inexpensive, allowing the collection of large quantities of data. This consciously derived feedback is a relatively easy and affordable way to provide a researcher or clinician with accurate information pertaining to an individual’s conscious emotional experience. As stated by Walla and Panksepp, (2013), Walla, (2011) and Winkielman and Berridge, (2004) emotional affect and consequently an individual’s emotional experience is composed of both non-conscious and conscious processes. What
is evident, however, is that in order to gather a more complete understanding of an individual’s emotional appraisal, both non-conscious and conscious processes need to be taken into account. Relying solely on one process denies the researcher or clinician information about emotion processes which may provide a more accurate, or at the very least, a more rounded interpretation of an individual’s full emotional spectrum. Additionally, there are further confounds with regards to utilising only self-report based methods of data acquisition which may involve, among others, participants filling in their responses in isolation to the researcher. This allows the integrity of the data to come into question as researchers can’t ensure that subjects complete all items in the questionnaire (Schmidt, 1997). Another confound includes reverse-scoring questions which are often used to preserve the integrity of participants’ responses can at times become confusing due to the way the question is phrased. Moreover, with the relatively recent usage of online questionnaires, there is no possibility for respondents to ask for clarification if they happened to come across a question they do not understand. Furthermore, with reference to the present project, self-report itself can come under a host of inherent biases especially when determining attitudes and emotions which pertain to behaviours which may be deemed socially or morally taboo or unacceptable (Krumpal, 2013; Van de Mortel, 2008). An example of this was demonstrated in a study by Kelly, Soler-Hampejsek, Mensch & Hewett, (2013) which showed that the method utilised to collect data on sexual behaviour influenced the reported prevalence of the behaviour in male respondents. They suggested that more research is required to investigate and improve methods by which sensitive data is collected. It is clear that there is a requirement to integrate more objective measurements with regards to delineating emotional processes especially with regards to socially or morally taboo behaviours and emotions.
2.4 Pornography use and its effects

The term pornography has often been used extemporaneously to cover a wide array of sexually stimulating material. It has been described in the past as explicit sexual activity where one or more of the participants may be objectified or portrayed as non-consenting or powerless (Marshall & Barrett, 1990), and also explicit sexual content which depicts consenting, pleasurable, non-violent and non-degrading sexual interactions (Fisher & Barak, 1989). The latter explanation is also often used in research circles to equate more so to the term ‘erotica’ rather than pornography and this distinction is often dependent, among other factors, on culture, time or societal appropriateness (Rissel, Richters, de Visser, McKee, Yeung & Caruana, 2017).

In the past 40 years, the accessibility of pornographic material has shifted from movie theatres, video cassettes and television to the present day with internet and smartphones (Price, Patterson, Regnerus & Walley, 2016). Since that time, due to the first wide scale public inquiry into pornography by the US commission in 1970, there has been a long-standing debate about the harmful effects of pornography (Seto, Maric, & Barbaree, 2001). Several studies have since attempted to determine whether exposure to pornography (particularly violent or degrading pornography) has any harmful effect on physiology and behaviour (Allen, Emmers, Gebhardt & Giery, 1995; Prause, Steele, Staley, Sabatinelli & Hajcak, 2015; Prause, Steele, Staley & Sabatinelli, 2014; Roberts et al., 2015; Buzzel, Foss & Middleton, 2006; Hilton & Watts, 2011; Kuhn & Gallinat, 2014; Mancini, Reckdenwald & Beauregard, 2012; Seto, 2007; Steele, Staley, Fong & Prause, 2013; Vega & Malamuth, 2007). Although some researchers such as Seto et al. (2001) believe that evidence for a causal link between pornography use and sexually aggressive behaviour is equivocal, there are some researchers such as Ferguson & Hartley (2009),
who report that due to many studies reporting an inverse relationship between pornography use and rape rates, the hypothesis that pornography contributes to increased sexual assault behaviour is to be discarded. There are, however, alternative views in this area. A more recent study performed by Mancini et al. (2012) investigated the effect of pornography use by incarcerated offenders during adolescence, adulthood, and immediately prior to their offence based on the level of physical injury as well as the extent of humiliation experienced by their victims. The researchers’ sample consisted of 616 incarcerated offenders previously convicted of a sex crime who were subjected to a semi-structured interview and the Computerised Questionnaire for Sexual Aggression. Their findings indicated that adolescent exposure to pornographic material was a significant predictor of the elevation of violence as it increased the extent of victim humiliation. They also suggested a tempering, or cathartic effect of pornography whereby using pornography just prior to the offence was correlated with reduced victim physical injury. It is believed that this “cathartic” effect may somehow account for the inverse relationship noted in the studies investigated by Ferguson & Hartley (2009). Furthermore, a meta-analysis of 24 studies was conducted by Allen et al. (1995) where they showed that studies which relied solely on participant questionnaire responses showed almost no relationship between use and exposure to sexually explicit material and their positive attitudes towards rape myths. Their review however, showed that experimental studies (i.e. studies which do not solely rely on self-report data) were shown to have a positive (albeit small) effect. What they in essence demonstrated was that there is a correlation between pornography exposure regardless of depictions of violence and an increased acceptance of rape myths. It also further illustrates the need for more stringent measures and/or methods to identify possible risks and consequences associated with the abuse of this material.
2.4.1 Brain imaging studies on sexual behaviour

There are few objective brain imaging studies tackling problematic sexual behaviour. The current framework presents indications that the brain’s reward pathways are stimulated with sexually stimulating activities. Nestler (2005), as cited in Hilton and Watts (2011), described addiction as having dysfunction in the mesolimbic reward centres in the brain. He went on to state that these dopaminergic systems which signal the pleasure/reward pathways can be hijacked by exogenous drugs or endogenous processes key to our survival such as food and sex. It is therefore, possible to assume that, like with drug use, the brain reduces in sensitivity to these chemicals over time and habituates with continued exposure whereby more frequent, novel and/or higher intensity pleasure seeking activities (i.e. increased frequency of masturbation and/or increased valence of pornography viewed) may need to be performed to achieve the same effect (Park et al., 2016). In order to illustrate similar effects, Pannacciulli, Del Parigi, Chen, Le, Reiman & Tataranni, (2006) looked at obesity to see whether similar patterns of brain abnormalities occur with more natural, evolutionarily important behaviours to those that have been established by studies done on drug addiction such as cocaine (Franklin et al., 2002) and methamphetamine (Thompson et al., 2004). Thompson suggested that these drug studies showed that there was measurable volume loss in several brain areas, namely the ventromedial, orbitofrontal cortex, anterior cingulate, anteroventral insula and superior temporal cortices. The obesity study somewhat surprisingly found that several brain structures which were different to controls were the same as those involved in behavioural control and reward, i.e. it showed volume loss in the frontal lobes of the brain and other areas involved with judgment and control (structures affected were similar to those seen in methamphetamine and cocaine users and consequently, aggressive individuals). This finding is very important as it shows the visible modification to the brain involved in a
natural, endogenous addiction and how similar it is to an exogenous drug addiction. Research performed by Kringelbach, Stein and van Hartevelt (2012) and Georgiadis and Kringelback (2012) showed that the dynamics of the eating response which includes the wanting, liking and satiety are very much similar to those involved in the sexual response. This allows us to ask a very important question: If we can see brain changes specific to one addictive endogenous and seemingly natural survival activity (eating) which can lead to overeating and thus obesity, can we see similar effects in individuals who indulge in excessive sexual behaviour - another natural survival activity?

The above studies highlight the requirement for more objective measures to be utilised in the field of pornography/sex research. As the merits of the use of physiological measures has been highlighted, it is suggested they be used in conjunction with traditional self-report in studies pertaining to pornography/sex to determine a more holistic and accurate representation of emotional affect.

2.5 What is aggression and how does it pertain to violence?

Aggression is an observable behaviour which can range from relatively trivial acts (e.g. pushing, gesturing), to more serious acts (e.g. physical assault, murder; Allen & Anderson, in press). Although various definitions exist, several prominent researchers in this field have postulated similar definitions (Anderson & Bushman, 2002; Baron & Richardson, 1994; Krahe, 2013). Baron and Richardson (1994, p. 7) for example, stated that the term aggression could describe “any form of behaviour directed toward the goal of harming or injuring another living being who is motivated to avoid such treatment”. Violence, on the other hand, is considered by social psychologists to be a subset of aggression (Allen & Anderson, in press). Krahe, (2013, p. 12) stated that violence is more
narrow a construct and is “restricted to behaviours carried out with the intention of causing serious harm that involve the use or threat of physical force”. Using this definition, examples of violence may be physically striking someone or, in extreme cases, taking a life. Krahe goes on to state that as a result of this, “not all instances of aggression involve violence, but all acts of violence qualify as aggression” (p. 12).

2.5.1 Types of aggression

It is important to note that there are many aspects of aggression. The majority of these fall into two broad categories: premeditative and impulsive. Stanford, Greve and Gerstle, (1997) suggest that an apparent issue in the field of aggression research is that most studies on aggressive behaviour tend to treat aggression as a homogeneous construct which does not discriminate between premeditated and impulsive aggressive individuals. According to Gerstle, Mathias and Stanford (1998), most individuals in studies of violence and aggression have already been incarcerated or are referred neuropsychiatric patients and, as a result, these studies ignore the large number of individuals in the general population who commit acts of violence which may be nontrivial in a societal context, but have not as yet come into contact with the criminal justice or mental health systems. The aforementioned authors suggest that as a result of these sampling problems, the usefulness of the results as a means to develop interventions and treatments to reduce specific forms of violence is not given. In order to counteract this bias, Stanford et al. (1997) examined neuropsychological correlates of impulsive aggression/violence deliberately using a sample population considered to be functioning “normally” by societal standards. They showed that these impulsive aggressive subjects performed similarly to impulsive aggressive incarcerated criminals with regard to executive function, verbal strategic processing and executive control.
The present thesis, although aware of the multimodal nature of aggression, proceeded to determine self-reported aggression as a singular construct and did not differentiate groups based on impulsivity. The Barratt Impulsiveness Scale (BIS-11; Patton & Stanford, 1995) was employed to determine whether those who self-reported as having more aggressive tendencies were also more likely to self-report being impulsive.

2.5.2 Brain imaging studies on aggressive behaviour

Aggression as a behavioural characteristic often presents in extreme cases as a component of clinical disorders associated with abnormal brain functioning (Siegel & Victoroff, 2009). Many studies investigating violent and/or aggressive individuals tend to focus on incarcerated individuals or neuropsychiatric patients referred by doctors. As mentioned previously, Gerstle et al. (1998) noted that it is for this reason studies generally do not tend to focus on individuals who behave “normally” in a societal context. This precludes investigations from taking place on any individual who may undertake violent or aggressive acts which may be considered consequential but has eluded the criminal justice or mental health systems.

The limbic system is an important brain region which allows the modulation of violence and aggression. This area typically consists of the hippocampus, amygdala, septum, nucleus accumbens, ventral striatum, and the pre-frontal and anterior cortices (Siegel & Victoroff, 2009). Common techniques used to study brain processing and brain activity in the above-mentioned areas include functional imaging techniques such as positron emission tomography (PET), functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). Most studies investigating aggressive individuals have utilised PET and have shown that when compared with normal controls, aggressive individuals typically present with abnormalities in the prefrontal areas of the brain.
More specifically, Raine, Meloy, Bihrlle, Stoddard, Lacasse and Buchsbaum, (1998) found after dividing a group of convicted murderers based on the degree of impulsivity and proactivity (acquired via self-report data) that prefrontal dysfunction was specific only to the impulsive group. Raine, Buchsbaum and Lacasse (1997) found that specific areas of the limbic system of murderers, namely the amygdala and hippocampus, contained an asymmetry whereby the left areas had reduced activation compared with the right. Coccaro, McCloskey, Fitzgerald and Phan (2007) showed that subjects with Intermittent Explosive Disorder (IED) – a disorder which is categorised by impulsive aggressive behaviour, showed higher amygdala activity and lower orbitofrontal cortex (OFC) activation to faces depicting anger when compared to controls. Similar findings were reported by other authors e.g. Gansler et al. (2011), who showed that the orbitofrontal cortex was associated with motor impulsivity and aggression after scanning the brains of psychiatric inpatients who had self-reported high impulsivity.

These studies confirm that there are distinguishable neural features which are observable in individuals with high aggressive tendencies and therefore, leads to the requirement to incorporate objective recording measures in the future study of aggressive behaviour. Further to this, the use of objective-based methods may also be utilised to determine non-conscious affects in other sects of behaviours. Of specific focus in the present thesis is the way in which aggressive individuals and people who view pornography process emotional content.
2.6 Establishing the use of Electroencephalography (EEG)

Electroencephalography (EEG), unlike fMRI and PET, excels in its temporal resolution allowing for real-time changes in cortical brain activity to be captured and therefore, provides a unique perspective on emotion research in the two groups focused as it is sensitive to a combination of conscious and non-conscious brain processing levels. More specifically, event-related potentials (ERPs) obtained via EEG has been used widely in emotion research to determine neural correlates of emotion behaviour and appraisal (Cuthbert, Schupp, Bradley, Birbaumer & Lang, 2000; Harmon-Jones, Gable & Peterson, 2010; Moser, Hajcak, Bukay & Simons, 2006; Rozenkrants, Olofsson & Polich, 2008; Van Dongen, Van Strien & Dijkstra, 2016). Utilising ERPs in research has been shown to provide non-conscious biomarkers which have been shown to vary from responses obtained via conscious means. An example of this is via a two-part study performed by Rugg, Mark, Walla and Schloersheidt, (1998) who assessed the neural correlates of memory. In the first part of the study, participants were asked to view single words in two different contextual situations. They were asked to determine if the first and last letters were in alphabetical order (shallow context) and they were asked to use the word in a sentence (deep context). Participants were then shown these words again, however they were intermixed with additional words they had not seen previously. They were asked to identify whether or not each of the presented words were new or seen previously. Results from the ERPs showed that across frontal electrode sites, ERP amplitudes were more positive going for correctly recognised words than for old words or for new words identified as old words. In addition, old words produced more positive going waveforms than new words in parietal areas regardless of how accurate their recognition of the words were consciously. In summary of this study, Rugg suggested that the evidence provided the idea of a neural correlate of memory independent of
conscious recognition. Studies such as this support the idea that EEG is a measure which may be sensitive to non-conscious behavioural output.

2.6.1 Disadvantages associated with EEG

Although the study by Rugg et al., (1998) provides useful insight into the use of EEG as a measure of non-conscious brain processing which translated to a behavioural output, it is important to note that what is actually being measured is difficult to determine and not yet widely understood in the extant literature. As electrical activity in the brain (which is what EEG is sensitive to) is measured at the cortex during EEG testing, it is subject to various atomic, spatial and microbiological interactions before passing through fluid layers and the scalp which may have distorted or modified the initial signal. This problem is also limited by technology (especially within a research context) which has to contend with only being able to pick up electrical signals at the cortex or risk being rather invasive. Additionally, due to the reasons mentioned previously, although EEG recordings suffer from poorer spatial resolution than other recording techniques (e.g. functional Magnetic Resonance Imaging (fMRI), Positron Emission Spectroscopy (PET)) they excel in temporal resolution (Patrick, 2008). This facet makes EEG an ideal tool to investigate non-conscious emotion processes as changes in brain electrical physiology can be recorded in real time.

2.6.2 EEG and hemispheric asymmetry

Many studies utilising EEG suggest that it can be used to determine hemispheric-specific associations and asymmetry. Early research suggested that the difference between the cortical activities of both hemispheres of the brain was specific to affective quality (Silberman & Weingartner, 1986). That is, it suggested that positive affect is mediated by the left hemisphere and negative affect the right. Recent studies however,
have suggested that hemispheric neural asymmetry is a predictor of the motivational
direction regardless of the affective valence (Keune, van der Heiden, Varkuti, Konicar &
Veit, 2012). This ‘approach-withdrawal model’ states that strong anterior cortical activity
in the left hemisphere is a predictor of approach-related behaviour and the right anterior
hemispheric activity is associated with withdrawal behaviours (Davidson, 2004). This
effect was further alluded to in studies by Gable and Harmon-Jones, (2008) and Harmon-
Jones and Gable, (2009). The authors utilised self-report measures to assess the degree of
‘liking’ of dessert and the time since they had last eaten. Using this, the authors assessed
the individual’s emotion and motivation and presented them with images of neutral
images and images of desserts. They showed that irrespective of the image in isolation,
individuals who have stronger emotive tendencies (as measured by the time since they
had last eaten) towards a desirable image showed greater left frontal activity. A study by
Schon, Schomberg, Gruber and Quirin, (2016) showed increased frontal asymmetry by
way of increase left relative to right hemispheric activation when exposing individuals to
erotic images compared with clothed attractive women. This effect was suggested to be
not due strictly to the increased approach motivation elicited by the erotic images but,
rather by the fact that the erotic images themselves are a motivational object. As a result,
the authors stated that the approach motivation elicited by sexual arousal in experimental
conditions (by way of exposing individuals to erotic images) may be distinct to the
approach motivation elicited by presenting images of, for example, food and that they
may emerge via different neural mechanisms.

Studies in EEG brain wave asymmetry among violent and aggressive individuals
have consistently shown an increase in slow wave activity primarily in the frontal and
temporal regions of the brain (Volavka, 1990). Keune (2012) empirically demonstrated
this by showing that aggression (which is a more approach-related behaviour) was
associated with stronger right-frontal alpha activity in violent individuals compared with observations made in the general population. Harmon-Jones & Allen, (1998) also demonstrated increased neural activation in the left frontal areas of individuals with high self-reported anger and hostility. As alpha power is inversely related to cortical brain activity, it may be safe to suggest that increased right frontal alpha activity (therefore increased left activation) may be a correlate of trait aggression. A theoretical interpretation of why violent and aggressive behaviour may be correlated with increased slow wave activity may be a result of cortical immaturity which may result in reduced inhibitory control (Volavka, 1990), and cortical under-arousal which is why sensation seeking behaviours are pursued (Raine, Venables, & Williams, 1990). One example where the inability to determine what is exactly being measured via EEG is particularly noteworthy is knowledge of the P300 component of the ERP. The P300 component as it is named, occurs approximately 300ms post stimulus onset. What is known is that it is usually elicited during cognitive processing and evaluation of a stimulus. It has also been shown to be modulated by attention (Coull, 1998), perceptual processing and stimulus relevance (Donchin & Coles, 1988). Despite Coull describing the P300 as the most researched component of the ERP waveform, the complete P300 signature is not fully understood (Rutiku, Martin, Bachman & Aru, 2015).

2.6.3 Aggression and the P300 component

Research into violent and aggressive individuals typically identify the modulation of the P300 component as a marker for aggression. Lower amplitude P300 has been suggested to reflect less efficient cognitive functioning (Hillyard & Kutas, 1983). Working memory is typically also reduced and such higher order functioning is often categorised with diminished P300 amplitude in impulsive aggressive individuals when
presented with an oddball task (Patrick, 2008; Harmon-Jones, Barratt & Wigg, 1997; Bond & Surguy, 2000). The diminished P300 component has also been shown to be a marker specific to impulsive aggressive individuals rather than premeditated aggressors (Bond & Surguy, 2000, Patrick, 2008). Regarding exposure to violent material, Bartholow, Bushman and Sestir, (2006) showed that individuals who played violent video games on a regular basis also elicited a reduced P300 when passively viewing violent images when compared to non-violent video game players. Another study by Engelhardt, Bartholow, Kerr and Bushman, (2011) showed that the P300 component could be reduced after one session of playing a violent video game – leading to the suggestion that an attenuated P300 may be a reliable marker for physiological desensitisation to violence.

2.6.4 The P300 and its modulation based on pornography viewing behaviour

With regards to the P300 effect on individuals who view pornographic material, the literature suggests a numbing effect due to increased pornography exposure. Steele et al, (2013) showed large P300 differences in individuals between viewing neutral images and sexually explicit images and that the P300 amplitude was negatively related to measures of sexual desire. They suggested that this negative finding was most likely due to the individuals studied already reported viewing high volumes of pornographic material to which the sexually explicit material had no novel significance, which thus, suppressed the P300 component. They went on to suggest that with regards to studies of pornographic behaviour, the later occurring late positive potential (LPP) may provide a more useful tool due to it being able to index motivational processes.

2.6.5 The Late Positive Potential (LPP)

The LPP is a slow positive deflection of the ERP and has historically been investigated to provide further insight into processes pertaining to emotion and emotion
regulation (Moran, Jendrusina & Moser, 2013). The LPP is reflected by a sustained positivity in the ERP curve beginning at approximately 300ms and continuing to 800ms post-stimulus onset however, such effects have been noted as late as 5000ms post-stimulus presentation. An enhanced LPP amplitude is said to index sustained processing of emotionally relevant stimuli and has been said to be a marker of motivational significance (Voon et al., 2014; Cacioppo, Crites, Gardner & Berntson, 1994; Cuthbert et al., 2000; Schupp, Cuthbert, Bradley, Cacioppo, Ito & Lang, 2000).

Studies have typically investigated the LPP in posterior parietal sites as this has been shown to be where the amplitude of the LPP is more pronounced (Cunningham, Espinet, DeYoung & Zelazo, 2005). In studies investigating frontal LPP, results, much like the previously mentioned hemispheric approach, withdrawal model, show relative greater left activation as indexed by larger amplitude LPPs to images inducing approach motivation. Gable and Harmon-Jones, (2010) presented individuals with images designed to elicit high and low approach motivation by utilising images of desserts and neutral rocks respectively. They observed larger LPP amplitudes to dessert images in the left hemisphere frontal-lateral sites relative to the right frontal-lateral sites. For further information and a recent review of EEG frontal asymmetry, see Harmon-Jones and Gable (2018). Similar effects have been noted in studies presenting visual cues of alcohol to people who report liking alcohol (Gable, Mechin, & Neal, 2016) and cocaine to users of cocaine (van de Laar, Licht, Franken, & Hendriks, 2004) whereby larger slow wave activity were noted in the frontal left but not right hemisphere regions.

2.6.6 The LPP and its modulatory effect on pornography viewership

Within the context of the current thesis, the LPP has been studied with regards to problematic pornography viewing behaviour. Although the extant literature pertaining to
pornography use and LPP amplitudes is scarce and still in its infancy, Prause et al. (2015) reported that individuals who had problems policing their pornography use had a higher desire for sex coupled with lower LPP amplitudes when presented with sexually explicit images. Prause suggested that this was unexpected due to addiction-related studies showing an enhanced LPP curve when individuals were presented with images of their specific addiction-inducing substance (Minnix et al., 2013). Kuhn and Gallinat (2014) along with Prause offered a suggestion as to why this may be the case by suggesting that this observation may be an example of physiological downregulation in the processing of appetitive content due to habituation effects.

2.7 Establishing the use of Startle Reflex Modulation (SRM)

To further increase the likelihood of measuring different emotion impacts between implicit and explicit measures of emotion, we head to deeper, more sub-cortical effects of emotion processing and utilise startle reflex modulation (SRM). Startle reflex modulation is a technique by which a short, unexpected burst of white noise, in the order of 100-110dB, is played binaurally into the ears of an individual whilst exposed to a controlled foreground stimulus containing affective content (Lang, Bradley & Cuthbert, 1990). The purpose of eliciting the startle response is to determine raw affective information processing which is generated in subcortical brain regions (Mavratzakis, Molloy & Walla, 2013).

SRM has been shown to be a good predictor of non-conscious emotional states (Lyons, Walla, & Arthur-Kelly, 2012), and provides an empirical index of the degree of pleasure or displeasure experienced by an individual at a non-conscious level. It has been successfully utilised to demonstrate that the same set of stimuli can produce different
explicit (conscious) and implicit (non-conscious) responses (Patrick, Bradley & Lang, 1993; Grahl, Greiner & Walla, 2012). Studies employing SRM have consistently found that the reflexive eyeblink to a startle probe reduces in strength, or magnitude, when viewing pleasant pictures, and increases when viewing unpleasant pictures (Bradley, Cuthbert, & Lang, 1991; Cuthbert, Bradley, & Lang, 1990).

