

Article

Conscious and Non-Conscious Measures of Emotion: Do They Vary with Frequency of Pornography Use?

Sajeev Kunaharan ¹, Sean Halpin ¹, Thiagarajan Sitharthan ², Shannon Bosshard ¹
and Peter Walla ^{1,3,4,*}

¹ School of Psychology, Centre for Translational Neuroscience and Mental Health Research, University of Newcastle, Callaghan 2308, NSW, Australia; sajeev.kunaharan@newcastle.uon.edu (S.K.); Sean.halpin@newcastle.edu.au (S.H.); shannon.bosshard@gmail.com (S.B.)

² Sydney Medical School, University of Sydney, Sydney 2006, NSW, Australia; thiagarajan.sitharthan@sydney.edu.au

³ Cognitive Neuroscience & Behaviour Lab (CanBeLab), Department of Psychology, Webster Vienna Private University, Palais Wenkheim, 1020 Vienna, Austria

⁴ Faculty of Psychology, Vienna University, 1010 Vienna, Austria

* Correspondence: peter.walla@webster.ac.at; Tel.: +43-1-2699-293

Academic Editor: Takayoshi Kobayashi

Received: 1 March 2017; Accepted: 26 April 2017; Published: 11 May 2017

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.

Keywords: conscious versus non-conscious processes; pornography; emotion; affective responses; EEG; triangulation

1. Introduction

1.1. Ease of Access

There is an ever-increasing amount of pornographic material available online for public consumption [1,2]. 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 [3,4].

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 [5].

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 [3,6–15]. 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 [16,17]—even showing that physical abusers and sexual predators generally use pornography at a significantly higher rate than the average individual [18]. A meta-analysis performed by Allen et al. [6] 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 [19]. These correlations were higher if perpetrators were exposed to sexually violent pornography over non-violent forms. Mancini et al. [12] 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 [20], 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 [21], depressive symptoms [22], and the inability to initiate and maintain an erection with real sexual partners without the aid of pornography [23], 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.

1.3. Physiological Effects of Pornography

Event-related potentials (ERPs) have often been used as a physiological measure of reactions to emotional cues, e.g., [24]. Studies utilizing ERP data tend to focus on later ERP effects such as the P300 [14] and Late-Positive Potential (LPP) [7,8] 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) [25] as well as sustained processing of emotionally-relevant stimuli (LPP) [26]. Steele et al. [14] 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 [7,8]. 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 [27]. Prause et al. [7,8] 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., [28]. 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 [28]. Lang et al. [29] 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 [30], multiple disabilities [31], odours [32], schizophrenia [33], product design [34], walking through urban neighbourhoods [35], and emotion ownership [36]. SRM has also been introduced to consumer neuroscience [37–40]. However, the use of this recording measure in the processing of sexual information has been scarce [41]. 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 [42], and fearful [43] content. In 2014, SRM was suggested for use in exactly the context of the current study [44].

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.

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 [45,46]. 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 [13,45,47], and cognitive pollution [48]. 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 [38,49–51]. 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* [48]. 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.

2. Methods

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).

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 [52], 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 [53] 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. [54]. 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. [48].

2.3. Stimuli

Stimuli for the present study comprised of 150 images sourced from the International Affective Picture System (IAPS) [55]. 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., [56]. 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.

2.4. Procedure

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.

2.4.2. Experiment 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.

2.5. Analysis

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.

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.

2.5.3