There have been limited studies performed which show experimental evidence suggesting variations in results between objective and subjective measurements with regards to SRM data. For instance, Patrick et al. (1993) utilised SRM to measure emotion responding among psychopaths compared with normal college aged students as a control group. Their clinical cohort consisted of groups made up of incarcerated sexual offenders who were divided up between non-psychopathic, psychopathic and mixed groups as determined by file and interview data. The college students and non-psychopaths showed a linear relationship between slide valence and startle magnitude with amplitudes highest for unpleasant slides and lowest for pleasant slides. The psychopaths however, did not show this effect. Furthermore, this observed effect had no bearing on self-report data collected. The authors concluded by stating that SRM was able to distinguish between emotional processing by psychopaths which was independent of affective self-report. Another study performed by Grahl et al. (2012) utilised SRM to determine emotion related aspects of bottle shapes. They presented male and female participants three bottles which differed only in shape. Self-report data was also collected to determine conscious appraisal. What they found was males responded with a larger eye blink to one of the bottles when compared to female participants. The authors indicated that due to the nature of the startle reflex that the males associated that particular bottle with a negative emotional state. What was interesting however, was that both males and females rated that bottle similarly with regards to their conscious responses.
2.7.1 SRM effects based on aggressive behaviours

A search on the extant literature revealed no studies investigating SRM in aggressive individuals within non-clinical populations. In all cases where the startle reflex was monitored, the aggression and/or violence was usually symptomatic of some other disorder. There have been several studies which have utilised SRM to study clinical groups which may present with aggression and/or violence in their symptomology, primarily: schizophrenia (Dawson, Hazlett, Filion, Nuechterlein & Schell, 1993; Kumari et al., 2005), criminal psychopathy (Vaidyanathan, Hall, Patrick & Bernat, 2011; Patrick et al., 1993), borderline personality disorder (Hazlett et al., 2007) and antisocial personality disorder (Kumari et al., 2005; Miranda, Meyerson, Meyers & Lovallo, 2003; Vaidyanathan et al., 2011) among others. The study by Patrick used SRM to determine the emotional responding of criminal psychopaths relative to a mixed control group in the normal population not diagnosed with psychopathy and a non-psychopathy group. They found that the psychopathy group did not show the clear linear relationship between slide valences and startle amplitude which was seen in the non-psychopathic and mixed subject controls. They suggested the psychopathy group had abnormalities in the processing emotional stimuli on a sub-cortical brain level.

2.7.2 SRM effects on pornography viewership

The only known study on pornographic viewing behaviour and its correspondence to SRM revealed minor differences with a trend towards statistical significance in relation to the processing of affective content based on frequency of pornography use (Kunaharan, Halpin, Sitharthan, Bosshard & Walla, 2017). The authors suggested that a trend was evident showing the discrepancy between frequent and non-frequent users of pornography and that this effect should be further investigated with larger cohorts.
As the present study aims to decipher possible physiological desensitization effects, as well as dishonesty and unintentional self-misperception, this method offers a unique insight into unconscious emotional reactions and valence that questionnaires (or any other explicit measure) cannot provide. In addition, the use of SRM is potentially groundbreaking and may further our knowledge of the use of this particular methodology within the specific samples used in the present project.

2.8 Key definitions used throughout this thesis

In the current thesis, we aim to use the terms *affect* and *affective processing* to describe sensory input and neural activity which pertain to information processing deep in subcortical areas of the brain. The term *emotion*, within the current scope of this thesis, though being less specific will follow the Walla and Panksepp (2013) model and relate to the resultant of physiological activity of both brain and body. According to Reisenzein (2007) it was not possible to correctly define emotions prior to empirical research due to the means of understanding the nature or essential features of emotion being central to the question. Taking this into account, the current body of work attempts to utilise physiological underpinnings in conjunction with conscious appraisal to determine a more complete picture of emotional affect.

The terms *conscious* and *non-conscious* with regards to emotional affect are also used throughout this thesis and will be used synonymously with the terms *explicit* and *implicit* respectively to denote aspects of emotion which are above (conscious/explicit) and below (non-conscious/implicit) awareness. More specifically, the terms explicit will largely refer to specific behavioural actions pertaining to emotional appraisal and implicit will refer to unintentional processes.
The identification and definition of pornography is many and varied often depending on subjective judgments. To avoid confusion, several researchers in the field have resorted to categorizing pornographic material as Visual Sexual Stimuli (VSS) in their research papers (Prause et al., 2014, 2015; Steele et al, 2013). It is known that several genres of pornography exist as well as various ways in which to access pornography (internet, magazines etc.), and although information was collected in our participant pool with regards to the type of pornography they view and their method of access, for the purpose of the manuscripts presented in the current thesis (i.e. frequency of pornography use), we did not aim to delineate between the genres or the particular methods of access. What we were most interested in was the frequency with which pornographic material was viewed regardless of the intensity or the methods of acquisition. Due to the lack of an existing operational definition of pornography, the following thesis adheres to loosely define pornography or pornographic material in accordance with the Oxford Dictionary (2017) as any “printed or visual material containing the explicit description or display of sexual organs or activity, intended to stimulate sexual excitement”.

The terms violence and aggression are also used in this thesis largely to refer to a range of behaviours or actions which may result in injury or harm to another person. Allen and Anderson (in press) in the Wiley Handbook of Aggression and Violence, suggest that the words “aggression” and “violent” are often used in ways that don’t adhere to the scientific social psychological definition. They use the examples of suggesting that an enthusiastic salesperson may be referred to as “aggressive” or that a sudden change in mood can be described as “violent”. Due to the vagaries of these terms, they are often used synonymously. The manuscripts in this thesis will utilize the term aggression in accordance to Anderson and Bushman, (2002) who stated that human aggression may refer to “any behaviour directed toward another individual that is carried out with the
proximate (immediate) intent to cause harm. In addition, the perpetrator must believe that the behaviour will harm the target, and that the target is motivated to avoid the behaviour” (p. 28). More specifically, the following thesis utilises a questionnaire (Buss-Durkee Hostility Inventory (BDHI); Buss & Durkee, 1957) to determine the potential for aggression in our participant cohort. Violence, on the other hand, is considered by social psychologists to be a subset of aggression (Allen & Anderson, in press). It is suggested that the differentiation lies in the fact that violence can be defined as the most extreme form of aggression which has severe physical harm as its primary objective (Anderson & Bushman, 2002). In the following thesis, violence will largely be used denote visual representations of the acts of aggression. Put simply, the term violence will generally refer to the acts and consequences of aggression portrayed in visual material presented as part of the experimental procedure.

2.9 Aims and hypotheses

Emotions and associated behaviours have both a non-conscious and a conscious component, so the reliance on subjective criteria (in this case, interviews and self-report questionnaire measures) may not provide adequate insight into the individual’s complete emotional experience. Questionnaires can provide useful information pertaining to emotion. However, there are shortcomings with the exclusive use of questionnaires for research and diagnosis, as conclusions about emotional affect have to be concluded via subjective criteria. Individuals may not always be fully aware of what effect their non-conscious thoughts, feelings and attitudes have on their conscious experience, from which important information may not be captured in a self-report format. For these reasons, and
those mentioned previously, there exists a requirement for complementary approaches to studying aspects of emotion which may be below conscious awareness.

The aim of this project was to generate the awareness of discrepancies between self-reported and objectively measured emotion in groups with aggressive tendencies as well as people who frequently view pornographic material. The project was thus divided to test two broad hypotheses:

Hypothesis 1: Individuals with high self-reported aggressive tendencies and pornography usage demonstrate larger discrepancies between explicitly reported emotion and implicitly measured emotion than people with low such tendencies.

Hypothesis 2: Multiple exposures to violent and pornographic material to low self-reported pornography users will differently modulate physiological measures whilst maintaining similar self-reported emotion.

It was hypothesised that for the high aggressive individuals and high pornography users, startle reflex will be inhibited for images portraying violence and erotica respectively. Similarly, it was believed that the converse be true for those in the low aggressive and low porn usage groups. Minimal incongruences were expected for ‘Neutral’ images.

Explicit measures of emotion were taken in the frame of active rating performance (conscious decisions and following button presses) and it was hypothesised that no statistically meaningful differences will be noted. As the EEG has been shown to be sensitive to the neural activity underlying aggressive behaviour and has been recently utilised in studies involving pornography use, it was the method of choice regarding the monitoring of brain activity.
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Chapter 3

CONSCIOUS AND NON-CONSCIOUS MEASURES OF EMOTION: DO THEY VARY WITH FREQUENCY OF PORNOGRAPHY USE?

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Abstract

Increased pornography use has been a feature of contemporary human society, with technological advances allowing for high speed internet and relative ease of access via a multitude of wireless devices. Does increased pornography exposure alter general emotion processing? Research in the area of pornography use is heavily reliant on conscious self-report measures. However, increasing knowledge indicates that attitudes and emotions are extensively processed on a non-conscious level prior to conscious appraisal. Hence, this exploratory study aimed to investigate whether frequency of pornography use has an impact on non-conscious and/or conscious emotion processes. Participants \((N = 52)\) who reported viewing various amounts of pornography were presented with emotion inducing images. Brain Event-Related Potentials (ERPs) were recorded and Startle Reflex Modulation (SRM) was applied to determine non-conscious emotion processes. Explicit valence and arousal ratings for each image presented were also taken to determine conscious emotion effects. Conscious explicit ratings revealed significant differences with respect to ‘Erotic’ and ‘Pleasant’ valence (pleasantness) ratings depending on pornography use. SRM showed effects approaching significance and ERPs showed changes in frontal and parietal regions of the brain in relation to ‘Unpleasant’ and ‘Violent’ emotion picture categories, which did not correlate with differences seen in the explicit ratings. Findings suggest that increased pornography use appears to have an influence on the brain’s non-conscious responses to emotion-inducing stimuli which was not shown by explicit self-report.
3.1 Introduction

3.1.1. Ease of access

There is an ever-increasing amount of pornographic material available online for public consumption (Harkness, Mullan and Blaszczynski, 2014; Fisher and Barak, 2001). Lack of regulation means that the Internet has quickly become an easy and efficient means by which pornographic material can be circulated, distributed, and available for consumption within one’s own home, with the benefits of accessibility, anonymity, and affordability (Kuhn and Gallinat, 2014; Cooper 1998). Additionally, technological advances such as smart phones, Wi-Fi, and high speed internet services mean that the older problem of having to be tethered to a desk and cable no longer limits one’s ability to access a rich variety of pornographic material. Unsurprisingly, problems pertaining to viewing sexual stimuli have become the most common high frequency sexual problem in recent times (Reid et al 2012).

3.1.2. Pornography use and its behavioural effects

Several studies have explored the notion of whether exposure to pornography has any effect, be it positive or negative, on individual cognitive and behavioural processes (Allen, Emmers, Gebhardt & Giery, 1995; Praise, Steele, Staley, Sabatinelli & Hajcak, 2015; Praise, Steele, Staley & Sabatinelli, 2014; Roberts et al, 2015; Buzzel, Foss & Middleton, 2006; Hilton & Watts, 2011; Kuhn & Gallinat, 2014; Mancini, Reckdenwald & Beauregard, 2012; Seto, 2007; Steele, Staley, Fong & Prause, 2013; Vega & Malamuth, 2007). Many of these papers have attempted to address these societal concerns, by examining the issue of whether increased exposure to pornographic material leads to sexually aggressive behaviour. Meta analyses of this work have shown that increased frequency of pornography consumption can predict negative outcome measures in
humans (Wright, Tokunga & Kraus, 2015; Paolucci, Genuis & Violato, 1997) — even showing that physical abusers and sexual predators generally use pornography at a significantly higher rate than the average individual (Johnson, 2015). A meta-analysis performed by Allen et al. (1995) demonstrated that non-experimental methods of analysis showed almost no effect of pornography exposure and acceptance of rape myths, whereas experimental studies (not solely relying on self-report) showed a small but positive effect (exposure to pornography increases rape myth acceptance). Other meta-analyses have found a significant positive association between pornography use and attitudes supporting violence against women in both experimental and nonexperimental studies (Hald, Malamuth & Yuen, 2010). These correlations were higher if perpetrators were exposed to sexually violent pornography over non-violent forms. Mancini et al. (2012) performed an investigation of sexual offenders and found that adolescent exposure to pornography significantly predicted the elevation of violence by way of degree of victim humiliation. The authors also found that pornography use just prior to the offence resulted in reduced victim injury which they attributed to a cathartic effect the pornography had on the offender. There are other researchers who seem to agree that viewing of pornographic material has little if no negative effect on cognition and behaviour. Ferguson and Hartley (2009), in their review, suggest that evidence for a causal relationship between pornography exposure and sexual aggression is minimal and any positive correlation between pornography consumption and violent behaviour is inconsistent at best. They suggest the hypothesis that increased pornography exposure leads to increased sexual assault behaviour needs to be discarded. Often, the problem is simply a lack of differentiation between correlation and causation.

Several other studies rather than looking at the possible correlations between violence and pornography have instead started focussing on emotionally, socially, and
sexually detrimental effects related to excessive pornography consumption. Potential and reported effects among others include: increased anxiety (Szymanski & Stewart-Richardson, 2014), depressive symptoms (Conner, 2014) and the inability to initiate and maintain an erection with real sexual partners without the aid of pornography (see review by Park, 2016), which, in turn, could lead to depression and anxiety-related disorders.

It is often remiss that correlation of certain behaviours and their ill effects may be a cause for concern which may result in termination of that particular behaviour, however, it does not necessarily indicate causation. Although it is understandable that increased viewing of pornography (as with many other pleasure-seeking behaviours) may be undertaken by many, it is a small number of individuals who present with adverse effects and therefore it cannot be assumed that correlation of these ill-effects with pornography viewership means causation.

3.1.3. Physiological effects of pornography use

Event-related potentials (ERPs) have often been used as a physiological measure of reactions to emotional cues, (e.g. Prause et al, 2015). Studies utilizing ERP data tend to focus on later ERP effects such as the P300 (Steele et al, 2013) and Late-Positive Potential (LPP; Prause et al, 2014, 2015) when investigating individuals who view pornography. These later aspects of the ERP waveform have been attributed to cognitive processes such as attention and working memory (P300) (Linden, 2005) as well as sustained processing of emotionally-relevant stimuli (LPP; Voon et al, 2014). Steele et al. (2013) showed that the large P300 differences seen between viewing of sexually explicit images relative to neutral images was negatively related to measures of sexual desire, and had no effect on participants’ hypersexuality. The authors suggested that this negative finding was most probably due to the images shown not having any novel significance to the participant pool, as participants all reported viewing high volumes of pornographic material,
consequently leading to the suppression of the P300 component. The authors went on to suggest that perhaps looking at the later occurring LPP may provide a more useful tool, as it has been shown to index motivation processes. Studies investigating the effect pornography use has on the LPP have shown the LPP amplitude to be generally smaller in participants who report having higher sexual desire and problems regulating their viewing of pornographic material (Prause et al, 2015). This result is unexpected, as numerous other addiction-related studies have shown that when presented with a cue-related emotion task, individuals who report having problems negotiating their addictions commonly exhibit larger LPP waveforms when presented images of their specific addiction-inducing substance (Minnix et al, 2013). Prause et al. (2015) offer suggestions as to why the use of pornography may result in smaller LPP effects by suggesting that it may be due to a habituation effect, as those participants in the study reporting overuse of pornographic material scored significantly higher in the amount of hours spent viewing pornographic material.

In contrast to ERPs, startle reflex modulation (SRM) is a relatively new technique in this field which has also been used in emotion research to provide information pertaining to raw affective information processing, (e.g. Mavratzakis, Molloy & Walla, 2013). The purpose of SRM is to measure the magnitude of eye blinks elicited with an unexpected burst of loud auditory white noise while the startled person is exposed to controlled foreground stimulation with varying affective content (Lang, Bradley & Cuthbert, 1990). Lang showed that the level of eye blink magnitude recorded by the unexpected auditory stimulus correlated with the relative appetitive (resulting in smaller eye blinks) or aversive (larger eye blinks) affective content of the visually presented stimuli. That is, eye blinks associated with the startle probe are enhanced when a person is presented with unpleasant or fearful stimuli and diminished when presented with pleasant stimuli.
Numerous studies have introduced startle reflex modulation as a measure of raw affective processing in relation to varying contexts, including psychopathy (Patrick, Bradley & Lang, 1993), multiple disabilities (Lyons, Walla & Arthur-Kelly, 2013), odours (Ehrlichman, Brown Kuhl, Zhu a& Wrrenburg, 1997), schizophrenia (Dawson et al 1993), product design (Grahl, Greiner & Walla, 2012), walking through urban neighbourhoods (Geiser and Walla, 2011) and emotion ownership (Walla, Rosser, Scharfenberger, Duregger & Bosshard, 2013). SRM has also been introduced to consumer neuroscience (e.g. Koller & Walla, 2012; Walla, Koller & Meier, 2014; Walla & Koller, 2015; Koller & Walla, 2015). However, the use of this recording measure in the processing of sexual information has been scarce (Koukounas and Over, 2000). However, the use of this recording measure in the processing of sexual information has been scarce (Koukounas and Over, 2000). Studies which have been performed consistently show a reduced startle eye blink reflex to images portraying positive (sexual) scenarios relative to images showing unpleasant, neutral (Jansen and Frijda, 1994) and fearful (Ruiz-Padial and Vila, 2007) content. In 2014, SRM has been suggested to be used in exactly the context of the current study (Kunaharan and Walla, 2014).

The present study aims to use neurophysiological measures (EEG and SRM) to determine whether varying amounts of pornography consumption within the normal population has any effect on non-conscious emotional states as well as conscious self-report measures of emotion.

3.1.4. Self-report

Self-report questionnaires are arguably the most common means by which researchers and clinicians attempt to ascertain emotional attitudes and behaviours within users of pornographic material, often to the exclusion of other methodologies (Wiedelman and Whitley, 2012; Davidson, 2003). Although self-report questionnaires can be an
excellent way to collect large amounts of data over a wide population, they are susceptible to recall biases, social desirability biases (Wiedelmen & Whitley, 2012; Seto, 2007; Koukounas & McCabe, 2001), and cognitive pollution (Walla, Brenner & Koller, 2011). Emotion processing has been shown to have components relating to non-conscious, subcortical brain structures as well as conscious cortical structures. Thus, facets of emotion can exist without conscious awareness (Walla & Koller, 2015; Walla, 2011; Winkielman & Berridge, 2004; Tamietto & Gelder, 2010). The ability to give explicit answers to anything emotional requires a level of conscious cognitive processing which results in an evaluation. This cognitive evaluation, however, is the resultant of a combination of deep physiological processes which occur subcortically in the brain coupled with more conscious cortical brain processing. This has been shown to colour conscious interpretations of underlying physiological reactions, a phenomenon referred to as cognitive pollution (Walla et al., 2011). Therefore, it is possible that an overreliance on data acquired purely by self-report measures does not truly obtain an accurate representation of an individual’s thought processes. To account for this shortcoming, the authors in the current study decided to utilize physiological measures to ascertain non-conscious processes in addition to traditional measures (i.e., to follow a triangulation approach). Electroencephalography (EEG), which measures cortical brain activity and involves coordinated information from cortical and sub-cortical brain structures, was used. In addition, Electromyography (EMG) by way of Startle Reflex Modulation (SRM), which relates to sub-cortical brain functions and measures non-conscious raw affective information processing, was also utilised together with traditional self-report measures (questionnaires, rating scales) which requires a measured, higher-order cognitive response involving cortical information processing. These three methods were used to triangulate
any differences in participants’ non-conscious physiological states and conscious responses and to tap into the different levels of information processing of emotion.

3.2 Methods

3.2.1. Participants

Fifty-two male participants were recruited via Newcastle University’s experimental management system called SONA, word of mouth, or flyers. Participants were all students at the University of Newcastle, Australia aged between 18 and 30 years (M = 21.1; SD = 2.9). All participants provided written informed consent. As part of the inclusion criteria, participants recruited into the study explicitly stated that they were heterosexual, right-handed, had normal/corrected to normal vision, had no history of neuropathological/psychiatric illness, were free of central nervous system affecting medications or substances, had no history of being a victim of physical/sexual abuse, and had no history of being incarcerated in a penitentiary. Participants were either financially reimbursed for their time or awarded with course credit. Women were excluded to present a more homogeneous sample population for comparison purposes. Traditionally, males are more likely to seek out visual sexual material for recreational purposes and therefore that was where our focus was for the current study. The study was approved by the University of Newcastle Human Research Ethics Committee (H-2013-0309, 5 December 2013).
3.2.2. Measures

The initial part of this study involved the use of online questionnaires to assess conscious emotion responses from each participant. An online survey was created using Lime Survey (http://www.limesurvey.org), which included demographic questions, the Buss-Durkee Hostility Inventory (BDHI), Barratt Impulsivity Scale (BIS-11) to determine whether each of the formulated groups varied in their self-reported impulsivity scores; the Snyder Self-Monitoring Scale (Snyder, 1974) to determine the extent to which each group monitored their self-presentations; and a purpose-built questionnaire to gauge pornography viewing behaviour consisting of several items developed by the authors as well as incorporating items from Harkness et al. (2014). Only heterosexual participants aged between 18 and 30 years were eligible to complete the questionnaire and were subsequently invited to complete the physiological measures. The survey took approximately 20–25 min to complete.

Electroencephalography was measured using a 64 channel BioSemi Active Two system (BioSemi, Amsterdam, The Netherlands) and Startle Reflex Modulation (SRM) was administered by using a Nexus-10 mobile recording device (produced by Mind Media BV, Herten, The Netherlands). For a more detailed description of the respective procedure and technology, please refer to Walla et al. (2011).

3.2.3. Stimuli

Stimuli for the present study comprised of 150 images sourced from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2008). The IAPS is a standardised collection of around 1000 images which depicts people, places, objects, and events and is used widely in emotion research, e.g., (Van Dongen, Van Strien & Dijkstra, 2016). For the purposes of the current study, images were categorised into one of five
categories: Violent, Erotic, Pleasant, Unpleasant, and Neutral, with 30 images in each group. Each category of images differed from one another in their normative valence. Each image was shown to each participant for 5 s. Participants then rated each image on separate 9-point Likert scales for valence and arousal.

A total of five startle probes were associated to randomly chosen 5 out of 30 pictures per emotion category (total 25 startle probes during the experiment). Startle probes were presented binaurally at 110 dB and consisted of 50 ms long bursts of acoustic white noise.

3.2.4. Procedure

3.2.4.1. Lab experiment

Following completion of the online questionnaire, participants were individually invited into the lab. During this session, baseline measurements of EEG and SRM were collected whilst participants viewed and rated the IAPS images. The collection of explicit data involved participants rating each of the stimuli in terms of arousal and valence whilst simultaneously, EEG and SRM were used to assess implicit responses. Participants were seated comfortably in front of a 32” LED monitor (resolution 1024 × 768 pixels). Participants were connected to the BioSemi Active Two EEG system and brain potential changes were measured by using 64 cranial electrodes as well as eight additional electrodes placed lateral ocularly, supra ocularly, infra ocularly, and on the mastoids. Two 4 mm Biotrace electrodes were used in addition for Startle Reflex Modulation (with approximately 20 mm spacing on the inferior orbicularis oculi of the left eye).

The computer program, Presentation (Neurobehavioral Systems, Albany, NY, USA) was used to visually present the appropriate instructions and stimulus lists. The presentation of stimuli and all psychophysiological signal recording was conducted from a separate room. Participants were given a brief overview of the study during set up of
the equipment and were asked to read the instructions for the task at hand on the screen prior to recording. Headphones (Sennheiser HD280, Wedemark, Germany) were placed over the participant’s ears and testing commenced with the participant by themselves in a dimly lit room to ensure adequate focus on the stimuli.

3.2.4.2. Experimental task

Each IAPS image was presented on the screen for 5 s, one at a time. Following each image, participants were shown a rating scale and asked to rate the valence (pleasantness) of the image using a scale from 1 “very pleasant” to 9 “very unpleasant”. Following this initial rating, participants were shown another rating scale and asked to rate the arousal (intensity) of the image using a scale from 1 “very intense” to 9 “very calming”. Following this, a small white fixation cross appeared on black background for 1 s before the next image was presented. If a startle probe was coupled with an image, it occurred on the 4th second post-stimulus presentation. Physiological and explicit measures were taken for all 150 IAPS images. Images were presented in randomised order. A short break was offered to the participant at the halfway point to reduce effects of fatigue. Obviously, for SRM analysis only images that had a startle probe associated were further analysed as well as only those images’ related explicit responses.

3.2.5. Analysis

3.2.5.1. Questionnaire analysis and formation of groups

Participants were separated into groups based on their responses to two separate items on the Pornography Use Questionnaire. These items were: “When viewing pornography, how much time will you spend during one episode?” and, “In the last year, what is the frequency with which you have viewed pornography?” Answers to each item
were scored separately for each participant and multiplied to determine the approximate number of hours of pornography consumed per year. The authors were initially going to perform a median split on the cohort but after finding many participants scoring on or around the median score and the range of scores largely clustered into three observably separate groups, it was decided to divide the groups into “low”, “medium”, and “high” groups based on the spread of scores. Means and standard deviations of the number of hours each group viewed pornography can be seen in Section 3.2.

3.2.5.2. Explicit responses

Raw explicit responses (valence and arousal) from each participant were categorised into their respective groups (low, medium, or high) based on responses to the online questionnaires. Each group’s responses were then averaged and analysed using a Repeated Measures Analysis of Variance (ANOVA) using the within subjects factor of Emotion (Pleasant, Unpleasant, Erotic, Violent, and Neutral) and the between subjects factor of Pornography Use (low, medium, and high). ANOVAs were performed independently for “valence” and “arousal” measures.

In addition, a One-Way ANOVA was conducted to assess responses obtained via the Snyder Self-Monitoring Scale to determine if there was any relationship between hours of porn used and self-monitoring.

3.2.5.3. Event-related potentials (ERPs)

Brain potential changes were recorded at a rate of 2048 samples/s using a 64-channel BioSemi Active Two system and ActiView software (BioSemi, Amsterdam, The Netherlands). Data sets were batch processed using EEG-Display (version 6.4.8; Fulham, Newcastle, Australia). During processing the sampling rate was reduced to 256 samples/s and a band pass filter of 0.1 to 30 Hz was applied. ERP epochs were defined in relation
to the presentation of each IAPS image from −100 ms pre- to 1000 ms post-stimulus onset. All epochs were baseline corrected with the correction occurring 100 ms prior to stimulus onset and data points along the ERP were reduced to 15 data points along the first second post-stimulus presentation for further statistical analysis. A Repeated Measures ANOVA was used to analyse ERP amplitudes at each time point using the within-subject factors emotion (Pleasant, Unpleasant, Erotic, Violent, and Neutral) and hemisphere (left, right).

Upon visual inspection, it was observed that the main differences between each group were obviously occurring for the ERP curves of the ‘Violent’ and ‘Erotic’ condition relative to other conditions, and so these two emotion categories were used as references for the contrasts. To correct for violations of sphericity, the Greenhouse-Geisser procedure was utilised. Simple contrasts were used to determine the direction of any significant main effects.

3.2.5.4. Startle reflex modulation (SRM)

Eye blink responses used for startle reflex modulation were measured using a Nexus-10 (produced by Mind Media BV) recording device and Bio-trace + software. Bipolar EMG electrodes were attached to the left eye of each participant and potential changes of the musculus orbicularis oculi were measured. The EMG sampling rate was 2048/s and a band pass filter from 20–50 Hz was applied whilst recording. Raw EMG data was then recalculated using the root mean square (RMS) method to convert raw frequency signals into amplitudes. The startle blink amplitude value was defined as the peak rise in the EMG waveform on trials involving the startle probe. As above, repeated measures ANOVAs were carried out for statistical analyses (see Mavratzakis, Herbert & Walla, 2016).
3.3. Results

3.3.1. Participant demographics

Our cohort consisted of a largely homogeneous sample. A majority of the participants in the study reported themselves as being students who have completed at least a secondary school level of education, either living with a partner or never being married, and identified themselves as being Caucasian born in Australia (see Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>Never Married</td>
<td>39</td>
<td>75</td>
</tr>
<tr>
<td>De Facto/Living with a partner</td>
<td>12</td>
<td>23.1</td>
</tr>
<tr>
<td>Widowed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Divorced/Separated</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Highest Level of Completed Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary School</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Secondary School completed</td>
<td>22</td>
<td>42.3</td>
</tr>
<tr>
<td>Secondary School not completed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Trade Qualification</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>University or other Tertiary Study</td>
<td>29</td>
<td>55.8</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Work</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full time</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Part time</td>
<td>7</td>
<td>13.5</td>
</tr>
<tr>
<td>Unemployed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Working in the home/home duties</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Retired</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Descriptives of participant responses to the questionnaire can be seen in Table 2.

Participant groups were divided based on frequency of pornography use. Mean ages did not significantly differ between groups. Importantly, one-way independent ANOVA showed that there was no significant difference between low, medium, and high porn use groups with regards to Snyder total score $F(2, 49) = 1.892, p = 0.162$.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low Porn Use ($N = 18$)</th>
<th>Medium Porn Use ($N = 14$)</th>
<th>High Porn Use ($N = 20$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.8 ± 3</td>
<td>20.7 ± 2.2</td>
<td>22 ± 3.5</td>
</tr>
<tr>
<td>Hours of Porn Viewed per Year</td>
<td>6.5 ± 2.9</td>
<td>31 ± 7.7</td>
<td>110.4 ± 62.8</td>
</tr>
<tr>
<td>Snyder Total Score</td>
<td>10.2 ± 3.1</td>
<td>9.9 ± 4.1</td>
<td>12 ± 3.3</td>
</tr>
</tbody>
</table>

*Not all sum due to non-responders.*
3.3.3. Explicit responses

Results from explicit valence ratings did not show a significant overall Group by Emotion interaction. Follow-up contrasts though showed a significant interaction for ‘Erotic’ and ‘Pleasant’ explicit valence (pleasantness) ratings $F(2) = 3.243, p = 0.048$. No significant differences were found with explicit “arousal (intensity)” ratings in any emotion categories (see Figure 1).
Figure 1. Explicit Valence (A) and Arousal (B) ratings for each emotion category across all groups. A significant Group interaction occurred for valence ratings in the ‘Erotic’ and ‘Pleasant’ categories (marked by asterisks).
3.3.4. Physiological measures

Startle Reflex Modulation results showed a Group effect on eye blink amplitude over all conditions approaching significance $F(2) = 3.176, p = 0.051$ see Figure 2.

*Figure 2.* Startle-elicited eye blink responses (left) and column graphs (right) for Low (A), Medium (B), and High (C) porn use groups.
Despite the absence of any significant main interaction effects, simple contrasts showed significant ERP Group effects for ‘Unpleasant’ vs. ‘Violent’ emotion categories 250–563 ms in frontal areas of the brain. Significant effects between the same two emotion categories were also seen in posterior sites during a later time period (563–875 ms) (See Table 3; Figure 3). The absence of main effects is interpreted as a result of rather focussed ERP differences.

Table 3. Summary of significant Group effects related to unpleasant vs. violent emotion category event-related potentials (ERPs).

<table>
<thead>
<tr>
<th>Electrode Sites</th>
<th>Emotion Category</th>
<th>Time (ms)</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF7/AF8</td>
<td>Unpleasant vs. Violent</td>
<td>250</td>
<td>3.236</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td></td>
<td>484</td>
<td>5.682</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>563</td>
<td>3.454</td>
<td>0.04</td>
</tr>
<tr>
<td>P5/P6</td>
<td>Unpleasant vs. Violent</td>
<td>563</td>
<td>3.454</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>719</td>
<td>3.938</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td></td>
<td>797</td>
<td>3.472</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td></td>
<td>875</td>
<td>4.258</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Figure 3. ERPs at frontal (AF7/AF8) and parietal (P5/P6) locations across all emotion categories for Low, Medium, and High porn use groups. Note significant group effects for ‘Unpleasant’ vs. ‘Violent’ emotion categories 250–563 ms in frontal areas of the brain and between 563–875 ms in parietal regions.
3.4. Discussion

The current study employed a top-down triangulation approach utilising several methods simultaneously to describe different approaches to studying affective responses and their physiological significance. To point out the main differences again, explicit ratings are behavioural measures which require a conscious, deliberate response and therefore utilise cortical information processing. Startle Reflex modulation is a non-conscious measure of raw affective information processing on the basis of motivational priming (see Kanorki, 1967) and relates to subcortical brain structures, e.g., (Lang et al., 1990). Electroencephalography (and further to that, ERP) is mainly sensitive to cortical information processing, but it also involves the coordinated input from sub-cortical brain (largely non-conscious) processes. It can be said that all physiological measures are rather implicit by nature in contrast to explicit rating performance.

With this knowledge in tow, can we determine if the frequency of pornography use alters the way in which we consciously (explicit measures) and non-consciously (implicit measures) respond to emotional information? Although the Snyder scores for each group did not differ significantly—indicating no difference in self-monitoring—the results obtained in the current study indeed demonstrated discrepancies in the results obtained via explicit and implicit measures.

3.4.1. Explicit ratings

The ‘Erotic’ images were explicitly rated as less pleasant by the low porn use group than either the medium porn use or high porn use participants. Perhaps low porn users rarely seek out erotic or pornographic material, so the low porn group found the presentation of ‘Erotic’ images during the experimental session to be less pleasant if not even a bit disturbing. Another possible explanation could include that low porn users have
not had as much exposure to pornography and so have not habituated as much as medium or high users. Contrastingly, people who find porn unpleasant may choose not to use it and so fall into the low use group and habituation may not at all be a factor. Interestingly, the high porn use group rated the ‘Erotic’ images as more unpleasant than the medium use group. The authors suggest this may be due to the relatively “soft-core” nature of the ‘Erotic’ images contained in the IAPS database not providing the level of stimulation that they may usually seek out, as it has been shown by Harper and Hodgins (2016) that with frequent viewing of pornographic material, many individuals often escalate into viewing more intense material to maintain the same level of physiological arousal. The ‘Pleasant’ emotion category saw valence ratings by all three groups to be relatively similar with the high use group rating the images as slightly more unpleasant on average than the other groups. This may again be due to the ‘Pleasant’ images presented not being stimulating enough for the individuals in the high use group. Studies have consistently shown a physiological downregulation in processing of appetitive content due to habituation effects in individuals who frequently seek out pornographic material (Kuhn & Gallinat, 2014; Prause et al, 2014, 2015). It is the authors’ contention that this effect may account for the results observed.

3.4.2. Event-related potentials (ERPs)

Notable significant differences were observed between the ‘Unpleasant’ relative to the ‘Violent’ condition between groups, which is in contrast to explicit rating results. Upon visual inspection of the curves, an increased negative peak can be seen in the low porn use group for the ‘Unpleasant’ condition during the LPP phase of the curve (400–500 ms) across both hemispheres in frontal areas of the brain. This appears to only be present in the right hemisphere for the medium and high porn use groups. Although this laterality effect did not survive statistical analysis, the trend observed could indicate a
possible lateralisation effect of more frequent porn users. This prominent negative peak was also demonstrated by a study performed by Cuthbert, Schupp, Bradley, Birbaumer & Lang, (2000), where they found that frontal areas of the brain showed greater positivity for pleasant than unpleasant pictures albeit, the “neutral” condition in their study was the most negative going. The authors of the aforementioned paper attempted to make sense of this relative positive shift of pleasant images by stating that it could reflect augmented affective arousal rather than an intrinsic valence difference due to the pleasant images in their study evoking a significantly greater change in autonomic activity (skin conductance) rather than subjective arousal ratings. In addition, this pattern of frontal asymmetry can be explained by the relative positive going waveform the ‘Unpleasant’ images produced in the left hemisphere of the medium and high porn use groups. Recent research suggests that increased relative left frontal activity may be associated with approach motivational processes (see Harmon-Jones et al, 2010; Hoffman, 2008). This would indicate that due to the relative frontal difference in activation to the ‘Unpleasant’ images, more frequent users of pornography possibly consider the unpleasant images to contain more positive affect.

Furthermore, the ‘Violent’ and ‘Unpleasant’ emotion categories across the right hemisphere appear to increasingly follow a similar trajectory at slightly later time periods (>500 ms) moving from low to medium to high porn users—particularly in the frontal region of the brain. These findings suggest that similar processing may be utilised by frequent users of pornography when passively viewing violent and unpleasant emotion images relative to lower pornography users at implicit levels. Heading more posteriorly to more sensory-related areas of the brain, the same two emotion categories (‘Violent’ and ‘Unpleasant’), again, appear to be processed more similarly in the high porn use group during the LPP phase (>500 ms) where they remain separate in the low and medium
use groups. This pattern of physiological responses may suggest that frequent exposure to pornographic material may increase the liking and therefore approach motivation towards that stimulus, thereby resulting in an enlarged LPP comparable to the LPP generated due to the possible avoidance motivation resulting from viewing violent imagery. Contrastingly, as mentioned above, it has been shown that many frequent users of pornography often gravitate towards more graphic or intense material over time due to desensitisation effects and the need to view more novel and extreme material to become aroused (Harper & Hodgins, 2016). This material may often include pornographic genres which depict varying acts of (sexual) violence which individuals in the high use group may be primed to and therefore respond to the ‘Erotic’ images on a physiological level similarly to the ‘Violent’ images.

3.4.3. Startle reflex modulation (SRM)

Startle reflex modulation, as mentioned previously, is sensitive to subcortical affective processing with a clear emphasis on valence. As expected, results showed the ‘Erotic’ category to be the least startle-inducing, and across all three groups, the ‘Violent’ emotion category elicited the largest startle response. Although results obtained showed a $p$-value only approaching significance, upon visual inspection of the curves it can be seen that there are three distinct profiles of startle responses characteristic to each group. A trend is visible moving from low to medium to high pornography use, as the relative distribution of startle responses appear to increase in variability (i.e., the high porn use group has the biggest range of startle responses between the least arousing (Erotic) and the most arousing (Violent) emotion categories). This indicates that higher frequency porn users process the ‘Erotic’ images as more appetitive in relation to the other emotion categories on a non-conscious level (however, only qualitatively). The observed effect seems to be in adherence to most studies in this field, whereby startle reflex to aversive
stimuli result in higher amplitude blink responses compared to more pleasant stimuli (Ehrlichman et al, 1997; Jansen & Frijda, 1994; Ruiz-Padial & Vila, 2007). A possible explanation as to why the high porn use group showed a relative decrease in startle response to the ‘Erotic’ images may be due to all the images presented more than likely being novel to the participants and therefore their affective non-conscious startle response indicated that it was a pleasant stimulus which had not proceeded to habituation. As it is so, it would be interesting to determine what effect repeated viewing of the same images may have, as previous studies have shown repeated viewing of erotica results in increased eye blink response to a startle probe due to the material becoming boring and aversive (Koukounas & Over, 2000). The relative higher amplitude startle effect seen in the low and medium porn use groups may be explained by those in the group intentionally avoiding the use of pornography, as they may find it to be relatively more unpleasant. Alternatively, the results obtained also may be due to a habituation effect, whereby individuals in these groups do watch more pornography than they explicitly stated—possibly due to reasons of embarrassment among others, as habituation effects have been shown to increase startle eye blink responses (Koukounas & Over, 2000; Jansen & Frijda, 1994).

Although the significance level obtained may not be what was expected, a trend seems to be emerging from the data showing the discrepancy between frequent and infrequent pornography users. It is of the authors’ view that the lack of a concrete result may be attributed to low participant numbers. A larger cohort would more than likely increase power to detect more robust effects. However, it appears that the observed trend in physiological data of the current study provides another pattern of findings dissimilar to explicit ratings.
3.4.4. Limitations

Although the current study was comprehensive, there remained inevitable limitations. It should be mentioned that the images which formed the ‘Erotic’ category obtained via the IAPS database may be seen as an outdated representation of erotica or pornography compared with what may be construed as “average pornography” which, in the modern era, is more expansive and visually stimulating. Future studies may need to utilise a more up-to-date standardised image database to account for changing cultures. Also, maybe high porn users downregulated their sexual responses during the study. This explanation was at least used by Prause et al (2015) to describe their results which showed a weaker approach motivation indexed by smaller LPP (late positive potential) amplitude to ‘Erotic’ images by individuals reporting uncontrollable pornography use. LPP amplitudes have been shown to decrease upon intentional downregulation (Hajcak, MacNamara & Olvet, 2010; Sarlo, Übel, Leutgeb & Schienle, 2013). Therefore, an inhibited LPP to erotic images may account for lack of significant effects found in the present study across groups for the ‘Erotic’ condition. This may be due to participants not being allowed to masturbate whilst watching pornographic (or in this case, erotic) images during the testing session, which is what they may do otherwise (Hald, 2006).

A further limitation of the current study was that the participant pool was divided into pornography use groups based on self-reported pornography usage. As studies based on physiology in this field of pornography consumption is relatively recent, there does not yet exist a set of physiological markers or a physiological profile which allows for a clear distinction between, say, a “low” or a “high” pornography use group. The obvious issue presented with this method may be due to some respondents’ under-reporting or over-reporting their actual porn use. Further, the current study did not rely on a clinical sample with known and clinically diagnosed pornography use problems. The cohort used
for the present study exists within a “normal” range with unproblematic porn use which may be termed not clinically significant and therefore may not have provided as robust a result as a comparison between clinically diagnosed and non-clinically diagnosed individuals.

Furthermore, the effects noted in this paper differentiating between pornography use groups may indicate a correlation effect rather than causation. A link may be drawn here comparing individuals in the general population who consume alcohol. Both pornography consumption and alcohol use may be pleasurable and potentially damaging behaviours engaged in by many, but only a minority of individuals excessively participate in these behaviours to the point where it causes distress and associated adverse behavioural effects. It is entirely likely that our cohort was comprised of individuals who have not and will never suffer any sort of observable adverse behavioural effect due to their (excessive) use of pornography.

The study of excessive pornography use is a relatively recent phenomenon, and there is a need to develop a standardised questionnaire used to explicitly measure pornography use and its associated conscious effects. There exist several already established scales and measures used to determine various aspects of sexual behaviour, among them: the Sexual Compulsivity Scale (Kalichman & Rompa, 1995), the Pornography Craving Questionnaire (Kraus and Rosenberg, 2014), the Pornography Consumption Effects Scale (Hald & Malamuth, 2008) and the Problematic Pornography Use Scale (Kor, Zilcha-Mano, Fogel, Mikulincer, Reild & Potenza, 2014), but with the quickly changing nature of individuals’ pornography acquisition via the internet and what is available on it, many of the items on these scales may be seen as obsolete and need to be updated, but due to the lack of an existing, well-validated and psychometrically sound measure many studies (as we have done) have opted to develop and use their own in-house, purpose-built and
developed items and methods of scoring whilst others (especially those studying pornography addiction) have simply resorted to adapting existing substance addiction scales and substituted the addictive substance (e.g., alcohol, cocaine, heroin, etc.) with the word pornography. The problem with this is a lack of reproducibility and validity of the measure to acquire consistent and accurate results among studies in this field.

In summary, although all measures showed significant (or close to significant) outcomes, it is important to note that differences observed in the explicit ratings were not the differences observed in the physiological measures. Similar to word information processing where a dissociation was found between explicit and implicit responses (see Rugg, Mark, Walla, Schloerscheidt, Birch & Allan, 1998) this indicates that there are definitely grounds to conclude that as there are differences in the way affective information is processed both consciously and non-consciously, no single method of measurement can provide an accurate description of an individuals’ true emotional state. In saying so, multiple standardised methods incorporating both implicit and explicit measurement techniques may need to be utilised in order to gauge all different aspects of affective processing leading to emotions. Surely, a survey alone does not lead to solid results.
References


Chapter 4

DOES EEG AND STARTLE REFLEX MODULATION VARY WITH SELF-REPORTED AGGRESSION?

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Abstract

Increased violence and aggressive tendencies are a problem in much of the world, and are often symptomatic of many other neurological and psychiatric conditions. Current methods of diagnosis of problem aggressive behaviour, among clinicians, rely heavily on the use of conscious self-report measures as described by the DSM-5 and ICD-10. This approach does not place adequate emphasis on non-conscious processes. Numerous studies provide evidence that attitudes and emotions can be processed at a non-conscious level before conscious awareness. This exploratory study aimed to determine whether individuals in the normal population, grouped by self-reported aggression, differed in conscious and non-conscious emotion processing. Participants (N=52) were grouped based on their responses to the Buss-Durkee Hostility Inventory. They were then presented with affect-inducing images while brain Event-Related Potentials (ERPs) and Startle Reflex Modulation (SRM) were recorded to determine non-conscious processes. Explicit valence and arousal ratings for each image were taken to determine conscious emotion effects. Results indicated no significant group differences for explicit ratings or SRM. However, ERP results demonstrated significant group differences between the ‘Pleasant’ and ‘Violent’ emotion condition in frontal, central and parietal areas across both hemispheres. These findings suggest that non-conscious responses differ from conscious appraisal of affective stimuli in these groups.
4.1 Introduction

Violent behaviour is a major social and public health problem in most parts of the world (Siegel & Victoroff, 2009). Consequently, the identification and effective management of individuals who present with violent or aggressive behaviour is of paramount importance. Aggression is can be symptomatic of a variety of underlying psychiatric and neurological illnesses (Siegel & Victoroff, 2009; Barratt, Monahan & Steadman, 1994). Aggression is also shaped by culture, the environment and societal factors (Eron, 1987). To date, many clinicians and researchers have aimed to assess the effects and extent of aggression in individuals using self-report measures to determine whether individuals meet diagnostic criteria as described in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) and the International Classification of Diseases (ICD-10; World Health Organisation, 1993). These methods of assessment comprise almost exclusively of traditional questionnaires and face to face interviews, allowing the clinician or researcher to make a diagnosis. A major weakness of these methods is that, even when several measures are taken, they rely predominantly on conscious self-report which has been shown to have inherent biases (Fulmer & Frijters, 2009). These biases are most highly evident when the individual discusses behaviour subject to social disapproval, termed Social Desirability Bias (van de Mortel, 2008; Herbert, Clemow, Pbert, Ockene, I. S & Ockene, J. K, 1995; Kelly, Soler-Hamperjsek, Mensch & Hewett, 2013). Conscious explicit responses (derived from questionnaires and face to face interviews) can be modified over several stages of processing, and may not accurately reflect what might be occurring on a level below conscious awareness. Several papers have pinpointed the influence the non-conscious has on our consciously perceived reality (Walla, 2011; Walla, Brenner & Koller, 2011; Berridge & Winkielman, 2003; Winkielman & Berridge, 2004; Tamietto & de Gelder,
One solution may be to try to identify neural substrates and mechanisms underlying the expression of aggressive behaviour (Siegel & Victoroff, 2009).

4.1.1 Types of aggression

It is important to recognize that aggression is by no means a unimodal behaviour. Several authors have postulated various types of aggression. For example, Moyer (1968) examined the following aggression sub-categories: fear-induced aggression, maternal aggression, inter-male aggression, sexual aggression, irritable aggression, predatory aggression and territorial aggression. Many of these terms were formulated during animal studies in aggression; Siegel and Victoroff (2009) state that human aggression is even harder to categorise as any one of the abovementioned categories could involve one or more types of aggressive behaviour. Siegel and Victoroff argued that the varieties of aggression listed above may be reduced to two main categories: affective aggression (which may also be called reactive, defensive or hostile aggression) and predatory aggression (which may be referred to as impulsive, proactive, premeditated or instrumental aggression). Predatory aggression differs from affective aggression, which is mostly associated with a threat or fear. In the present study, however, we determined self-report aggression as a unitary construct and did not categorise groups based on impulsivity. However, the Barratt impulsiveness scale (Patton & Stanford, 1995) was provided to participants to determine if the cohort were more likely to be impulsive in nature if they self-reported higher aggressive tendencies.
4.1.2 Limitations of self-report measures in assessing aggression

As aggressive behaviour is often symptomatic of many other clinical disorders, clinicians may be faced with the challenge of assessing the presence and extent of aggression and aggressive subtypes. The Diagnostic and Statistical Manual of Mental Disorders (DSM 5; American Psychiatric Association, 2013) and the International Classification of Diseases (ICD-10; World Health Organisation, 1993) list behavioural and cognitive symptoms, the presence of which are typically assessed using self-report, behavioural observation, and clinical interviewing. Although, such methods are a useful way to determine an individual’s conscious emotional state, these methodologies are subject to biases through conscious deception or even the fact that emotional cognitive processes and biases can occur without conscious awareness (Walla & Koller, 2015; Walla, 2011; Winkielman & Berridge, 2004; Tamietto & Gelder, 2010). The act of explicitly delivering responses requires conscious cognitive processing, which incorporates a coordinated use of sub-cortical brain processes and conscious cortical brain processing. Walla et al (2011) have shown that this approach has been shown to modify conscious evaluations of non-conscious physiological processing, also known as cognitive pollution.

It has been demonstrated that information consciously reported via self-report does not always correspond to what is recorded non-consciously. Grahl, Greiner & Walla, (2012) utilised both self-report measures and startle reflex modulation (SRM) to determine if bottle shape elicits a variation in gender specific emotion. They showed that although subjective self-report showed no differences between males and females, a significant gender effect was noted in the SRM blink amplitude of male respondents to a particular shape of bottle. They concluded that physiological measures of non-conscious
emotion processing may be sensitive to emotion cues which are not revealed by conscious self-report. Additionally, Berridge and Winkielman (2003) showed that participants altered their behaviour depending on whether they were subliminally exposed to a happy, neutral or angry face stimulus. They posited that the subliminally presented emotion faces caused affective reactions which altered behaviour without conscious awareness. These findings further support the notion that the non-conscious plays a pivotal role in our behaviour regardless of conscious awareness.

It appears that questionnaire and other self-report tools can provide a quick and reliable information about cognitive and behavioural processes occurring on a conscious level. However, they only capture what may be fraction of an individual’s psyche. It is therefore timely to examine whether we can use physiological measure to observe differences in the unconscious mind that are inaccessible when using conscious self-report measures.

4.1.3 Aggression and event-related potentials (ERPs)

Event-Related Potentials (ERPs) provide a method by which we can examine non-conscious processing effects. ERPs provide an easily obtainable and non-invasive method to study neural activity and, due to ERPs advantages in temporal resolution, real-time discrimination of cognitive processes (Patrick, 2008). Studies examining the ERPs of aggressive individuals predominantly identify the P300 component as a marker of aggression. The P300 component appears to reflect perceptual processing used to identify stimulus relevance (Donchin & Coles, 1988). This includes the latency, which measures evaluation time, and amplitude, which relates to ability to process a stimulus. Lower amplitude P300 is suggestive of less efficient cognitive functioning (Hillyard & Kutas, 1983). The P300 wave is associated with higher order cognitive functioning, and working
memory is typically reduced in those who present with impulsive aggressive tendencies when presented with an oddball task (Patrick, 2008; Harmon-Jones, Barratt & Wigg, 1997; Bond & Surguy, 2000). Gerstle, Mathias & Stanford, (1998) demonstrated that within the normal population, individuals who self-reported as being impulsive aggressive presented with significantly lower P300 amplitude in frontal electrode sites compared with nonaggressive controls. In contrast, individuals who presented as being premeditated aggressors did not show the reduced P300 component characteristic of impulsively aggressive individuals (Stanford, Houston, Villemarette-Pittman & Greve, 2003; Barratt, Stanford, Kent & Alan, 1997). This suggests that the P300 could serve as a marker specific to individuals who present with aggression of an impulsive nature (Bond & Surguy, 2000).

The N400 component of the ERP has also been studied in populations of aggressive individuals. Gagnon et al. (2016) measured the neural activity associated with violating expectations about hostile and non-hostile intentions in aggressive and non-aggressive groups. The researchers presented various hostile and non-hostile scenarios, followed by a character’s ambiguous aversive behaviour. ERPs that were analysed were taken when critical words were presented that were specific to the hostile versus non-hostile intent behind the behaviour. Aggressive individuals produced a larger N400 response compared to controls when exposed to a critical word which violated a hostile expectation. They also posited the notion that an increased N400 component could be a reliable method of determining hostile attribution bias (HAB; described in their paper as the tendency to interpret the intention of others as hostile in ambiguous social contexts, which is associated with impulsive aggressive behaviour in adults) as both high and low aggression groups studied scored statistically significantly different (albeit marginally) in the Hostile Attribution Bias sub-section of the Social Information Processing—
Attribution and Emotional Response Questionnaire (SIP-AEQ; Coccaro, Noblett & McCloskey, 2009). Additionally, aggressive individuals showed an enhanced late positive potential (LPP) when hostile scenarios took place in a non-hostile context. The LPP is a sustained positivity in the ERP usually in the central and parietal regions of the scalp, and is a marker for processing of affective content (Schupp, Flaisch, Stockburger & Junghofer, 2006). Beginning at around 300ms post stimulus onset, the LPP is greater in amplitude for negative and positive stimuli than it is for neutral stimuli. That is, the more affect inducing or motivationally significant the stimuli, the larger (or more meaningful) the LPP. Studies on the modulation of the LPP in violence and aggressive individuals are scarce. Most studies tend to focus on the P300 component as it is considered to be a more reliable indicator of violence. However, a larger LPP effect for individuals who report as being more aggressive has been observed (Gagnon et al., 2016).

4.1.4 Aggression and startle reflex modulation (SRM)

Startle reflex modulation (SRM) is a technique in which a short, unexpected burst of auditory white noise (usually around 100-110dB) is presented to each ear of unsuspecting participants while they are exposed to a controlled foreground stimulus depicting varying affective content (Lang, Bradley & Cuthbert, 1990). The resultant startle response, measured by the intensity and latency of the eye blink reflex, pertains to raw affective information processing and is usually determined by the appetitive nature of the affective foreground stimulus. Lang et al, (1990) showed that the magnitude of the eye blink recorded resulted in smaller blinks if the foreground stimulus was appetitive and larger when the foreground stimulus was aversive.

A search of the literature revealed no studies investigating startle effects of violent or aggressive individuals within non-clinical populations. In all cases where startle was
studied, the target behaviour (aggression/violence) was symptomatic of some other disorder. Several studies have utilised SRM to study particular clinical groups which present with violence and/or aggression as a symptom of their condition, these being: criminal psychopathy (Patrick, Bradley & Lang, 1993; Vaidyanathan, Hall, Patrick & Bernat, 2011), schizophrenia (Dawson, Hazlett, Filion, Nuechterlein & Schell, 1993; Kumari et al., 2005), antisocial personality disorder (Kumari et al., 2005; Miranda, Meyerson, Myers & Lovallo, 2003; Vaidyanathan et al., 2011) and borderline personality disorder (Hazlett et al., 2007) among others. Hazlett et al. (2007) showed that patients with borderline personality disorder (BPD) exhibited larger eye blink responses to unpleasant but not neutral words. The authors suggested that individuals suffering from BPD respond to aversive stimuli as a result of an exaggerated physiological effect. Patrick et al (1993) used SRM to determine the emotional responding of criminal psychopaths and found the psychopathy group did not show the clear linear relationship between slide valences and startle magnitude as was evident in the non-psychopathic and mixed subject controls. This suggested the psychopathy group had an abnormality in the processing of emotional stimuli.

The present study aimed to determine whether individuals present with differences between their conscious self-reported measures and their non-conscious physiological recordings. It was hypothesised that participants with higher levels of self-reported aggression would show attenuated P300 and LPP amplitudes as well as startle responses to emotion images exhibiting negative affect (‘Violent’ and ‘Unpleasant’) than participants with lower levels of self-reported aggression. It was also hypothesised that there would be no differences in conscious valence and arousal responses to the emotion images between participants with high aggression and lower aggression.
4.2 Methods

4.2.1 Participants

Participants were 52 male students enrolled at the University of Newcastle, Australia with an age range between 18 and 30 years (M=21.13; SD=2.93). Participants provided informed written consent and were native English speakers, right-handed, had no known history of neuropathology, no history of being a victim of physical/sexual abuse, no history of being incarcerated in a penitentiary and were not taking any nervous system targeting medication such as stimulants or anti-depressants. The project was approved by the University of Newcastle Human Research Ethics Committee (H-2013-0309).

4.2.2 Measures

4.2.2.1 Online questionnaire

An online questionnaire was administered to determine conscious self-report measures prior to physiological testing. The online questionnaire was created using LimeSurvey (www.limesurvey.com) and included demographic questions, a modified version of the Buss-Durkee Hostility Inventory (BDHI; Buss & Durkee, 1957), Snyder Self-Monitoring Scale-Revised (Snyder & Gangestad, 1986) and Barratt Impulsivity Scale (BIS-11; Patton & Stanford, 1995). The BDHI was modified from its original publication by grouping all questions into sub-groups under relevant headings. This was done intentionally to determine if any conscious self-monitoring effects could be seen, as participants would know exactly what component of their own aggressive traits were being measured. This could then be compared to scores obtained by the Snyder self-monitoring scale. Total scores for the modified Buss-Durkee Hostility Inventory were determined by following the scoring protocol outlined by Buss and Durkee (1957). A
median split of total BDHI score was utilized to determine “high” and “low” aggressive individuals. The BIS-11 and Snyder self-monitoring questionnaires were used to determine if there was any relationship between total scores for these measures and “high” and “low” aggression. The questionnaire took 20-25 minutes to complete.

4.2.2.2 Stimuli

The experiment used 150 images obtained from the International Affective Picture System (IAPS, Lang et al., 2008). Each image was categorised into 1 of 5 emotion categories: Violent, Neutral, Pleasant, Unpleasant and Erotic. Each emotion category contained 30 images. Each emotion category differed in normative valence (M = 7.3 Erotic, 3.22 Violent, 5.09 Neutral, 7.38 Pleasant, 2.01 Unpleasant) and arousal (M = 6.76 Erotic, 5.94 Violent, 4.53 Neutral, 5.94 Pleasant, 5.95 Unpleasant) ratings (scale range 1-9; All normative values based on data acquired from Lang, Bradley & Cuthbert, (2008). All participants were shown all images and were asked to explicitly rate each image from 1-9 based on each valence and arousal.

4.2.2.3 EEG recordings

Brain potential changes were recorded using a 64-channel BioSemiActiveTwo system and ActiView software (BioSemi, Amsterdam, The Netherlands) at a rate of 2048 samples/second. Electrode layout conformed to the international 10-20 standard of electrode placement and all electrodes were finally referenced to a common average signal. Data sets were batch processed using EEG-Display (version 6.4.8; Fulham, Newcastle, Australia). During processing the sampling rate was down-sampled to 256 samples/s and filtered from 0.1Hz to 30Hz. ERP epochs were defined in relation to the presentation of each IAPS image from -100ms pre stimulus to 1000ms post stimulus onset. All epochs were baseline corrected with the correction occurring 100ms prior to
stimulus onset and data points along the ERP were reduced to 15 data points along the first second post stimulus presentation.

4.2.2.4 Startle reflex modulation recordings

Orbicularis occuli muscle potential changes as responses to startle probe presentations were measured. Startle responses were measured using a Nexus-10 (produced by Mind Media BV) recording device and Bio-trace + software. Bipolar EMG electrodes were attached to the left eye of each participant and potential changes of the musculus orbicularis occuli were measured at a sampling rate of 2048/s with a band pass filter of 20-500 Hz during the recording. The raw EMG data was then converted into amplitudes using the root mean square (RMS) calculation. Startle blink amplitude value was defined as the peak rise in the EMG wave across startle trials upon stimulus presentation. Each image category (Violent, Neutral, Pleasant, Unpleasant and Erotic) contained 5 images which were paired with a startle probe (total 25 startle probes during the experiment). Startle probes were presented binaurally at 110dB using headphones (Sennheiser HD280).

4.2.2.5 Explicit responses

Conscious explicit responses during the experimental stage for both valence and arousal were determined by each participant for each image presented. Scores participants rated each image using a likert scale from 1-9 for valence (1= Very Pleasant; 9= Very Unpleasant) and arousal (1= Very intense; 9= Very calming). Scores for each emotion category were averaged across individuals for analytical statistics and then gran averaged for displaying findings.
4.2.3 Experimental task and procedure

Only participants aged between 18 and 30 were allowed to complete all sections of the questionnaire and were therefore invited to do the physiological recordings. Participants reporting an age outside of this range were automatically taken to the end of the survey and were unable to proceed.

Upon completing the online questionnaire, participants were asked to complete the remainder of the experiment at the Functional Neuroimaging Laboratory (University of Newcastle). Each participant was seated approximately 50cm in front of a 32” LED monitor (resolution 1024x768 pixels) and fitted with a 64 channel BiosemiActiveTwo EEG system and two 4mm Biotrace electrodes (with approximately 20mm spacing on the inferior orbicularis oculi of the left eye) for Startle Reflex Modulation. Additional electrodes were placed laterolaterocularly, supraocularly, infraocularly and on the mastoids for reference and to monitor eye blinks. To visually present instructions and visual stimuli, the computer program Presentation (NeuroBehavioral Systems, Albany, United States) was used. Stimuli presentation and all physiological recordings were conducted by the researcher from a separate room.

Each participant was provided with a brief overview of the experiment and asked to read the instructions on the screen before beginning. Headphones were placed over the participant’s ears and the lights in the room were dimmed slightly to allow for adequate focus on the screen. Upon commencement, participants each viewed all 150 IAPS images, randomly ordered, and rated each image based on valence and arousal. Each image was presented for 5 seconds, followed by the valence rating scale and then the arousal rating scale. Participants were allowed to take their time with the rating of each but were instructed to try not to think about it too much and to provide their most instinctive
response. Upon the rating of each scale, a fixation cross appeared in the center of the screen for 1 second before the following image was presented. Startle probes occurred randomly but with at least a 40s time window between consecutive startle probes. If and when a startle probe was to be paired with an image it would occur on the 4th second post image presentation to ensure adequate affect. Physiological and explicit measures were taken from each participant for all 150 IAPS images with a short break offered to the participant during the halfway point to help reduce effects of fatigue.

4.2.4 Statistical analysis

The analysis for all measures was a fully within-subjects design with the main factor of Emotion (Pleasant, Unpleasant, Erotic, Violent and Neutral). For each event-related potential mean value across the time point of interest, a general linear repeated measures model was used with the additional within subjects factor of hemisphere (left, right) to determine hemispheric asymmetry effects. A general linear repeated measures model was also used for the analysis of the startle effect and explicit measures with only the within subjects factor of emotion utilized. To correct for violations of sphericity across all calculations, the Greenhouse-Geisser procedure was utilised. Simple contrasts were used to determine the direction of any significant main effects.

4.3 Results

4.3.1 Participant demographics

Our cohort consisted of a largely homogeneous sample of undergraduate and postgraduate students at an Australian University. A majority of the participants were students who had completed at least a secondary school level of education, were either
living with a partner or never being married, and identified themselves as being Caucasian born in Australia (see Table 1).

Table 1. Demographic characteristics of sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>(%)</th>
</tr>
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<tr>
<td><strong>Marital Status</strong></td>
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<tr>
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<tr>
<td>Never Married</td>
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<td>DeFacto/Living with a partner</td>
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<td>Widowed</td>
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<td>0</td>
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<tr>
<td>Divorced/Separated</td>
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<td>0</td>
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<td><strong>Highest Level of Completed Education</strong></td>
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<td></td>
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<td>0</td>
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<tr>
<td>Secondary School completed</td>
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<tr>
<td>Secondary School not completed</td>
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<td>0</td>
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<td>Trade Qualification</td>
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<td>University or other Tertiary Study</td>
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<td>0</td>
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<td>0</td>
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<td>86.5</td>
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<td>Other</td>
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<td><strong>Country of Birth</strong></td>
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<td>Australia</td>
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<td>Other</td>
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<td>African</td>
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<td>Aboriginal or Torres Strait Islander</td>
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<tr>
<td>Other</td>
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</table>

* Not all sum due to non-responders
4.3.2 Self-reported aggression, impulsivity and self-monitoring

Descriptive statistics of participant responses to the questionnaire can be seen in Table 2. Participant groups were divided based on a median split of BDHI total score. Mean ages did not significantly differ between groups. Importantly, one-way independent ANOVA showed that there was no significant difference between low and high porn use groups with regards to Snyder total score $F(1,50) = 2.421, p = 0.126$. However, analysis did reveal that those in the high aggressive group scored significantly higher in the impulsivity scale $F(1, 50) = 7.644, p = 0.008$.

Table 2. Descriptive statistics of total scores for Low and High scoring groups based on the Buss-Durkee Hostility Inventory (BDHI) and in the Total Sample

<table>
<thead>
<tr>
<th></th>
<th>Low BDHI scorers (N=26)</th>
<th>High BDHI scorers (N=26)</th>
<th>Total sample (N=52)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Age</td>
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<td>3.48</td>
<td>21.38</td>
</tr>
<tr>
<td>BDHI total</td>
<td>20.77</td>
<td>5.98</td>
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</tr>
<tr>
<td>Snyder total</td>
<td>10.08</td>
<td>3.57</td>
<td>11.58</td>
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<td>BIS-11 total</td>
<td>62.35*</td>
<td>8.12</td>
<td>70.12*</td>
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</table>

* Denotes significant differences between low and high aggression groups
4.3.3 Explicit Responses

Results obtained from the general linear model for the explicit valence and arousal ratings did not show a significant *Group by Emotion* interaction for either valence scores (F(1.574) = 0.441, p = 0.597) or arousal scores (F(2.041) = 0.632, p = 0.536; See Figure 1).
Figure 1. Explicit Valence (A) and Arousal (B) Ratings for each emotion category across low and high aggression groups. Note no significant differences were noted in explicit valence and arousal ratings between both high and low aggression groups.
4.3.4 Physiological measures

4.3.4.1 Startle reflex modulation (SRM)

Results were only obtained for N=50 participants due to faulty channels. Both excluded cases were from the low aggression group. Startle Reflex Modulation results showed no significant between-subjects effect of amplitude over any emotion condition (F(3.456) = 0.678, p = 0.587; see Figure 2).

![Startle reflex curves and column graphs for Low (A) and High (B) aggression groups.](image)

**Figure 2.** Startle reflex curves and column graphs for Low (A) and High (B) aggression groups.
4.3.4.2 Event-related Potentials (ERPs)

Significant group by emotion by hemisphere effects (utilising the Greenhouse-Geisser method to correct for violations of sphericity) were seen at 94ms over central (F(3.51, 175.522) = 3.693, p = 0.009) and parietal (F(3.42, 171.41) = 2.541, p = 0.05) regions and at 328ms over the central (F(3.49, 174.615) = 2.576, p = 0.047) region between the ‘Violent’ and ‘Pleasant’ emotion categories. Simple contrasts showed significant ERP Group by Emotion interaction effects for ‘Pleasant’ vs ‘Violent’ emotion categories between 328 - 1000ms at frontal electrode sites. Significant effects between the same two emotion categories were also seen in central and posterior sites during earlier time periods and extending throughout the 1 second analysed epoch (94 – 1000ms) (See Table 3a,b; Figure 3). Significant effect across all time periods are shown; however, for the purposes of the current manuscript, only significant later ERP effects will be discussed. The absence of main group effects is interpreted as a result of rather focussed ERP differences.
Figure 3. ERP effects representing frontal (AF3/AF4), Central (C3/C4) and parietal (P3/P4) locations across all emotion categories for Low (A) and High (B) aggression use groups. Note significant effects for ‘Pleasant’ vs ‘Violent’ emotion categories between 328 - 1000ms in frontal areas of the brain and between 94 – 1000ms in central and parietal regions.

Table 3: Summary of significant ERP results for group by emotion (a) and group by emotion by hemisphere (b) across all time periods for Pleasant vs Violent emotion categories.

<table>
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<th>Electrode sites</th>
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<th>df</th>
<th>F</th>
<th>P value</th>
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</thead>
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<tr>
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<tr>
<td></td>
<td>484</td>
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<td></td>
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b)

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<td>4.94</td>
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4.4 Discussion

The present study aimed to determine whether a particular sub-section of the general population, characterised only by their self-reported aggressive tendencies, differed in their conscious evaluation of emotional stimuli compared to their non-conscious physiological reaction to the same stimuli. By utilising a triangulation approach incorporating explicit rating measures (which require conscious, evaluative reasoning and responding via cortical brain processing), SRM (which is a measure of raw, affective information processing and is sensitive to sub-cortical brain processes), and EEG (which measures a combination of conscious, cortical and non-conscious, sub-cortical brain processing), we were able to demonstrate that our participants differed in their conscious and their non-conscious appraisal of affective stimuli.

Event related potential analysis showed significant group effects related to differences between the ‘Pleasant’ and ‘Violent’ emotion conditions across both hemispheres between both groups. Upon visual inspection of the curves in frontal areas of the brain, the ERPs of the ‘Pleasant’ and ‘Violent’ emotion categories appear to follow a similar trajectory in the high aggression group which then separates in the left hemisphere approximately 800ms post stimulus onset. In the low aggression group, both curves (‘Pleasant’ and ‘Violent’) appear to follow a similar trajectory across both hemispheres but remain separate throughout the 1000ms epoch studied. The larger ERP amplitudes noted in later time periods of the high aggression group to images portraying violence may be due to increased attention payed to the image. As individuals who are low aggressors are perhaps less likely to view violent images, the larger amplitude ERP perhaps indicated an increased motivational relevance due to the perception of threatening stimuli. Heading more posteriorly to central and parietal sites, similar trends between the ‘Pleasant’ and ‘Violent’ emotion conditions can be seen. The ERP of the
‘Violent’ emotion category appears to be more attenuated in the high aggressive group and so follows a similar trajectory to the ERP curve of the ‘Pleasant’ condition, whereas the ERP curves of the ‘Violent’ and ‘Pleasant’ conditions remain separate in the low aggressive group. These findings are consistent with previous studies demonstrating that highly aggressive individuals tend to show a more inhibited (smaller amplitude) P300 response than low aggressive individuals (Bartholow, Bushman & Sestir, 2006; Jinghua & Yong, 2014; Wang et al., 2012; Bond & Surguy, 2000; Surguy & Bond, 2006). These studies posit the idea that the smaller P300 component may be due to cognitive deficits (Jinghua & Yong, 2014) or be associated with increases of aggression. Wang et al., (2012) stated that this effect may imply a reduction in brain activity which has been known to reflect activation of the aversive motivational system which can be linked to aggressive behaviour (Engelhardt et al., 2011). A further explanation of the observed findings may be that, as a consequence of life experience, high aggressors may be somewhat less responsive to violent stimuli, due to desensitisation effects. This may prevent them in engaging cognitively with the stimulus, resulting in attenuated ERP amplitudes.

It is pertinent to note that studies performed by Stanford et al, (2003) and Barratt et al, (1997) showed that the reduced P300 component was only seen in impulsive aggressive individuals, prompting the idea that reduced P300 may only be characteristic of aggressive individuals who are impulsive and not premeditative (see Patrick, 2008). The current study did not divide its sub-groups based on a combination of aggression and impulsivity scores. However, the authors did administer the BIS-11 (Patton & Stanford, 1995) and found that participants in the high aggression group showed a higher mean score on the BIS-11 which may account for the diminished P300 in the ERPs for this group. Additionally, a study by Surguy and Bond (2006), whilst also utilising the BDHI among a non-clinical population, revealed the same smaller amplitude P300 among
higher aggressive individuals. They proposed that they may have seen greater differences in P300 amplitude had they recruited a cohort who may have scored more extremely on the scale. The mean BDHI scores within our high aggression cohort scored similarly, albeit slightly lower than those reported in the aforementioned study. Our study participants were younger than those studied by Surguy and Bond and were members of the general community, and not selected based on their aggression or hostility. It is therefore possible that our results may have been slightly diminished due to moderate rather than extreme levels of aggression in our sample as was also seen by Surguy and Bond (2006).

As was expected, conscious explicit valence and arousal ratings for all emotion categories showed no statistically significant differences between the low and high aggression groups. Several other studies have pinpointed the existence of similar results whereby conscious self-report often does not yield differing results among different subgroups (Patrick et al., 1993; Meffert, Gazzola, den Boer, Bartels & Keysers, 2013; Grahl et al., 2012). A possible explanation may be that the initial variation between high and low aggressive groups may not have been large enough to create a significant difference of conscious appraisal of emotional stimuli, as our cohort was drawn from a non-clinical population. Another possibility may be due to Social Desirability Bias (SDB), whereby due to self-presentation concerns, respondents may have deliberately altered their ratings to more socially desirable ranges. The Snyder self-monitoring scale was utilised to determine if either group was acutely more aware of how much they engaged in the expressive control of how they presented themselves in public. As both groups scored equally with no significant mean difference, it was evident that self-monitoring probably did not account for the non-significant results obtained from the explicit ratings. The conscious action-oriented nature of the valence and arousal ratings meant that our
participants were required to consciously evaluate the emotion-laden images and through cortical, conscious brain processes, determine their affective evaluation of the images presented. Consequently, a multitude of non-conscious brain processes take place prior to initiating the conscious component of the task (explicit rating). This being so, it is evident that the two groups studied did not differ in their conscious interpretation but did differ in their non-conscious brain processes of emotion images.

Startle reflex modulation also failed to show any significant main effects of group in the analysis. Perhaps self-reported aggression did not extend down to the sub-cortical areas of emotion processing, accounting for the lack of significant differences between the high and low aggression groups. However, our study compared aggression using a median split within a non-clinical and non-forensic population. Therefore, the variation between high and low aggression within this cohort may have been insufficient to reveal differences in raw affective emotion processing which SRM has demonstrated in comparisons between clinical and non-clinical populations (Dawson et al., 1993; Hazlett et al., 2007; Kumari et al., 2005; Miranda et al., 2003; Patrick et al., 1993). SRM amplitude and latency have been shown to be higher and earlier respectively with increasing threat-related stimuli presentation with aggressive individuals generally presenting with an inhibited response to threat-related stimuli compared to matched controls (Patrick et al., 1993). Upon visual inspection of the startle curves, it can be seen that the ‘Erotic’ and the ‘Violent’ images have the smallest and largest peak amplitudes respectively across both groups. This finding is consistent with previous studies utilising this technique.

Despite the comprehensive nature of this study, there were unavoidable limitations. Many studies highlight the differences between premeditated and impulsive
aggressive individuals, with physiological biomarkers such as the P300 being indicative of impulsive and not premeditative aggressors. Therefore, it may have been preferable to group this cohort into ‘Low BDHI’ and ‘Low BIS11’ in order to determine physiological responses to impulsive aggressive individuals. As not all of the individuals who scored highly on the BDHI also scored highly on the BIS-11, this method would have meant we would have had to exclude several individuals from analysis and so, the authors chose to sacrifice this story for increased power during analysis and to look at aggression as a whole/unitary construct. Additionally, we utilised a modified version of the BDHI whereby we attempted to make it more apparent to our cohort that we were attempting to determine the extent of their aggressive traits with the hope they may intrinsically increase their self-monitoring. Future studies may wish to administer this questionnaire in its intended format as changing the format may have had an effect on self-monitoring as our cohort scored lower on the scale compared with similar studies which also utilised a normal population (see Surguy & Bond, 2006). This also allows easier comparisons with previous literature allowing for more conclusive interpretations of results. Additionally it may have been interesting to administer a questionnaire on Social Desirability (SD). As with aggression and violence, we are determining somewhat controversial and socially detested behaviours and this is where social desirability has been shown to take precedence (Krumpal, 2011). We aimed to decipher this by utilising the Snyder self-monitoring scale but as it has been shown that the use of SD scales in questionnaire research influences results (van de Mortel, 2008). Future studies in this field may endeavour to utilise this construct.

Taken together, our results indicate that it is possible to differentiate individuals within a normal population based on trait aggression by presenting them with affectively relevant stimuli. It may be evident that, as Surguy and Bond (2006) postulate, the
differentiation between this normal population may be more complex than what could be revealed when comparing highly aggressive individuals or patient populations to controls. As we were utilizing effects determined from exposure to affect-inducing images, it may have been interesting to determine how much violent imagery our cohort are generally exposed to (by way of violent video games, movies, television shows etc.) in addition to their self-report aggression. We may have been able to determine whether the physiological findings were not only caused by conscious appraisal of aggressive tendencies but also if they are characteristic of desensitisation effects to violent stimuli. It is known that there are observable physiological desensitisation effects attributable to increased exposure to violent stimuli (Bartholow et al., 2006; Bailey, West & Anderson, 2011). Future studies may look to further elaborate on the current studies results and introduce exposure levels to violent stimuli as another variable when looking at conscious versus non-conscious emotional appraisal in this sub-group.
References


Chapter 5

DOES VARYING LEVELS OF EXPOSURE TO PORNOGRAPHY AND VIOLENCE HAVE AN EFFECT ON OUR NON-CONSCIOUS EMOTION?

Reference for publication:

Kunaharan, S., Halpin, S., Sitharthan, T., & Walla, P. (2017). Does varying levels of exposure to pornography and violence have an effect on our non-conscious emotion?

Manuscript submitted for publication
Co-author statements

By signing below, I confirm that Sajeev Kunaharan contributed to the majority of written content to the paper/publication entitled: Kunaharan, S., Halpin, S., Sitharthan, T., & Walla, P. (2017). Does varying levels of exposure to pornography and violence have an effect on our non-conscious emotion? Manuscript submitted for publication.

11/12/2017

Sean Halpin     Date

Thiagarajan Sitharthan     Date

13/12/2017

Peter Walla     Date

11/01/2018

Frances Martin     Date

Assistant Dean Research Training
Faculty of Science
Abstract

As we are often inundated with images of violence and pornography in modern times with the aid of mobile devices and unrestricted online access and content, the non-conscious effect of such exposure is an area of concern. To date, many clinicians and researchers in behavioural sciences rely on conscious responses from their clients to determine affective content. In doing so, they overlook the effect the non-conscious has on an individual’s emotions. The present study aimed to examine variations in conscious and non-conscious responses to emotion inducing images following varying amounts of exposure to violent and pornographic images. Eighteen participants who self-reported as being low pornography users were presented with emotion inducing images after no exposure (Session 1), 1 round of exposure to 50 pornographic and 50 violent images (Session 2) and a further 9 rounds of exposure to 50 pornographic and 50 violent images (Session 3). Sessions were temporally separated by at least 2 days while Startle Reflex Modulation (SRM) and scalp-recorded event-related potentials (ERPs) were used to determine non-conscious emotion-related processes. Explicit valence and arousal ratings were assessed for each presented image to determine conscious emotion effects. Conscious explicit ratings and SRM amplitudes revealed no difference between the sessions. However, frontal ERP analysis revealed significant changes between processing of ‘Violent’ and ‘Unpleasant’ images at later ERP time windows, further supporting the growing body of research which shows that relying on self-report data does not result in a full understanding of emotional responses.
5.1 Introduction

Violent and pornographic material available to people is ubiquitous in the modern age. Violence and violent images are often portrayed as entertainment in movies and on television and its prevalence and effect is often unavoidable in print media. Access to pornography, on the other hand, has enjoyed a boom in recent times thanks to high speed internet services, Wi-Fi and mobile devices ensuring accessibility, anonymity and a wealth of content allowing for increased exposure to a vast array of legal content without fear of consequences or repercussions. Society’s increased and continued access and exposure to this content has the potential to alter our emotions, emotion perception and emotional responses and perhaps become desensitised to its effect (Kunaharan & Walla, 2014; Harper & Hodgins, 2016; Hilton & Watts, 2011; Koukounas & Over, 1993). Several studies have attempted to determine whether increased exposure to violence (Englehardt, Bartholow, Kerr & Bushman, 2011; Elmore, W.R., 2014; Stockdale, Morrison, Kmiecik, Garbarino & Silton, 2015; Wood, Griffiths, Chappell & Davies, 2004; Bailey, West & Anderson, 2011; Bartholow, Bushman & Sestir, 2006; Carnagey, Anderson & Bushman, 2007) or pornography (Prause, Steele, Staley & Sabatinelli, 2014; Prause, Steele, Staley, Sabatinelly & Hajcak, 2015; Kuhn & Gallinat, 2014) has any effect on our emotions and whether exposure to either one has any effect on the other (e.g. if viewing excess pornography increases the risk of sexual violence) (Allen, Emmers, Gebhardt & Giery, 1995; Ferguson & Hartley, 2009; Hald, Malamuth & Yuen, 2010; Johnson, S.A., 2014; Kingston, Federoff, Firestone, Curry & Bradford, 2008; Mancini, Reckdenwald & Beauregard, 2012; Vega & Malamuth, 2007; Wright, Tokunga & Kraus, 2015). A common feature of many studies in this field is the use of questionnaire derived data to determine participant affect; few studies make use of alternative methodology required to determine emotional affect beyond conscious thought.
5.1.1 Problems with relying solely on self-report based methods

Currently, a majority of clinicians and researchers in the field of behavioural science rely foremost on the guidelines obtained from the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) and/or International Classification of Diseases (ICD-10; World Health Organisation, 1993) to categorise and diagnose patients (Evans et al., 2013; Reed, Correia, Esparza, Saxena & Maj, 2011). What is concerning about this is that too often many of these guidelines require conscious appraisal from the potential patient either via the utilisation of questionnaires or face to face interviews with the clinician/researcher. It is an already established notion that emotions and, further to that, emotional appraisal contains an implicit non-conscious as well as an explicit conscious component, and accordingly, the overreliance to obtain a ‘true’ measure of an individuals’ emotional state via the use of ‘conscious’ self-report measures remains problematic. Aside from virtually leaving out all non-conscious emotion responses from analysis, self-report as such can come under a host of inherent biases especially when determining attitudes and emotions pertaining to behaviours which may be deemed socially and morally unacceptable or taboo (Krumpal, 2013; Van de Mortel, 2008). Social desirability bias (SDB) is a term used to describe the often conscious altering of a response to conform to a known social ideal. This can often occur due to fear of judgment, embarrassment or for moral purposes. There is evidence to suggest that SDB has an effect on participant responses. Kelly, Soler-Hamperjsek, Mensch and Hewett, (2013) demonstrated that the method utilised to collect data on sexual behaviour influenced the reported prevalence of the behaviour among male respondents. The authors suggested that more research is required to investigate and improve methods by which sensitive data is collected. Further to this, as emotional affect has been known to be a composition of various levels of processing, involving both
cortical brain structures (including conscious processing) and deeper sub-cortical structures processing information non-consciously (Walla, 2011). Merely relying on one such facet (in this case, questionnaires) belies the interpretive significance of the affect in question. Put simply, a more complete and accurate understanding of an individuals’ affective state would be achieved through combining several methods of collecting data. Each method should be sensitive to a specific level of emotion processing to contribute to a true representation of emotional affect and appraisal. One way this may be done is via the use of physiological measuring tools such as Event-Related Potentials (ERPs via Electroencephalography) and Startle Reflex Modulation (via Electromyography) in conjunction with self-report measures. The present paper aims at using those measures in a triangulation approach combined with self-report data.

5.1.2 Event-related potentials (ERPs)

Previous research suggests that later effects, such as the P300 component and late positive potential (LPP), are most relevant to investigating emotional responses to violence and pornography. The P300 amplitude is commonly used as an index of higher order cognitive functioning as well as the amount of evaluative processing directed at the content of the foreground stimulus (Linden, 2005; Hillyard & Kutas, 1983; Bailey et al, 2011). The LPP, which is reflected by a sustained positivity beginning at around 300ms post-stimulus, and extends from the central and parietal regions of the brain, is generally greater in amplitude for stimuli which elicit stronger affect (Olofsson, Nordin, Sequeira & Polich, 2008; Ito & Cacioppo, 2005; Hajcak, Dunning & Foti, 2009; Bosshard Bourke, Kunaharan, Koller & Walla, 2016).

The P300 component has consistently been shown to be somewhat attenuated with regards to violence and aggression. Surguy and Bond (2006) showed that individuals who
self-reported as being aggressive generally had decreased P300 amplitudes in frontal areas of the brain. Harmon-Jones, Barratt and Wigg, (1997) also showed that reduced P300 amplitudes in central areas of the brain correlated with physical and verbal aggression, and hostility. Similar results were also obtained by Bernat, Hall, Steffen and Patrick (2007), who showed that inmates convicted of violent offences showed a robust negative relationship with P300 amplitude whereas non-violent inmates did not. Smaller P300 amplitude appears to reflect the involvement of fewer neural resources and engagement, suggesting that aggressive individuals may utilise fewer cognitive resources when presented with information pertaining to violence and aggression (Wang, Zhao, Qiu, Ybarra, Liu & Huang, 2012).

The P300 component also appears to be a relevant feature in studies of the effect of exposure to violent material. Bartholow et al. (2006) showed that individuals who played violent video games on a regular basis elicited a reduced P300 when viewing violent images than non-violent video game players. Engelhardt et al (2011) further showed that participants who were previously low in exposure to violent video games showed a reduction in the P300 component of the ERP after 1 session of playing a violent video game, suggesting an attenuated P300 might be a reliable marker for physiological desensitization.

Studies investigating neural attributes to problematic or frequent pornographic material use is relatively scarce. Unproblematic or infrequent use of pornographic material generally induces an enhanced LPP waveform when individuals are presented with erotic visual information (Prause et al, 2015). A larger amplitude LPP is an index of sustained processing of emotionally relevant stimuli and is a marker of motivational significance (Voon et al., 2014). In contrast, with regards to ERP effects of problem
viewing of visual sexual stimuli, existing literature has generally shown a reduced amplitude LPP component. Prause et al., (2015) presented individuals who either reported or denied problematic pornography use with emotion-inducing images (including explicit sexual images). Individuals who reported problems policing their pornography use and who had a stronger desire for sex demonstrated lower LPP amplitudes in response to the explicit sexual images. The authors suggested that this result was unexpected. Numerous studies of individuals with addictive behaviours have employed cue-related emotional tasks. Typically, these studies have found an increased LPP amplitude when presented with images of the individual’s addiction-inducing substance (Minnix et al, 2013). Prause et al., (2015) suggested that this unexpected finding may be due to habituation effects, as the participants who presented with the reduced LPP waveform also scored significantly higher in the amount of hours they spent viewing pornographic material.

5.1.3 Startle reflex modulation (SRM)

Deeper, sub-cortical effects of emotion processing may be associated with startle reflex modulation (SRM). SRM is a technique by which a short, unexpected burst of white noise, usually in the order of 100-110dB, is played binaurally into the ears of an individual while being exposed to a controlled foreground stimulus containing affective content (Lang, Bradley & Cuthbert, 1990). SRM is a relatively new technique used in emotion research to assess raw affective information processing (Mavratzakis, Molloy & Walla, 2013). The startle response, once elicited, is measured by the intensity and latency of the recorded eye blink. Appetitive foreground stimuli generally result in smaller blinks, and aversive affective content results in larger blinks (Filion, Dawson & Schell, 1998; Lang et al, 1990).
Several studies have utilised SRM to investigate emotion in its raw affective state, including studies related to marketing (Walla, Brenner & Koller, 2011; Grahl, Greiner & Walla, 2012; Walla & Koller, 2015), walking in urban environments (Geiser & Walla, 2011), schizophrenia (Dawson, Hazlett, Filion, Nuechterlein & Schell, 1993), psychopathy (Patrick, Bradley & Lang, 1993), food preferences (Walla, Richter, Farber, Leodolter & Bauer, 2010) and disabilities (Lyons, Walla & Arthur-Kelly, 2012). Many of the SRM studies pertaining to exposure and reaction to violence have been used in conjunction with video games, and have examined whether continued exposure can lead to violent behaviour (Wood et al., 2004). A dissertation investigating the effects violent video games have on aggressive behaviour and the SRM found that participants who played a violent video game prior to viewing violent negative images showed an attenuated startle response to the violent unpleasant image compared to participants who played a non-violent video game (Elmore, 2012). This effect was seen for both chronic and acute violent video game exposure, and it was suggested that these results supported the desensitization hypothesis in that playing violent video games desensitizes players to violence. The use of SRM in recording the processing of sexual information is rare (Koukounas & Over, 2000). The literature consistently depicts an attenuated startle effect when participants are exposed to a positive sexual foreground stimulus (Jansen & Fridja, 1994; Ruiz-Padial & Vila, 2007; Koukounas & McCabe, 2001). Startle reflex also appears to be a more reliable indicator of a person’s raw affective state than self-reported emotion (Filion et al., 1998). Allen, Trinder and Brennan (1999) investigated the modulation of the startle effect in depressed and non-depressed participants. The self-reported valence of presented images remained similar across both depressed and non-depressed groups. However, the SRM demonstrated clear between group differences. Another recent study by Walla, Koller, Brenner & Bosshard (2017), which used varying
rounds of evaluative conditioning of liked and disliked brands found that conditioning effects resulted in selective differences in self-report versus SRM measures. In a review of studies utilising startle to determine affect in individuals who play games, Nesbitt, Blackmore, Hookham, Kay-Lambkin & Walla, (2015) suggested that although subjective feedback (via self-report) is important, an objective measure such as SRM may provide more about an actual state of affect than the individual may do on their own volition. Furthermore, it has also been suggested that SRM be utilised in the study of pornography and other matters which may be considered taboo in order to determine a more objective measure of affective state (Kunaharan & Walla, 2014).

In summary, emotional affect involves a complex system incorporating conscious as well as non-conscious mechanisms. Therefore, a multi-level approach that accounts for several levels of emotion processing from conscious to non-conscious would be invaluable. The present study aimed to build upon the work by Kunaharan, Halpin, Sitharthan, Bosshard & Walla (2017), by determining how varying degrees of priming (short-term exposure) to violent and pornographic images can alter conscious and non-conscious emotion processing. The varying degrees of priming was added to the methodology on the basis of the results obtained from the evaluative conditioning paper by Walla et al., (2017). On the basis of this paper, it made sense to expose participants to increased amounts of violence and pornography to determine whether habituation or priming effects had any effect on physiological and/or self-reported measures. We aimed to do this by utilising a combination of conscious self-report methods including conscious evaluation of affective content in terms of valence and arousal, as well as methods pertaining to emotional appraisal below conscious awareness such as Electromyography (EMG) by way of startle reflex modulation (SRM) and Electroencephalography (EEG). We hypothesised that ERPs elicited by emotion pictures during later time periods would
attenuate with increasing prior exposure to violent and pornographic material due to physiological habituation. Startle reflex was also hypothesised to be attenuated resulting in smaller amplitudes with increased prior exposure to violent and pornographic images. We did not expect explicit self-report to vary significantly across sessions.

5.2 Methods

5.2.1 Participants

Fifty two male participants enrolled at the University of Newcastle were recruited via word of mouth, flyers or the University of Newcastle’s School of Psychology’s experimental management system (SONA). Participants were all current undergraduate or postgraduate students at the University of Newcastle, Australia with an age range between 18 and 30 years (M=21.13; SD=2.93). All participants provided written informed consent and were native English speakers. Participants recruited into the study explicitly stated that they were heterosexual, right-handed, had normal/corrected to normal vision, had no history of neuropathological/psychiatric illness, were free of central nervous system affecting medications or substances, had no history of being a victim of physical/sexual abuse and had no history of being incarcerated in a penitentiary. Participants were either financially reimbursed for their time ($60AUD) or awarded with course credit (if recruited via SONA) at the completion of the experiment. The study was approved by the University of Newcastle Human Research Ethics Committee (H-2013-0309).

Only participants between the ages of 18 and 30 were eligible to complete all sections of the questionnaire and were then invited to complete the physiological
recording sessions. Any participant who reported their age to be outside of that range was automatically taken to the end of the survey and were not able to continue.

5.2.2 Measures

5.2.2.1 Online questionnaire

An online survey was administered to assess conscious emotion responses from each participant prior to the initial physiological testing session. The survey was created using Lime Survey (www.limesurvey.com) and included demographic questions as well as the Snyder Self-Monitoring Scale-Revised (Snyder & Gangestad, 1986). The Snyder Self-Monitoring Scale was included as it is sensitive to how much individuals understand and monitor their self-presentations and expressive control. Also included was a purpose built Pornography Use Questionnaire to gauge pornography viewing behaviour incorporating items from Harkness et al (2014) and Sitharthan et al. 2017 (in preparation) in addition to several items developed by the authors. For the purposes of analysis, participants were divided into 3 groups (low, medium, high) based on their responses to two separate items on the Pornography Use Questionnaire. The questions were worded: “When viewing pornography, how much time will you spend during one episode?” and, “In the last year, what is the frequency with which you have viewed pornography?” Answers were scored as per Kunaharan et al. (2017) and an approximate number of hours per year of pornography use determined. For a full description of the scoring procedure see Kunaharan et al., (2017). Of those groups, only data from those participants who were in the “low” group were considered in this study. Additionally, only scores from the Snyder Self-Monitoring scale were considered in this paper further to determine our cohort’s level of self-monitoring.

The survey took approximately 20-25 minutes to complete.
5.2.2.2 Stimuli

5.2.2.2.1 IAPS images

Stimuli for the present study comprised of 150 images sourced from the International Affective Picture System (IAPS, Lang et al., 2008). The IAPS is a standardised collection of around 1000 images which depicts people, places, objects and events, and is used widely in emotion research (e.g. Van Dongen, Van Strien & Dijkstra, 2016; Mavratzakis et al., 2013). In the present study, images from this database were used on the basis of pre-evaluation results and was categorised into 1 of 5 equal emotion categories, these being: Violent, Neutral, Pleasant, Unpleasant and Erotic (each category containing 30 images). Each emotional image category used in the current experiment differed in pre-evaluative normative valence and arousal ratings based on data acquired from Lang, Bradley & Cuthbert, (2008). Those valence ratings (scale range 1-9) for each emotion category were as follows: Erotic, M = 7.3 (SD = 0.40); Violent, M = 3.22 (SD = 0.86); Neutral, M = 5.09 (SD = 0.30); Pleasant, M = 7.38 (SD = 0.36); Unpleasant, M = 2.01 (SD = 0.21). The arousal ratings (scale range 1-9) for each emotion category were as follows: Erotic, M = 6.76 (SD = 0.51); Violent, M = 5.94 (SD = 0.71); Neutral, M = 4.53 (SD = 0.92); Pleasant, M = 5.94 (SD = 0.86); Unpleasant, M = 5.95 (SD = 0.63).

All participants were shown all images and were requested to explicitly rate each image from 1-9 based on each valence and arousal using a button press on a computer keyboard.
5.2.2.2 Exposure images

Stimuli utilized for the exposure condition comprised of 100 still images sourced from the Internet depicting scenes of violence (50 images) and pornography (50 images). For standardisation purposes, the images depicting explicit sexual content were comprised of heterosexual couples engaging in consenting sexual behaviour. Each image presented included one or more of the following characteristics: vaginal penetration, anal penetration, oral stimulation. The violent images shown portrayed a combination of physical violence (rioting, police brutality) and the after effects of physical violence (graphic crime scenes, autopsy photos).

5.2.2.3 EEG recordings

Brain potential changes were recorded using a 64-channel BioSemiActiveTwo system and ActiView software (BioSemi, Amsterdam, The Netherlands) at a rate of 2048 samples/second. Electrode layout conformed to the international 10-20 standard of electrode placement and were referenced to a common average signal. Data sets were batch-processed using EEG-Display (version 6.4.8; Fulham, Newcastle, Australia). During processing the sampling rate was down-sampled to 256 samples/s and filtered from 0.1Hz to 30Hz. ERP epochs were defined in relation to the onset of presentation of each IAPS image from -100ms pre stimulus to 1000ms post stimulus. Epochs were baseline-corrected with the correction occurring 100ms prior to stimulus onset and data points along the ERP were reduced to 25 data points along the first second post stimulus presentation.
5.2.2.4 EMG recordings

Startle responses were measured using a Nexus-10 (produced by Mind Media BV) recording device and Bio-trace + software and batch-processed using EEG-Display version 6.4.8; Fulham, Newcastle, Australia). Bipolar EMG electrodes were attached under the left eye of each participant and potential changes of the musculus orbicularis oculi were measured at a sampling rate of 2048/s with a band pass filter of 20-500 Hz during the recording. The raw EMG data was then converted into amplitudes using the root mean square (RMS) calculation. Startle blink amplitude values were defined as the immediate peaks of the EMG waveforms on trials involving the startle probe. Each image category (Violent, Neutral, Pleasant, Unpleasant and Erotic) contained 5 images which were randomly paired with a startle probe (totaling 25 startle probes for each session of the experiment). Startle probes were presented binaurally at 110dB using professional headphones (Sennheiser HD280).

5.2.2.5 Explicit responses

Conscious explicit responses (valence and arousal) from each participant for each image were determined via the participant rating each image on a likert scale from 1-9 for valence (1 = Very Pleasant; 9 = Very Unpleasant) and arousal (1 = Very intense; 9 = Very calming). Valence and arousal scores for each emotion category were averaged separately across the 30 images for each recording session for each participant.
5.2.3 Experimental task and procedure

5.2.3.1 Baseline measure

Following completion of the online questionnaire, participants were asked to complete the entire experiment by attending each of the three physiological recording sessions in the Functional Neuroimaging Laboratory (University of Newcastle). For each session, participants were seated approximately 50cm in front of a 32” LED monitor (resolution 1024x768 pixels) and were then fitted with a 64 channel BiosemiActiveTwo EEG system and two 4mm Biotrace electrodes (with approximately 20mm spacing on the inferior orbicularis oculi of the left eye) for Startle Reflex Modulation. Additional electrodes were also placed laterolaterally, supraocularly, infraocularly and on the mastoids for reference and to monitor eye blinks. The computer program Presentation (NeuroBehavioral Systems, Albany, United States of America) was used to visually present instructions and visual stimuli. Stimuli presentation and all physiological recordings were conducted by the researcher from a separate room. Participants were given a brief overview of the experiment during set up of the equipment and were asked to read the instructions for the task at hand on the screen prior to recording. Headphones (Sennheiser HD280) were placed over the participant’s ears and testing commenced with the participant alone in a dimly lit room to ensure adequate focus on the stimuli.

Upon commencement of the experiment, each IAPS image was randomly ordered and presented on the screen for 5 seconds, one at a time, while participants viewed and explicitly rated valence and arousal. Participants were allowed to take their time with the rating of each but were instructed prior to testing to try not to think about it too much and to provide their most instinctive response. Upon the rating of each scale, a fixation cross would appear in the center of the screen for 1 second before the following image was
presented. Startle probes occurred randomly at the 4th second post stimulus onset to ensure adequate affect with at least a 40s time window between consecutive startle probes. Physiological and explicit measures were taken from each participant for all 150 IAPS images with a short break offered to the participant during the halfway point to help reduce effects of fatigue.

5.2.3.2 Subsequent recording sessions

Following completion of the baseline recording session, participants were invited to return to the lab for a further 2 recording sessions (totalling 3 recording sessions). Each recording session was temporally separated by at least 2 days.

The procedure for the second and third recording sessions was largely similar to that of the baseline recordings whereby 64-channel EEG and SRM physiological effects were recorded while each participant viewed and explicitly rated the valence and arousal of the same 150 IAPS images again. The timing of each image was exactly as per the baseline recording session and startle probes were again presented randomly on the 4th second post stimulus onset with an inter-startle latency of at least 40s. Prior to the participants undertaking this task, each participant was exposed to 1 round (session 2) and 9 rounds (session 3) of the 100 exposure images comprising of 50 violent and 50 pornographic images. Recordings were not taking place during the exposure. However, to ensure attention to the stimuli presented, participants were instructed to press left and right buttons on the keyboard when they identified the image presented as either pornographic (right button press) or violent (left button press). Each image was presented on the screen for 1 second, with an inter-stimulus interval of 500ms. In order to determine the perceived intensity of the images presented, at the completion of the first exposure round of session 2, participants were asked to determine how intense they found the presented violent and
pornographic images by indicating it on separate Likert scales from 0 (not very intense) – 10 (very intense). Following, completion of the exposure rounds, participants resumed with the viewing and rating of IAPS images.

5.2.4 Statistical analysis

As mentioned previously, only participants who had been categorized as ‘low’ pornography users based on their reported hours spent viewing pornography (N=18) were of interest in this analysis. For analysis of Explicit Ratings, a general linear repeated measures analysis was conducted of the 5 different emotion categories over the 3 sessions. SRM amplitudes for all emotion categories across all recording sessions were also analysed using a general linear repeated measures design with the within subjects factors of Emotion and Session. A general linear repeated measures design was also used to compare ERPs over the 3 exposure times for 2 of the emotion categories (‘Violent’ and ‘Unpleasant’) at frontal and parietal sites from both hemispheres (AF7, AF8, P5 and P6). To determine maximum later ERP effects including P300 and LPP components only 17 out of the 25 averaged data points of interest across the entire 1 second ERP epoch were analysed. The time span of interest was from 206ms to 997ms. To correct for violations of sphericity across general linear models analysis, the Greenhouse-Geisser procedure was utilised. Only data from those individuals who completed all sections of the experiment (online survey and all 3 EEG recording sessions) were subjected to analysis.
5.3 Results

5.3.1 Participant demographics

Participants (N=52) included in the analysis completed all aspects of the procedure including the online questionnaire in conjunction with all 3 separate EEG and SRM recording sessions. Sessions were separated by at least 2 days (Range = 2-229; Mean = 13; SD = 38.22). Participant cohort for this study was largely homogeneous with a majority reporting being of Caucasian descent born in Australia. The cohort also largely consisted of students having completed secondary school, and either living with a partner or never being married (see Table 1).
Table 1. Demographic Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Participants N=52</th>
<th>(%)</th>
<th>Low Porn Use Group N=18</th>
<th>(%)</th>
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<tr>
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<td>1.9</td>
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* Not all sum due to non-responders
5.3.2 Self-reported pornography and questionnaire scores

Number of hours of porn use per year for each participant was calculated as described in Kunaharan et al (2017). Participants in the “low porn use” group ranged between 1.8 and 9.75 hours of porn use per year with a mean of 6.5 hours per year of porn use. Snyder scores ranged between 5 and 15 (out of a possible score of 18), with a mean of 10.22 and intensity ratings for exposure images ranged from 3 to 10, with a mean of 8.19 for Violent images and 5-10, with a mean of 7.85 for pornographic images (See Table 2.).

Table 2. Mean questionnaire scores for Low porn use group

<table>
<thead>
<tr>
<th></th>
<th>Low Porn Use Group N=18</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Porn hours per year</strong></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>1.8 - 9.75</td>
</tr>
<tr>
<td>Mean</td>
<td>6.5</td>
</tr>
<tr>
<td>SD</td>
<td>2.89</td>
</tr>
<tr>
<td>Range (Max 18)</td>
<td>5 - 15</td>
</tr>
<tr>
<td><strong>Snyder total Score</strong></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>10.22</td>
</tr>
<tr>
<td>SD</td>
<td>3.12</td>
</tr>
<tr>
<td>Range (Max 10)</td>
<td>3.0 - 10.0</td>
</tr>
<tr>
<td><strong>Violent exposure images intensity rating</strong></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>8.19</td>
</tr>
<tr>
<td>SD</td>
<td>1.98</td>
</tr>
<tr>
<td>Range (Max 10)</td>
<td>5.0 - 10.0</td>
</tr>
<tr>
<td><strong>Pornography exposure images intensity rating</strong></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.85</td>
</tr>
<tr>
<td>SD</td>
<td>1.27</td>
</tr>
</tbody>
</table>
5.3.3 Explicit responses

Explicit ratings were taken from each participant for each recording session as they consciously rated each emotion image on valence (pleasantness rating) and arousal (intensity rating). For each of the 3 recording sessions, valence and arousal scores were then averaged across the 30 images for each emotion category. None of the emotions showed any significant changes over the 3 recording sessions for Valence (F(2.568) = 0.610, $p = 0.587$) or Arousal (F(2.281) = 0.741, $p = 0.500$). However, contrasts appeared to reveal significant effects for Arousal ratings between Unpleasant and Pleasant (F(1) = 5.143, $p = 0.037$) as well as Erotic and Pleasant (F(1) = 8.787, $p = 0.009$) emotion conditions both between sessions 2 and 3. Contrasts also revealed significant Valence differences between Neutral and Pleasant (F(1) = 4.958, $p = 0.040$) emotion conditions (see Figure 1).
Figure 1. Explicit Valence (A) and Arousal (B) Ratings for each emotion category across all 3 sessions. Note no significant differences in conscious explicit ratings in any emotion category across sessions.
5.3.4 Physiological Measures

5.3.4.1 Startle Reflex Modulation (SRM)

Startle Reflex modulation was utilised to determine if exposure to varying amounts of violent and pornographic images had any effect on startle amplitude. Although it can be seen that startle amplitudes for ‘Neutral’, ‘Unpleasant’ and ‘Pleasant’ emotion categories appear larger in session 2 than in sessions 1 or 3, results of the general linear model showed that there was no significant difference in startle amplitudes for any emotion categories over the 3 sessions (F(4.660) = 0.548, p = 0.727; See Figure 2).

![Startle reflex graph for each emotion category across all sessions](image)

**Figure 2.** Startle reflex graph for each emotion category across all sessions. Note no significant differences were seen within any emotion category across sessions for the ANOVA.
5.3.4.2 Event-Related Potentials (ERPs)

Only ERPs pertaining to ‘Violent’ and ‘Unpleasant’ emotion categories were analysed across 17 time points of interest spanning 206ms – 997ms. Results of the general linear model showed that there were significant effects for the 3-way interaction between Emotion, Session and Hemisphere in Frontal areas with significant effects occurring at 362ms and 460ms and consistently between 655-948ms (See Table 3). It is important to note significant effects were seen across both hemispheres between Sessions 1 and 2 as well as between Sessions 2 and 3 (barring the significant effect seen at time = 948ms, whereby significant effects were only seen across both hemispheres between Sessions 2 and 3). No significant differences were seen in Parietal brain regions (P5/P6) however contrasts appeared to reveal significant 3-way interactions between Emotion, Session and Hemisphere occurring between Sessions 1 and 2 at 411ms (F(1) = 5.033, p = 0.038; See Figure 3).

Table 3. Summary of significant effects (Greenhouse-Geisser corrected) across Frontal electrode sites (AF7/AF8) for Violent vs Unpleasant emotion categories

<table>
<thead>
<tr>
<th>Time (ms)</th>
<th>df</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>362</td>
<td>1.634</td>
<td>4.125</td>
<td>0.034</td>
</tr>
<tr>
<td>460</td>
<td>1.769</td>
<td>3.727</td>
<td>0.041</td>
</tr>
<tr>
<td>655</td>
<td>1.932</td>
<td>4.878</td>
<td>0.015</td>
</tr>
<tr>
<td>704</td>
<td>1.645</td>
<td>4.114</td>
<td>0.034</td>
</tr>
<tr>
<td>753</td>
<td>1.884</td>
<td>7.462</td>
<td>0.003</td>
</tr>
<tr>
<td>802</td>
<td>1.994</td>
<td>8.119</td>
<td>0.001</td>
</tr>
<tr>
<td>851</td>
<td>1.933</td>
<td>3.807</td>
<td>0.034</td>
</tr>
<tr>
<td>900</td>
<td>1.909</td>
<td>5.056</td>
<td>0.013</td>
</tr>
<tr>
<td>948</td>
<td>1.972</td>
<td>5.487</td>
<td>0.009</td>
</tr>
</tbody>
</table>
Figure 3. ERP effects representing frontal (AF7/AF8) and parietal (P5/P6) locations across all emotion categories for Low porn use group across Sessions 1, 2 and 3. Note significant effects for ‘Unpleasant’ vs ‘Violent’ emotion
categories in frontal areas of the brain at 362ms, 460ms and between 655 – 948ms. Across sessions, the difference between their respective ERPs (especially over the right hemisphere) gradually decreases as a result of varying exposures to erotic and violent images.

5.4 Discussion

The current study aimed to determine whether exposure to varying amounts of violent and pornographic material has any effect on emotional appraisal by using a multi-level approach to study emotion. It was hypothesised that due to emotion being a complex system encompassing many levels of processing incorporating conscious and non-conscious states, utilising several measures each with its own specific sensitivity to one of those levels may provide a more comprehensive idea of an individual’s true emotional state. Having this in mind, we aimed to determine whether varying levels of exposure to violent and pornographic material had any priming effect in the way individuals’ process emotional information either consciously or non-consciously.

5.4.1 Explicit ratings

As expected, conscious explicit ratings of valence and arousal showed no main statistical differences across sessions for all emotion categories. Although contrasts revealed there to be statistical differences between specific emotion categories in both valence and arousal, the absence of main effects mean that these findings need to be dealt with caution. It is conceivable that the results we obtained may be due to participants rating the same images on three separate occasions following conscious deliberation with limited scope for variability. As they only had the option of a categorical 1-9 Likert scale with which to register their responses, perhaps the variability of responses was not
adequate to capture any significant differences. Another reason responses perhaps did not vary across sessions may be due to participants consciously being aware of the effects of their responses. Snyder scores appeared to have a wide range of scores within this particular group. As we are looking specifically at the Low pornography use group, an assumption may be that those who scored on the lower end of the Snyder scale, and thus are low self-monitors, are more likely to be more honest in their contention that they infrequently watch pornographic material. The converse may be true for those who scored higher, whereby being high self-monitors, they are more likely to let their self-perception be dictated by how they will be perceived and thus, report dishonestly in explicit ratings. Social desirability bias (SDB) scales may have been a more useful measure with regards to the present project. Where SDB scales may have an advantage is that it may be deemed more specific to biases associated with social norms and/or taboos. In a review by Van de Mortel, (2008), it was found that in health-related studies which utilised questionnaires, almost half of those which used an SDB scale found that it influenced their results. Future studies investigating pornography and violence related behaviour may look into utilizing SDB scales when attempting to determine self-report data on sensitive topics such as those investigated in the current study. Additionally, ratings for the exposure images presented a mixed response. Mean intensity ratings of the pornographic images were on the higher end of the scale which is consistent with lower pornography use groups who may not be exposed to this material frequently. Violent images, however, showed a higher mean for intensity than pornographic images though with a wider spread of values. However, it is worthwhile to note that images chosen for the exposure condition were subjectively reported to be emotionally arousing, lending credence to the possibility that they may have induced altered affective states in the participants.
5.4.2 Event-related potentials (ERPs)

ERP data showed notable differences between the two emotion conditions studied (‘Violent’ and ‘Unpleasant’). These two emotion categories were of interest due to a previous published article from a related study showing significant changes in the ERPs of these emotions when comparing individuals who reported as being low, medium and high pornography users (Kunaharan et al, 2017). The ERP results obtained in the present study show significant and consistent changes between these two emotion conditions in frontal brain areas between 655ms and 948ms post-stimulus across recording sessions. Significant changes were also seen at 362ms and 460ms. Upon visual inspection of the curves it can be noted that beginning at session 1 (baseline) and continuing through to sessions 2 and 3, there appears to be a large negative peak for both emotion categories (though more prominent for the ‘Unpleasant’ emotion category and in the left hemisphere) at the 400-500ms mark which is prominent at session 1 but is largely absent in ERPs of subsequent sessions. This accentuated N400 peak has been shown to be smaller in individuals who were high in explicit aggression (Li & Zheng, 2014) though was seen to be larger in aggressors who in a study felt that their expected response had been violated (Gagnon et al., 2016). Leuthold, Filik, Murphy and Mackenzie, (2012) showed an increased N400 like effect when in their study, participants encountered a word which mismatched with the individual’s expected feelings in a given scenario. Due to the graphic nature of the images in the ‘Unpleasant’ category, it is possible that in the current study, the increased N400 like component observed in session 1 may be due to the unexpectedness of the images’ graphic nature indicating increased motivational significance. If so, this may help explain the absence of this component in subsequent sessions as participants may have habituated upon having seen the same images in the initial session. Alternatively, Cuthbert, Schupp, Bradley, Birbaumer and Lang (2000)
showed that a greater relative positivity observed in frontal areas of the brain was associated with viewing of pleasant images relative to unpleasant or neutral images. Building on work done previously by Davidson, Schwartz, Saron, Bennett and Goleman (1979), reviews performed by Harmon-Jones, Gable and Peterson (2010) and Hofman, (2008), suggest that an increase in left frontal activity may be associated with approach motivated processing which may be positive (enthusiasm) or negative (anger), indicating that with the exposure conditions in tow and the relative greater left hemispheric asymmetry, participants in the current study perhaps perceived the ‘Unpleasant’ (and to a lesser extent, the ‘Violent’) images as more positive that they had at baseline (with no exposure). Similar results were obtained in a related study performed by Kunaharan et al. (2017) whereby individuals who reported viewing greater amounts of pornography showed a diminished negativity peak over the left hemisphere over those who reported as viewing less pornography.

Investigating deeper, what is even more apparent is that at later time periods, ERP profiles for the ‘Violent’ and ‘Unpleasant’ emotion categories follow a similar trajectory in sessions 1 and 2 but appear to diverge in the left hemisphere moving from session 1 through to 3. The converse is seen in the right hemisphere, where ERP profiles converge at later time periods moving from session 1 through to session 3. This indicates that these two emotion categories are processed differently across each of the hemispheres and react complimentary to each other with regards to exposure to violence and pornography. To the best of our knowledge there is no literature on such contrary effects between the hemispheres to refer to in these specific emotion categories. Utilising the asymmetry model mentioned previously, it is conceivable that the relative de-coupling (and associated higher amplitude) of the ERP curve corresponding to the ‘violence’ emotion category in left frontal regions may indicate that the continued exposure to violence and
pornography perhaps led to an increased acceptance, habituation or approach motivation effect by the concluding session. The same may be said of what can be seen over the right frontal region where by the end of the third recording session, the curve corresponding with the ‘Unpleasant’ emotion condition shows a more inhibited response following exposure rounds – possibly indicating less avoidance relating behaviour at cortical processing levels.

The exposure of violence and pornography also only seemed to produce consistently statistically meaningful effects in frontal electrode sites. Although parietal areas showed larger LPP curves across both hemispheres for the ‘Unpleasant’ and ‘Violent’ image categories more than likely indicating increased motivational significance and affective valence, statistical analysis did not reveal significant changes of the ERP as expected. A notable finding is that although the other emotion conditions were not investigated further, from visual inspection it is noted that the profile of curves exhibited by our participants in session 3 appears to be similar to the ERP curve profile as seen in the high porn use group at baseline of a prior study – especially across the right hemisphere (see Kunaharan et al. 2017). In the current study, low porn users show that their brain activities elicited by ‘Unpleasant’ and ‘Violent’ images become more similar after increasing exposure to violent and pornographic material, while the Kunaharan et al. (2017) study showed the same trend, in this case depending on reported pornography use instead of controlled exposure in the lab. What is interesting to note is that by merely exposing individuals who self-reported as being low porn users to a total 10 rounds of 50 pornographic and 50 violent images, we were able to “artificially induce” ERP curves which were consistent with self-reported high porn users.
SRM also failed to show any significant main effects of emotion across all sessions. Koukounas and Over (2000) showed that with repeated erotic stimulation, the magnitude of eye blinks detected from their participants increased. It is widely accepted that startle eye blinks are diminished when participants are presented with pleasant stimuli and increased when presented with unpleasant stimuli. They suggested that with repeated erotic stimulation, the erotic material was perhaps perceived as boring and aversive which lead to the augmented eye blinks. The above study utilised film segments and repeated them 18 times in order to habituate their participants, it may be possible that with only 2 sessions of varying exposure rounds with individuals who are self-professed low users of pornography, the effect of the exposure in the present experiment was not sufficient to influence deeper cognitive faculties and allow participants to habituate. It is also evident that startle eye blinks for ‘Neutral’, ‘Pleasant’ and ‘Unpleasant’ emotion categories were noticeably larger during the second session (after 1 round of exposure) compared with the first (no exposure) and third (9 rounds of exposure). Elmore (2014) investigated the effect of violent video gaming on the emotion modulation of startle and aggression, and stated that increased startle eye-blink amplitudes may be the effect of priming a certain stimulus which involves pre-activation of neural circuitry. Desensitization to a stimulus, on the other hand, was described as a diminished neural response. This may explain the augmented startle effect seen after 1 round of exposure and the attenuated response seen in session 3 may be due to desensitization effects caused by the 9 rounds of exposure. Although not statistically significant, it is perhaps conceivable that short-term exposure to violence and pornography has a priming effect on these emotion conditions and may warrant further investigation. What is also interesting to note is that the ‘Violent’ emotion category showed the lowest startle eye-blink in session 3 (immediately after the 9
exposure rounds) indicating a possible desensitization effect though, like stipulated above, this finding may warrant further investigation due to it having no statistical significance.

5.4.4 Limitations

Although attempts were made to ensure a comparable temporal separation of sessions for all participants (2-5 days), student schedules, illness and accessibility of the laboratory meant this was not always possible. This meant several participants’ sessions were, at times, separated by weeks which added a confound in the interpretation and analysis of results. This however, may not have been as problematic as expected as the priming (exposure) condition was done immediately prior to the 2nd and 3rd recording session. It may have been more of an issue if the priming had been performed at the conclusion of the previous session.

In addition, it may have been interesting to determine via the questionnaire responses whether the study participants played violent video games on a regular basis or whether they regularly intentionally viewed violent images either in media or television/movies. Such data may have provided useful insight into the interpretation of the results to determine whether effects seen may have been caused by desensitization (long-term attenuation) or priming (short-term potentiation) effects. The exposure material utilized were chosen by the investigators. Special care and concern were taken to ensure the violent images were not images from television shows or movies to maximise the probability the participants had not seen the images presented previously.

Furthermore, with the vast amount and varying genres of pornography now available for consumption, the choice of relevant pornographic images for our exposure rounds was troublesome. It is for this reason the pornographic images utilised in the
exposure rounds were to depict the most basic form of heterosexual pornography available, namely vaginal and anal penetration as well as oral sex. With modern day high speed internet services, still pornographic images (which were more widely used in by-gone eras) have been usurped by short movie clips. It is arguable that visually assessing moving pictures would be more arousing and akin to demonstrating the effect of exposure the modern day pornography consumer has. That being said, assessing ERPs whilst utilising video clips goes beyond the capabilities of the method itself. Future studies may look to combine ERP research using still images along with fMRI and SRM covering moving pictures to determine the differential effect, if any.

Finally, the scarcity of participants available for this experiment possibly due to the strict inclusion criteria, time commitment and the nature of the topic itself, did not allow us adequate power to investigate separate groups. Ideally, one group would be exposed purely to pornographic images and the other only to violent images. Rather, we were required to combine both aspects into a single experiment comprising of exposure to both violent images and pornographic images. Further investigations may wish to divide the groups to determine variations (if any) that exist between priming with violent images and priming with pornography.

In summary, significant effects were noted in frontal electrode sites, which demonstrates that the exposure of varying amounts of pornographic and violent images has effects which are decipherable by EEG analysis but are too subtle to have an effect on more sub-cortical brain areas as evidenced by the lack of SRM differences noted. What is of utmost importance to note is that what was seen as minor differences in the explicit responses were not the same differences observed in the ERP analysis. Similar results have been found in a growing body of research which show that conscious self-report
measures have produced differing results to physiological methods (Grahl, Greiner & Walla, 2012; Patrick et al., 1993; Meffert, Gazzola, den Boer, Bartels & Keysers, 2013). The current paper adds further weight to a growing body of research which states that emotions may be processed both consciously and non-consciously and the utilisation of multiple methods which are sensitive to both implicit and explicit aspects of emotion must be used to determine a more accurate picture of human affect.
References


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Chapter 6

GENERAL DISCUSSION
6.1 Overview

The research presented in the current thesis outlines potential emotion modulation effects which may occur beyond conscious awareness in a group of individuals within the normal population who self-report as being pornography users and who also self-report as having various amounts of aggressive tendencies. Emotion modulation effects were seen utilising physiological measures whereby the corresponding consciously derived behavioural measure (as depicted by conscious self-report) showed either no change or changes different to what was observed in the physiological measures. The present thesis therefore makes advancements in the current knowledge of emotion research and posits the requirement that behavioural science, be it in a research context or a clinical context, utilise both conscious self-report data with physiological measures to better determine an individual’s (or group’s) true emotional affect. Furthermore, this thesis in its entirety, adds weight to the supposition that emotional affect and expression occurs on different levels of information processing and the utilisation of measures privy to each level is required to obtain a true representation of emotional affect.

The present thesis began with a prospective article emphasizing the requirement of utilising objective physiological measures in association with established self-report subjective measures of emotion in both a research and clinical context, highlighting particular samples from the general population. From that point we determined to find out if physiological measures did in fact present a differing set of results to self-report measures of emotion in groups of individuals who self-reported as being high and low frequency pornography users and high and low aggressors. It was hypothesised at these baseline levels, that later Event-Related Potential (ERP) and Startle-Reflex Modulation (SRM) effects would be differently modulated whereas conscious self-report measures
would be constant regardless of group. Based on existing literature, of particular interest with regards to ERPs, was the Late Positive Potential (LPP) for low pornography users compared to high users and the P300 component for the low aggressors compared to the high aggressors. It was additionally hypothesised that controlled exposure of pornographic and violent images to the Low pornography group would differently modulate ERPs and SRM in a sequential manner whereas conscious self-report measures would remain constant.

6.2 Questionnaires and explicit responses

It is evident that despite the objective of this thesis is to show that explicit self-report responses do not often provide the most well-rounded representation of an individual’s thoughts and feelings, the physiological data acquired (ERP and SRM) all show distinct profiles which may be characteristic of the groups studied. All participants included in the present thesis were grouped into varying levels of frequency of pornography use (low, medium and high users) and varying levels of aggression (low and high) based on subjective self-report questionnaires. The variations observed in the physiological underpinnings of these groups show that there is still merit to the use of questionnaire-based methods in determining particular aspects of emotional affect.

6.2.1 Online Questionnaires

Due to the lack of an existing validated, and psychometrically sound behavioural measure of pornography use, many researchers have opted to construct their own purposed-built measures to determine pornography viewing habits (as we have done). Although several established scales exist to assess aspects of pornography and related
sexual behaviours, among them the Sexual Compulsivity Scale (Kalichman & Rompa, 1995), the Pornography Craving Questionnaire (Kraus & Rosenberg, 2014), the Pornography Consumption Effects Scale (Hald & Malamuth, 2008) and the Problematic Pornography Use Scale (Kor, Zilcha-Mano, Fogel, Mikulincer, Reid & Potenza, 2014), the quickly changing nature of pornography acquisition in modern times due to high speed internet services – which allows accessibility of a vast assortment of pornographic sub-genres and media viewing options (i.e. static images, short movie clips and full length features), means that particular items on these scales may be seen as archaic and therefore need to constantly be updated. The temptation has also been, in the case of sexual or pornography addiction studies, to merely adapt already existing “addiction” questionnaires which pertain to other addictive substances (e.g. alcohol, heroin etc.) and replace the specific substance in each item with the word “sex” or “pornography”. Possible problems with this may be a lack of validity as it has been stated that as the selective viewing of pornographic images stimulates a natural, evolutionarily important, endogenous survival process, much like eating. The behavioural and motivational aspects of repeated, compulsive or addictive sexual-related behaviours (e.g. increased pornography consumption) may allude to an entirely different motivational and therefore physiological process to other addictive disorders where the substance of use (or abuse) is exogenous. This is evident in brain imaging studies of pornography use which have shown that pornography addicted individuals who are shown pornographic images generally show the opposite brain effect to individuals with other substance disorders when shown images of their specific substance of use (Kuhn & Gallinat, 2014; Prause, Steele, Staley, Sabatinelli & Hajcak, 2015). The pornography use questionnaire utilised within the present thesis was developed using items adapted from Harkness, Mullan & Blasczynski, (2014) and Sitharthan et al., (in preparation) in addition to several items
developed and added by the authors themselves (see appendix). Although the full extent of the items in the questionnaire were not utilised for the basis of the current thesis (we were only interested in frequency of pornography use), the questionnaire developed presents a useful framework for which several factors pertaining to modern day pornography usage may be procured and perhaps utilised and expanded upon in future studies.

The Buss-Durkee Hostility Inventory (BDHI) was utilised in the present study as it is a widely used multi-dimensional measure of hostility and aggression. Since its inception, it has also given rise to a fully revised version of the original BDHI called the “Aggression Questionnaire” (Buss & Perry, 1992) which is also widely used. The BDHI was utilised in this thesis in a modified form from the original (see Buss & Durkee, 1957), whereby each item was grouped intentionally into its specific sub-group under the relevant aggressive subtype (e.g. assault, indirect, irritability, negativism, suspicion, resentment, verbal and guilt; see appendix), to determine any self-monitoring effects which could be seen. It was noted that this may have had an effect on our cohort’s self-monitoring as our cohort’s mean scores were lower than those found in a similar study also utilising a non-clinical population (Surguy & Bond, 2006). Although we were able to utilise a median split in our participant cohort and demonstrate physiological variations between these groups, in hindsight it may have been wiser to simply administer the questionnaire in its intended format which would allow for increased construct validity and easier comparisons among other studies.

The Barratt Impulsiveness Scale (BIS-11; Patton & Stanford, 1995) and Snyder self-monitoring scale (Revised; Snyder & Gangestad, 1986) were also utilised, not in order to divide groups based on contrasting scores, but to provide more insight into the
behavioural mechanism of our groups. The BIS-11 scores showed significant variation between low and high aggression as determined by the BDHI, indicating that within our specific cohort, individuals who self-report as being aggressive are also more likely to self-report to be impulsive. This finding further allowed conclusions to be drawn with regards to physiological findings, in particular ERP effects (see section 6.3), for which impulsive aggressive individuals have been shown to display differing P300 amplitudes to those who are more premeditative in their aggression.

Personality factors were beyond the scope of the current project and may have also contributed to the variance seen in the results. The present study drew its hypotheses of frequency of pornography use having an influence on physiological responses based on the addiction model. This was done intentionally due to the appetitive nature of pornography and the sensation seeking behaviour evident in many of those who gravitate towards these behaviours. Sensation seeking behaviour is rooted in impulsivity and seeing that impulsivity is a strong factor in addictive behaviour, it may be hypothesised that impulsivity, too, could be a factor driving pornography use. Although not reported in the manuscripts covering pornography use, post-hoc analyses of the BIS-11 total scores of the groups, rather surprisingly showed that those who reported viewing the least amount of pornographic material scored highest, with mean scores per group reducing with medium users and lowest with high users (see Appendix). Nevertheless, individual differences may need to be considered in prospective studies to fully determine if such personality traits as an individual’s impulsivity may drive reactions to pornography rather than merely relying on self-reported pornography usage.

In addition, it has been suggested that many users of pornography may develop a compulsion to continue viewing such content. According to Kraus, Meshberg-Cohen,
Martino, Quinones and Potenza, (2015), compulsive use may be categorised by craving and behavioural impulsivity. It was suggested in Chapter 1 that the focus of the current thesis may be to specifically look at individuals who may be categorised as impulsive aggressors (rather than premeditated aggressors). This was proposed initially to attempt to draw comparisons and find connections within our cohort of individuals (or groups) who scored highly on impulsivity and who also viewed pornography more frequently. It was not intended to draw connections between impulsive violence and compulsive viewing of pornography, rather, the desired intention was to alert readers to the fact that impulsive and compulsive behaviours have been shown to be related (Robbins et al., 2012a; Robbins et al., 2012b; Fineberg et al., 2014).

The Snyder Self-monitoring Scale was also utilised within the framework of the current thesis to determine the extent to which individuals in each group were aware of their subjective reporting. At baseline, no significant difference was seen in mean scores between groups studied with respect to levels of pornography use or aggression and so it was concluded that self-monitoring most likely did not account for any non-significant results which were obtained from the explicit ratings. The wide range of self-monitoring scores seen in the low pornography use group, however, was alluded to in Chapter 5 and showed that within this group, there appeared to be individuals who were high and low self-monitors (with respect to each other) and those who were high self-monitors were more likely to be aware of their responding than those who scored lower. It was suggested that perhaps alternative methods such as using Social Desirability Bias (SDB) scales in place of the Snyder self-monitoring questionnaire be used when attempting to determine self-monitoring with regards to socially taboo or sensitive research areas which utilise conscious self-reported measures of emotion.
Explicit responses as measured in the context of this thesis referred to behavioural measures which pertained to conscious emotional valence and arousal ratings made by participants in response to emotion-inducing images. As expected, it was observed that there were slight statistically significant variations between low, medium and high pornography groups in their responses to ‘Erotic’ and ‘Pleasant’ emotional valence ratings at baseline, although corresponding ERP amplitudes did not show such difference in affect. Furthermore, no significant change was seen in subjective explicit ratings at baseline comparing high and low aggressive individuals nor were they seen for the low pornography use group following controlled exposure to violence and pornography across temporarily separated recording sessions despite both sets of results producing distinctly different ERP profiles. The consequence of these results further supports the notion that subjective reporting of emotion based data may provide information which varies from that which is objectively collected. To date, only a few studies have objectively shown this discrepancy between subjective self-report and objective physiological measures (Walla, Koller, Brenner & Bosshard., 2017; Patrick, Bradley & Lang, 1993; Meffert, Gazzola, den Boer, Bartels & Keysers, 2013; Grahl et al., 2012). A possible explanation for this may be that the variations between groups studied (low, medium and high pornography use as well as low and high aggressive individuals) may not have been large enough to create significant differences of deliberate self-report measures of emotional appraisal of emotion-inducing stimuli than would a clinical population. Patrick et al. (1993) and Meffert et al. (2013) did empirically show that clinical populations (in particular psychopaths) self-reported similarly to control groups whereby the physiological measures taken differed between the groups. As the participant pool in the present thesis was selected from a population which was considered to be functioning
“normally” by societal standards, the measures utilised in the studies presented in this thesis may not have been sensitive enough to identify possible discrepancies which may exist between the groups.

Another possible explanation for the lack of a discrepancy in self-report measures may be due to social monitoring. Although Snyder Self-Monitoring mean scores for each group studied across baseline measures were similar – indicating similar levels of self-monitoring between all groups, it was noted in the longitudinal portion of the study (Chapter 5) that individuals classified as “low pornography users” had a large range of scores. This meant that there were several individuals who were lower and higher self-monitors and so the assumption may be that those who scored higher in the self-monitoring scale (high self-monitors) are less likely to be truthful in describing their pornography viewing habits and those who scored lower (lower self-monitors) are more likely to be honest in their pornography viewing. Another similar type of scale used, are the Social Desirability Bias (SDB) scales. This type of scale can be seen as more advantageous due to its specificity to biases related to taboos and/or socially normative behaviour. Van de Mortel, (2008) found in a review that in questionnaire based health-related studies, almost half of those which used an SDB scale found that the scale influenced results. It was proposed that the use of SDB scales could be more advantageous in future studies involving questionnaires investigating pornography or aggression related behavioural measures as topics such as these can be a source of shame and embarrassment leading to dishonest self-reported data.
6.3 Event-related potentials (ERPs)

Of all the measures investigated as part of this thesis, electroencephalography (EEG) seemed to be the most sensitive measure to variations in emotion processing between groups as well as following exposure rounds. This reiterates the possibility of increased use of biologically based markers pertaining to ERP modulation in emotion research rather than relying solely on self-report measures.

At baseline, notable significant differences within the LPP phase (400-500ms) of the ERP were seen in “medium” and “high” pornography use groups across the right hemisphere when processing ‘Unpleasant’ images. Though this asymmetry effect observed was not statistically meaningful, the trend points to a possible lateralisation effect specific to more frequent pornography users. The asymmetry model asserted by Davidson, Schwartz, Saron, Bennett & Goleman, (1979) suggests that approach-motivated behaviours are linked with increased affect across the left anterior regions of the brain, and withdrawal-motivated behaviour are linked with increased affect across the right anterior region of the brain. The increased amplitude waves seen across the right hemisphere in low pornography users may stipulate that, according to the asymmetry model, they consider the ‘Unpleasant’ images to be more aversive than more frequent users of pornography. Furthermore, Cuthbert, Schupp, Bradley, Birbaumer & Lang, (2000) found greater positivity for ‘Pleasant’ over ‘Unpleasant’ images in frontal areas of the brain. Due to the ‘Pleasant’ images evoking a significantly greater change in skin conductance in their particular study, they concluded that the relative positive shift of ‘Pleasant’ images may reflect an augmented affective arousal rather than variations in intrinsic valences. It is possible that results we found were also as a result of this. Additionally, it was also noted that ERP curves for ‘Violent’ and ‘Unpleasant’ emotion
categories, at later time periods (>500ms), appeared to follow similar trajectories in more frequent pornography users across the right hemisphere. The effect was seen in frontal and parietal brain areas and was suggested that the pattern may indicate frequent pornography use increases the liking and therefore approach motivation towards these particular stimuli. Harper and Hodgins (2016) have noted that many frequent users of pornographic material often advance to utilising more novel material. This, at times, may include graphic and violent pornography in order to elicit a more aroused state due to habituation effects and so it is possible that similar processing of ‘Violent’ and ‘Unpleasant’ image categories may take place at implicit levels for frequent users of pornography.

Again, at baseline, when dividing groups based on high and low self-reported aggression, ERP analysis revealed significantly different changes between processing of ‘Pleasant’ and ‘Violent’ emotion categories. Consistent with prior research, high aggressive individuals appeared to display a more attenuated ERP curve at later ERP time windows (most notably at the P300 stage and later) with regards to processing of violent emotion inducing images (Bartholow, Bushman & Sestir, 2006; Jinghua & Yong, 2014; Wang, Zhao, Qui, Ybarra, Liu & Huang, 2012; Bond & Surguy, 2000; Surguy & Bond, 2006). What is interesting to note is that in the ‘high aggression’ group, the ERP curve for the ‘Violent’ emotion category appears to follow a similar trajectory to the ‘Pleasant’ emotion category, whereas they appear to be de-coupled in the ‘low aggression’ group. This finding indicates that similar implicit emotion processing to violent and pleasant images takes place in individuals who self-report as being highly aggressive when compared to those who are not aggressive.
Exposure effects of violent and pornographic images on low pornography users revealed unexpected results. Surprisingly, we were artificially able to reproduce the physiological effects of high pornography use in the final paper by way of ERP waves. Seeing as though the high pornography users at baseline had a mean pornography viewing number of hours of 110.4 hours per year, we were able to mimic the physiological ERP response with controlled short-term priming of pornographic and violent image exposure. What was equally surprising is the notion that we did not need to resort to long-term exposure of the low use group to see comparable physiological results to the high use group. This effect potentially shows that the brain may change rapidly to accommodate this stimuli in the short-term and as the high users’ ERP curves (at baseline, prior to any priming) were generated as a result of more long-term exposure to pornography, we can see that short-term potentiation effects are likely to potentially result in long-term effects. Having said that, it may have been interesting to note whether any individuals in the high pornography use group had viewed pornography just prior to attending the lab for baseline recordings. If such occurrences had taken place in the majority of individuals characterised as high pornography users, it may have influenced results by externally mimicking pornography exposure in uncontrolled conditions. To the best of our knowledge, there are no known brain physiology studies exploring priming and exposure to pornographic (and violent) material and the associated physiological effects on the brain. Although what is presented in this thesis is an interesting set of results, it is nonetheless exploratory by nature. The questions asked of the participants in the current study with regards to pornography use asked their usage behaviour “in the last 12 months”. What may have been additionally useful is the use of a timeline follow back in the presented studies to procure a more accurate idea of recent pornography use in the months leading up to participant recording sessions. It is evident that further research in
this area is required and results presented here should be aimed to be used as a starting point to build further investigations from.

6.4 Startle reflex modulation (SRM)

Startle reflex changes in this thesis did not reveal what was expected. It was expected that startle curve profiles would, for instance, decrease in magnitude from “low” to “high” pornography use and “low” to “high” aggression groups due to habituation effects – especially with regards to emotional valence associated with viewing ‘Erotic’ and ‘Violent’ emotion-inducing images respectively at baseline. The results showed no significant changes in startle profiles between “low” and “high” aggression groups. Variations between the pornography use groups (low, medium and high) showed a non-significant trend towards differing startle profiles. What is interesting, however, is the “low” pornography use groups’ startle curves did not change significantly across recording sessions following controlled exposure to pornographic and violent images. What this result suggests is that long-term exposure is perhaps required to elicit the deeper sub-cortical brain assessed through SRM. There have been studies investigating SRM effects due to exposure or conditioning effects. Walla et al. (2017) investigated evaluative conditioning effects on established liked and disliked brands and found that 6 rounds of evaluative conditioning was required to penetrate into deep subcortical brain structures in order to obtain significant SRM effects. Similarly, another study by Koukounas and Over (2000) showed that repeated stimulation of erotic material decreased eye blink magnitude across trials. Koukounas and Over exposed their participants to repeated erotic film segments 18 times in order to elicit a habituation effect (as measured by a significant reduction in eye blinks). It is difficult to draw conclusions based on whether the 2
exposure sessions as investigated in the current thesis allowed for enough stimulation to modify sub-cortical brain structures, as to the best of our knowledge, investigations involving varying rounds of exposure to static images of violence and pornography and associated SRM effects have not been studied with respect to infrequent users of pornography (as investigated here). Furthermore, additional data which may have been useful in this study would have been to ask participants how much violence they intentionally view on a regular basis, be it via television, movies or violent video games with realistic portrayals of violence. The acquisition of such data may have provided insight with regards to trends seen in the startle curves to allow us to determine if these trends were more likely to be due to short-term potentiation (priming) or long-term attenuation (desensitisation). Future longitudinal studies should endeavour to, using controlled exposure, determine the amount and/or intensity of exposure to pornographic and violent images (perhaps in isolation to each other in order to isolate specific effects) which affect deeper sub-cortical brain structures enough to elicit significantly altered startle responses.

6.5 Limitations of the current research

Although the current thesis presented the exploratory effects of implicit and explicit emotion in particular behavioural groups, there were inevitable limitations with this research. The absence of significant differences observed in the explicit responses between groups throughout the studies presented may, as discussed in previous sections, be a result of excessive self-monitoring. This could be attributed to shame as a consequence of responding to potentially taboo or socially awkward material. Alternatively, as hypothesised, it could have been possible that participants were
responding honestly but were unaware of their altered physiological response (as Walla, 2011 suggested that many of our feelings and attitudes occur below conscious awareness). Lack of variability seen in explicit responses may also be due to use of categorical responses for some variables. It is conceivable that had we asked for explicit responses on a scale and calculated responses utilising measurements with smaller denominations, we may have seen significant variations in participant responses between groups. Having said that, it is also possible that we may still have seen similar effects, be it either no change in explicit responses between groups, or alternatively, any significant differences observed may not have matched up with observed physiological variations between groups, lending credence to our original hypothesis. What is evident is that this is a hypothesis which warrants further investigation under more controlled conditions. Further to this, a pertinent question to consider by way of the present investigation is what can be concluded by way of viewing pornography. We showed that, at least in terms of ERP wave profiles, that relatively short-term exposure to still images of violence and pornography can mimic ERP profiles of frequent pornography users. Assuming the frequent users of pornography are also long-term viewers, does this mean that on a cortical level the brain habituates to viewing this material quickly, maintaining this habituated response? Or are the ERPs recorded from high frequency users as a result of participants viewing pornography a short time before the initial testing session and what we were indeed measuring was again immediate effects following short-term exposure? Unfortunately, information gathered in the present investigation did not allow us to confirm such determinations. To counter this, it may have been a good idea to perhaps ask participants who came in when the last time they viewed pornography was. The question then perhaps remains is how long these physiological profiles remain? It has been shown that physical problems with a physiological mechanism of action (e.g.
erectile dysfunction) which have (in part) been attributed to excessive pornography use has been observed to be corrected to normal functioning after 8 months of discontinued exposure (Bronner & Ben-Zion, 2014). Although, given the current data collected provides indication of artificially created ‘high’ pornography users by way of ERP profiles, it remains to be seen if discontinued use ‘restores’ the ERP to its unhabituated state. No study, to our knowledge, has attempted to determine what, if any, effect discontinued use of pornography has on a sample population who report being frequent users of pornography. A follow up study building on the existing data may be interesting which determines if discontinued use of pornographic material may in fact alter ERP profiles to perhaps make the previously recorded ‘high’ group, behave like the ‘low’ group. As mentioned previously, it is impossible to determine this given the data collected for the current experiment nevertheless, it is an interesting proposition for a future investigation.

6.6 Future studies

ERP analysis in the current thesis was limited to later ERP effects as dictated by overwhelmingly focused previous studies with respect to aggression and pornography viewership. As a majority of these studies focused on later ERP effects, namely, the P300 (aggressive individuals) and LPP (pornography viewers), investigating effects pertaining to these particular time frames appeared to be the best course of action for the current thesis. Though it was beyond the scope of the present thesis, follow up studies utilising data already acquired as part of the current investigation, as well as prospective studies, may attempt to determine if variations exist between disparate levels of the groups investigated here at earlier times following emotion stimulus presentation. Various
studies have found specific components of the ERP not investigated in the current thesis can be modulated with regard to emotional affect. For instance, Krendl, Zucker & Kensinger, (2017) found that the N2 component has been associated with the detection of novel information and so it may be worthwhile investigating whether any habituation effects to increased pornography and/or violent images modulates the N2 component with repeated exposure to firstly, the same set of stimuli, and then a novel set of stimuli. In addition to investigating other ERP based biomarkers, prospective studies should also follow on from the present research investigating ERP activity from other emotion conditions from varying sites. Our focus for the present thesis was with ‘Violent’ and ‘Unpleasant’ emotion conditions for pornography use and ‘Violent’ and ‘Pleasant’ emotion conditions for aggression as they appeared to be showing the most interesting activity when comparing groups, though it has been shown, for instance, that individuals who regularly view pornography generally have an attenuated LPP when exposed to erotic or pornographic images (Prause et al, 2015). It would be interesting to note if our cohort exhibited similar ERP effects to the ‘Erotic’ category of IAPS images.

In addition, the present thesis presented results from the longitudinal component of the present investigation which investigated the effect of exposure to violent and pornographic images to implicit and explicit emotion. To determine low level exposure of these images to infrequent pornography viewers, only individuals who reported viewing low amounts of pornography were utilised in the analysis. The authors felt this initial investigation and related findings would be adequate for concluding the current thesis; however, this facet of the thesis presents only the proposed initial stages of investigation into the effect of short-term exposure, or priming of violent and pornographic images on individuals. The results provide evidence to support the idea that short-term exposure does indeed present varying effects at different levels of emotion.
processing. As a result of this, and due to the large amount of data already collected for the purposes of this study, prospective investigations and analysis are currently set in place utilising this data to determine if/how more frequent users of pornography, as well as aggressive individuals modulate their implicit and explicit emotion with such exposure.

Although care was utilised to ensure we did not insinuate a direct comparison and/or correlation with viewership of pornography and violence, the topic of whether excess viewing of pornography as any effect on violent (particularly sexually violent) tendencies remains contentious. Even though it was beyond the scope of the present set of investigations, several studies have been staged in order to determine if such correlation/causation exists (Allen, Emmers, Gebhardt & Giery, 1995; Ferguson & Hartley, 2009; Hald, Malamuth & Yuen, 2010; Johnson, 2014, 2015; Kingston, Fedoroff, Firestone, Curry & Bradford, 2008; Mancini, Reckdenwald & Beauregard, 2012; Seto, Marie & Barbaree, 2001; Vega & Malamuth, 2007; Wright, Tokunga & Kraus, 2015). Nevertheless, results and interpretations of results remain largely polarised. Many of these studies suffer from methodological flaws which may need to be improved upon and may have swayed results one way or another. Data obtained in the current thesis present an interesting set of results regarding the connection between violence and pornography. The most visually representative comparison one can make is that ERPs recorded by individuals divided either by self-reported frequency of pornography use or trait aggression appear to show similar increased frontal negativity of individuals categorised as ‘low’ in both groups. This frontal negativity is not present in individuals categorised as ‘high’ in either of these groups. This finding was also seen in the final study presented (Chapter 5) where no exposure to the combined violence and erotica produced the same increased negativity in frontal brain areas, however this was not seen following subsequent increasing exposure to this material. It is possible that regardless of however
the groups were divided, that the novelty of the images shown in the initial phase of the experiment outlined in Chapter 5 may be equivalent to individuals who reported viewing ‘low’ amounts of pornography (Chapter 3) and who reported being ‘low’ aggressors (Chapter 4). The reduction or tempering of the ERPs analysed in response to successive exposure conditions outlined in Chapter 5 could be the equivalent of more frequently viewed pornographic material such as those seen in the ‘high’ pornography use group in Chapter 3 and the ‘high’ trait aggressors seen in Chapter 4. Although any conclusions one can draw will be purely speculative due to lack of highly convincing findings, it is nevertheless interesting to note the similar findings obtained.

Following on from this, although we are highlighting limitations of current methodologies favoured by clinicians and researchers in the behavioural sciences which involves the use of the DSM and ICD, it is important to highlight that the participant group utilised in the present study comprised of undergraduate and postgraduate University students with no history of diagnosed psychiatric illnesses. There are many factors which can contribute to the violence and aggression perpetrated by individuals who commit violent acts which include psychiatric illness among other factors. Generalising about the behaviour of an offender population based on results obtained from a healthy cohort brings about its own set of limitations due to variables which may not be taken into consideration. It is for this reason that although results obtained from this thesis sheds light onto behavioural and physiological measures of a ‘normal’ population, it is contentious that comparisons be made between our cohort and violent offenders with a diagnosis of psychiatric illness. In addition, the present thesis attempted to look at pornography use, a quantifiable behaviour as well as self-reported trait aggression. We attempted to quantify aggressive tendencies via the use of the BDHI questionnaire but the thought of determining behavioural traits pertaining to aggressive
tendencies (e.g. by asking participants about deliberate viewing of violent content, be it via video games, movies etc.) was, unfortunately, missing in our experimental procedure and may have provided interesting insight into behavioural markers of trait aggression. It is also an option for future studies to include both trait and behavioural measures whilst utilising knowledge gleaned from the studies presented in this thesis. This can be done by allowing a relatively unbiased methodological protocol which may account for an imbalance in established affective measurement by taking into consideration non-conscious affective states and social desirability biases. In addition to these items, future studies should look to advance knowledge in this area by incorporating further measurement tools such as EEG, SRM, fMRI etc. to better determine biological underpinnings of sexual and violent-based behaviour. Many of these physiological measurements may also be used simultaneously across the same study to achieve this purpose.

6.7 Implications of the current research

Traditional, explicit responding via self-report questionnaires, surveys or interviews more than adequately capture conscious emotion effects but as the present research shows, investigations delving deeper into non-conscious affective states may provide alternate findings which conscious self-report may not be privy to. It has been proposed that emotion, in and of itself is comprised of conscious and non-conscious affective states, and conscious appraisal of all aspects of emotion or affective states is not always accessible (Walla & Koller, 2015; Walla, 2011; Tamietto & Gelder, 2010). Having said this, it is possible that the conscious experience the individual reports, via methods like self-report, is what feels “real” to them. It is impossible to determine the
extent to which non-conscious processes have an effect on what is consciously perceived by the individual. As mentioned in the thesis introduction, Walla and Panksepp (2013) suggested that lower order affective states are influenced by higher-order cognitive states and so a cyclical version of emotional processing is evident whereby non-conscious emotional affect is predicated by conscious appraisal and vice versa. What is evident from the results presented in this thesis however, is the discrepant findings of explicit measures and implicit measures. Research in this field is still in its infancy, so a major limitation of utilising physiological measures, is that not only are clinicians limited by the cost of equipment and time required to gather these measures, but the very interpretation of the physiology itself also depends on a researcher or clinician’s subjective evaluation of the measures. In saying so, the results presented in this thesis could be used as the foundation of future, more specific studies which may add weight to the already burgeoning field of emotion-related research. This can empirically provide more consistent biomarkers specific to particular behavioural traits which can then be used together with existing methods to support a multilevel approach to understanding emotion.

As the integration of physiological methods of recording emotion is hampered by many factors be it, time, costs, availability of equipment and analysis and interpretation by trained staff, it is unlikely that the entire field of behavioural diagnostics will (at least in the near future) undergo a complete upheaval of its methods. Nevertheless, these challenges should not preclude the investigation of possible alternative methods of behavioural analysis. It may be that utilising measures such as SRM and EEG which are more sensitive to emotion beyond conscious awareness, may be used conjointly with current methods which are more concerned with conscious emotion processing.
It is important at this stage to reiterate what was mentioned in the Introduction to this thesis (Chapter 2), that the references made throughout this thesis to the DSM and ICD is not made to explicitly draw comparisons with our test population and the psychiatrically impaired. The citing of the DSM and ICD as diagnostic tools used in the behavioural sciences was highlighted purely due to the systemic nature in which these tools are used currently. It is pertinent to iterate that the mere accessing and viewing of pornographic material does not automatically imply that there is a behavioural pathology at play. The same can be said of individuals in the present study who scored highly on the (administered) BDHI. It is not the intention of this thesis to assume that simply by viewing pornographic material or scoring highly on the BDHI that these individuals are at high risk of developing disorders.

There are several researchers who have shown that viewing of pornography is by far harmless and unproblematic behaviour. For instance, a survey of Australian pornography consumers found that 58% of respondents felt pornography had a positive effect on their attitudes to sexuality and 35% felt it had no effect (positive or negative) at all (Mckee, 2007). Ferguson and Hartley (2009) found that any evidence of ill effects of pornography is inconsistent and even went on to suggest that viewing of pornography “may actually provide catharsis to alleviate sexual aggression” (p. 328). Further studies have also shown an inverse relationship between rape rates and consumption of pornography (D’Amato, 2006; Diamond, 2009). Hald and Malamuth (2017) also showed that self-perceived effects of “hardcore” pornography viewership assessed via a survey of Danish men and women aged 18-30 years showed more positive than negative effects based on how they felt pornography affected them personally, leading the authors to conclude that the individuals in the study believed that pornography had a primarily positive effect on various components of their lives. Conversely, it has been shown that
continued use of pornographic material accompanied with excessive masturbation has been attributed to behavioural and physiological ill effects such as poor sexual function including, among others, the inability to initiate and maintain an erection (see reviews by Love, Laier, Brand, Hatch & Hajela, 2015; Park et al., 2016). However, a study performed by Prause and Pfaus, (2015) may substantiate the notion that frequency of pornography use is a poor predictor of pornography-related problems. They found that increased viewing of pornography was related to a stronger sexual response desire for sex with a partner and was unrelated to problems like erectile dysfunction. Additionally, anxiety, depression and inhibited social functioning has been, at least partially attributed to excessive viewing of pornographic material (Levin, Lillis & Hayes, 2012).

As there is considerable contention regarding the possible ill-effects of pornography use, the present thesis utilised questionnaire or self-report based acquisition of data and subjective determinations of behaviour – methods which are often utilised by researchers and clinicians in the behavioural sciences. It is prioritised within this thesis to determine if, firstly, a change in protocol (i.e. administering of physiological measures) brings about a variation in response within our current population which is not seen in conscious, more deliberate assessment measures. Secondly, if these variations do tell us information which is important, is it enough to consider modifying the current framework by which researchers and clinicians in the behavioural sciences work under? It is for this reason that we proposed that the results presented in this thesis presents a clinical significance and provides evidence to alternative approaches of clinical systems already in place. Within the scope of the present thesis, we chose to focus on individuals who were “normal” by societal standards, that is, they were not a clinical sample and so it is important to reiterate that the groups (and sub-groups which we divided them into) investigated represented only extreme ends of what was considered to be a non-clinical
population. Despite this, variations were seen between implicit and explicit recording measures. The reason for choosing to investigate pornography use was to determine cognitive effects of the relatively increased variety, availability and accessibility of pornographic material in recent times via the internet. As mentioned previously, negative effects of pornography use have previously been a two-sided argument among researchers and clinicians. There has been relatively recent evidence to support adverse effects of increased pornography use in some individuals which includes, as mentioned previously, difficulty in achieving an erection without the aid of pornography and altered neurobiological networks reminiscent of addiction models (see review by Love et al., 2015). Aggression, on the other hand, is often a common behaviour associated with many other psychiatric and neurobiological illnesses such as psychopathy, schizophrenia and anti-social personality disorder. What the results of this thesis show, are variations in emotional affect in data collected within this normal population simply by the use of a multilevel approach to emotion research. By utilising a combination of physiological and self-reported measures it is expected that further disparities may arise when comparing a non-clinical population with a target population (i.e. those for whom pornography consumption might be a significant risk factor for future offending behaviour).

Despite the clinical significance these two groups investigated have, clinical investigations continue to rely heavily on subjective criteria by way of questionnaires, surveys and face to face interviews in order to determine emotional affect. Many of these criteria and approaches are outlined in the Diagnostic and Statistical Manual (DSM 5; American Psychiatric Association, 2013) and the International Classification of Diseases (ICD-10; World Health Organisation, 1993). A major concern is that a majority of Psychologists (60%) in 23 countries surveyed routinely utilise a formal classification system whereby the ICD was found to be utilised by 51% of those surveyed and the DSM
was used by 44% (Evans Reed, Roberts, Esparza, Watts, Correia et al, 2013). However, there has been a recent push to modify these classification systems and incorporate a more empirical working model based on physiological data (Lilienfeld, 2014, Krueger, Hopwood, Wright & Markon, 2014a, 2014b). In fact, under the Research Domain Criteria (RDoC) framework, the National Institute of Mental Health (NIMH) has recently eschewed support for research solely based on DSM categories and now encourages researchers to determine research questions based on neurobiology using many levels of information acquisition ranging from genomics to self-report, to better understand the various dimensions of human functioning (Krueger et al, 2014a). The investigators of the aforementioned paper suggest that this push has largely been due to clinicians and researchers being frustrated by not clearly being able to utilise the DSM in order to characterise patients using the existing and, at times, overly specific criteria. Within the scope of the current thesis, as we showed that individuals at various ends of a specific subset of the normal population exhibited distinctly different physiological effects (namely via EEG), it is believed that the evidence presented in the present thesis with respect to the multilevel approach to emotional affect acquisition further enforces the proposed ideology by the RDoC with respect to the requirement of multilevel analysis which is required to capture the full range of human emotional affect.

6.8 Final comments

The present thesis provides insight into the multileveled nature of human emotional affect with respect to a select population known to be functioning “normally” by societal standards. Not only has the sole use of historical and still widely utilised traditional methods of self-report measures in research and clinical practice been
criticised, but the use of physiological methods such as EEG and SRM has been proposed to be used in conjunction with self-report measures in order to determine a more complete understanding of the various levels of emotional affect albeit within a selected group. It is challenging to discuss participant group differences on measures of implicit and explicit measures of emotion and behaviour when those very groups have been divided solely on their explicit responses. However, there currently does not exist a set of established physiological biomarkers which could guide creation of participant groups related to pornography consumption. The purpose of this thesis was to posit the idea that a multilevel approach to understanding an individual’s emotion was important due to emotion being a construct composed of several levels of processing. It is unlikely that either method is innately superior; rather, each method highlights key components of emotion processing related to a particular level of emotion processing. This may provide a more holistic understanding and interpretation of the full emotional experience.

In sum, as research in this field is in its infancy, the studies presented in this thesis represents a benchmark in a new attitude towards what may be deemed a burgeoning field of emotion research and so a superficial representation of the multi-layered nature of affective states is what was presented. Potential research examining the groups investigated in this thesis may well attempt to take the above-mentioned exploratory variables into consideration in order to highlight further possible ERP biomarkers specific to the groups presented here. Subsequent research may also endeavour to perhaps combine qualitative and quantitative data from several sources – each with their own unique set of methodological weaknesses to further elucidate a wider understanding of emotional affect in these and other groups.
References


Appendix

Pornography Use Questionnaire

1. How old were you when you were first introduced to pornography (magazines, Internet pornography, X-rated videos)?
   - Before age 10
   - Age 11 to 13
   - Age 14 to 17
   - Age 18 to 21
   - Over age 22

2. After my first exposure to pornography, my curiosity led me back to it _______.
   - A few days later
   - Months later
   - A year later
   - More than a year later
   - Only one or two times since then

3. How many times did you see pornographic material before age 20?
   - One time
4. When you first started viewing pornographic images did it start with swimsuit issues/catalogues magazines (i.e. Playboy, Penthouse, etc.)

- R–rated videos
- Educational books or videos
- Internet (pictures)
- XXX rated videos

5. What type of pornographic images are you looking at now?

- Swimsuit / catalogues
- Magazines (Playboy, Penthouse, etc.)
- R- rated videos
- Educational books or videos
- Internet (images or popups)
- XXX rated
- Videos or downloaded clips via the Internet
- All of the above
- Other, please specify _______________________________
6. When viewing pornography (magazines, Internet, or video), how much time will you spend during one episode?

- 5 to 15 minutes
- More than 15 minutes but less than 30 minutes
- 30 minutes to 1 hour
- 1 to 3 hours
- 3 to 5 hours at a time
- 5 to 6 hours at a time
- 6 or more hours at a time (sometimes all day and/or all night)

7. In the last year, what is the frequency with which you have viewed pornography?

- 1 to 2 times
- Every two or three months
- Once a month
- Every two weeks
- Once a week
- 3 to 5 times a week
- Almost every day, if not daily

8. Once you start looking at pornography do you?

- View it briefly, but don't look again for weeks or months
- View it 3 or 4 times within a short period of time and then stop for weeks or months
- View it and then repeatedly look at it for a few days before trying to stop
• View it daily for a few weeks before trying to stop

• View it multiple times a day for weeks at a time and then stop for a few days before you go at it again

• View it as often as I can, every day all day if I could

9. **How much money have you spent on pornography in the last year?**

• *I don't spend money on pornography*

• *Between $1 to $25 dollars*

• *$26 to $100 dollars*

• *$101 to $500 dollars*

• *$501 to $1000 dollars*

• *$1001 to $5000 dollars*

• *$5001 to $10,000 dollars*

• *Over 10,000 dollars*

10. **How often do you think about or fantasize about viewing pornography?**

• *Multiple times a day*

• *Once a day*

• *Three to five times a week*

• *Once a week*

• *Every other week*

• *Once a month*

• *Every two or three months*
• Very rarely to never

11. How often do you act upon your fantasies and view pornography or act out?

• Multiple times a day
• Once a day
• Three to five times a week
• Once a week
• Every other week
• Once a month
• Every two or three months
• Very rarely to never

12. What is the longest period of time that you have gone without viewing pornography in the last year?

• 8 months to a year
• 6 to 8 months
• 4 to 6 months
• 2 to 4 months
• 1 to 2 months
• Two weeks to a month
• One week
• One or two days
13. What are the main themes or types of internet pornography which you have viewed in the last 12 months?

(You may check one or more)

Check any that apply

- Amateur
- Anal
- Anime Or Hentai
- “BBW” (Overweight)
- Bisexual
- Bizarre Or Funny
- Couple Or Romantic
- Double/Multiple Penetration
- Ejaculation, “Cream Pie” Or “Cumshots”
- Ethnic
- Fantasy
- Female Ejaculation (“squirting”)
- Female Friendly (Pornography for Women)
- Hardcore
- Homosexual Males
- “Interracial”
- Large Breasts
- Large Penis
- Lesbian
- Masturbation
- Mature
- Oral Sex
- Point Of View (“POV”)
- Sex Toys
- Teen Or “barely Legal”
- Threesome Or Group Sex
- Vintage Or Classic
- “Watersports”
- Other:
14. In the last 12 months, which of the following pornographic genres did you use most often?

(You may check one or more).

Check any that apply

- S & M (Sadism and Masochism) and B & D (Bondage and Discipline)
- Fetishism
- Bestiality
- Violent/ coercive sexual activities.
- None- I have not watched any of the above in the last 12 months.

15. To what extent has pornography affected your attitudes toward (or appeal of) specific sexual acts?

(Where 0= not at all to 10= Very much so)

Please select:

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Somewhat</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

16. To what extent has pornography affected your sexual behaviours?

(Where 0= not at all to 10= Very much so)

Please select:

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Somewhat</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
17. To what extent do you think pornography use influences aggression in the society?
(Where 0= not at all to 10= Very much so)
Please select:

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Somewhat</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

18. To what extent do you think pornography use has influenced your aggression?
(Where 0= not at all to 10= Very much so)
Please select:

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Somewhat</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
**Buss-Durkee Hostility Inventory (BDHI; Modified)**

Please read each of the following sentences below and place a tick next to either true or false as to how you think each of the sentences pertains to you. Do not spend too long thinking about each question and please answer truthfully.

<table>
<thead>
<tr>
<th>Assault</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once in a while I cannot control my urge to harm others.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can think of no good reason for ever hitting anyone.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If somebody hits me first, I let him have it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whoever insults me or my family is asking for a fight.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who continually pester you are asking for a punch in the nose.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I seldom strike back, even if someone hits me first.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I really lose my temper, I am capable of slapping someone.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get into fights about as often as the next person.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I have to resort to physical violence to defend my rights, I will.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have known people who pushed me so far that we came to blows.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indirect</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I sometimes spread gossip about people I don’t like.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I never get mad enough to throw things.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I am mad, I sometimes slam doors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I never play practical jokes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I am angry, I sometimes sulk.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sometimes pout when I don’t get my own way.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Since the age of ten, I have never had a temper tantrum.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I can remember being so angry that I picked up the nearest thing and broke it.

I sometimes show my anger by banging on the table.

<table>
<thead>
<tr>
<th>Irritability</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I lose my temper easily but get over it quickly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am always patient with others.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am irritated a great deal more than people are aware of.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It makes my blood boil to have someone make fun of me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If someone doesn't treat me right, I don't let it annoy me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes people bother me by just being around.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often feel like a powder keg ready to explode.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sometimes carry a chip on my shoulder.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can't help being a little rude to people I don't like.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don't let a lot of unimportant things irritate me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lately, I have been kind of grouchy.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negativism</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unless somebody asks me in a nice way, I won't do what they want.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When someone makes a rule I don't like, I am tempted to break it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When someone is bossy, I do the opposite of what he asks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When people are bossy, I take my time just to show them.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasionally when I am mad at someone I will give him the “silent treatment”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Resentment

<table>
<thead>
<tr>
<th>Statement</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don't seem to get what's coming to me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other people always seem to get the breaks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I look back at what's happened to me, I can't help feeling mildly resentful.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Almost every week I see someone I dislike.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Although I don't show it, I am sometimes eaten up with jealousy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don't know any people that I downright hate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I let people see the way I feel, I'd be considered a hard person to get along with.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At times I feel I get a raw deal out of life.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Suspicion

<table>
<thead>
<tr>
<th>Statement</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know that people tend to talk about me behind my back.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I tend to be on my guard with people who are somewhat more friendly than I expected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are a number of people who seem to dislike me very much.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are a number of people who seem to be jealous of me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sometimes have the feeling that others are laughing at me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My motto is &quot;Never trust strangers.&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I commonly wonder what hidden reason another person may have for doing something nice for me.

I used to think that most people told the truth but now I know otherwise.

I have no enemies who really wish to harm me.

I seldom feel that people are trying to anger or insult me.

<table>
<thead>
<tr>
<th>Verbal</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I disapprove of my friends’ behavior, I let them know it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often find myself disagreeing with people.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can’t help getting into arguments when people disagree with me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I demand that people respect my rights.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Even when my anger is aroused, I don’t use &quot;strong language.&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If somebody annoys me, I am apt to tell him what I think of him.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When people yell at me, I yell back.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I get mad, I say nasty things.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I could not put someone in his place, even if he needed it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often make threats I don’t really mean to carry out.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When arguing, I tend to raise my voice.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I generally cover up my poor opinion of others.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would rather concede a point than get into an argument about it.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Guilt</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The few times I have cheated, I have suffered unbearable feelings of remorse.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>I sometimes have bad thoughts which makes me feel ashamed of myself.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who shirk on the job must feel very guilty.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It depresses me that I did not do more for my parents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am concerned about being forgiven for my sins.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do many things that make me feel remorseful afterward.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure gives me a feeling of remorse.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I do wrong, my conscience punishes me severely.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often feel that I have not lived the right kind of life.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Barratt Impulsiveness Scale (BIS-11)**

DIRECTIONS: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

<table>
<thead>
<tr>
<th>Rarely/Never</th>
<th>Occasionally</th>
<th>Often</th>
<th>Almost Always/Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I plan tasks carefully.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I do things without thinking.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I make-up my mind quickly.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I am happy-go-lucky.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I don’t “pay attention.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I have “racing” thoughts.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I plan trips well ahead of time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I am self-controlled.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I concentrate easily.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I save regularly.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I “squirm” at plays or lectures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I am a careful thinker.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I plan for job security.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. I like to think about complex problems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. I change jobs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. I act “on impulse.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. I get easily bored when solving thought problems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. I act on the spur of the moment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. I am a steady thinker.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. I change residences.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. I buy things on impulse.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. I can only think about one thing at a time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. I change hobbies.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. I spend or charge more than I earn.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. I often have extraneous thoughts when thinking.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. I am more interested in the present than the future.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. I am restless at the theatre or lectures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. I like puzzles.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
30. I am future oriented.

Snyder Self-Monitoring Scale (18-item)

Please answer true or false to the following items:

1. I find it hard to imitate the behaviour of other people.
   T F
2. At parties and social gatherings, I do not attempt to do or say things that others will like.
   T F
3. I can only argue for ideas which I already believe.
   T F
4. I can make impromptu speeches even on topics about which I have almost no information.
   T F
5. I guess I put on a show to impress or entertain others.
   T F
6. I would probably make a good actor.
   T F
7. In a group of people I am rarely the centre of attention.
   T F
8. In different situations and with different people, I often act like very different persons.
   T F
9. I am not particularly good at making people like me.
   T F
10. I’m not always the person I appear to be.
    T F
11. I would not change my opinions (or the way I do things) in order to please someone or win their favour.
    T F
12. I have considered being an entertainer.
    T F
13. I have never been good at games like charades or improvisational acting.
    T F
14. I have trouble changing my behaviour to suit different people and different situations.
    T F
15. At a party I let others keep the jokes and stories going.
    T F
16. I feel a bit awkward in company and do not show up quite as well as I should.
    T F
17. I can look anyone in the eye and tell a lie with a straight face (if for a right end).
    T F
18. I may deceive people by being friendly when I really dislike them.
    T F
<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>74</td>
<td>50</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>59</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>76</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>56</td>
<td>58</td>
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<tr>
<td></td>
<td>67</td>
<td>71</td>
<td>68</td>
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<tr>
<td></td>
<td>68</td>
<td>45</td>
<td>72</td>
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<tr>
<td></td>
<td>72</td>
<td>56</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>73</td>
<td>79</td>
<td>57</td>
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<td></td>
<td>96</td>
<td>59</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>73</td>
<td>55</td>
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<tr>
<td></td>
<td>65</td>
<td>70</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td>86</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>78</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>85</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td></td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td></td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>76</td>
<td></td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>93</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>Mean</td>
<td>69.44</td>
<td>67.36</td>
<td>62.55</td>
</tr>
<tr>
<td>SD</td>
<td>10.80</td>
<td>13.11</td>
<td>8.03</td>
</tr>
</tbody>
</table>
Information on Participant Numbers

The original plan was to recruit 60 participants which would have allowed for 30 participants per group after performing a median split based on BDHI scores and frequency of pornography use. However, only 52 participants were recruited due to limited funds and time resources. A median split was done with BDHI scores, however, the ‘frequency of pornography use’ scores within our participant pool was structured in a way that made a median split impossible. The reason behind creating 3 separate groups was due to the data revealing what was, essentially 3 separate clusters of scores within our group which left us with smaller groups to study.

Having said that, the sample sizes in the present study though small, are not uncommon in the field of neurophysiological research. It should be noted that, among other studies, Dennis and Hajcak, (2009), Cunningham et al., (2005) and Foti and Hajcak, (2008) utilised 20, 17 and 26 individuals respectively to carry out their experiments and publish their results (full references at the end of this response). Furthermore, although there are studies which incorporate much more individuals, few of these are longitudinal studies. As a consequence of the research question(s) in the present thesis, each individual was required to undergo electrophysiological recording for 3 sessions (in essence, 156 recording sessions for N = 52 participants). Ultimately, the sophistication of the present study, funding and time, combined with the resources required and the strict exclusion criteria meant, unfortunately we were not able to continue with recruitment for an extended period of time to obtain a greater sample size and therefore more power.

It is also important to note that significant findings with small sample sizes can also reflect more robust findings indicating that if the sample size is small, it must mean that most cases will show the observed effect.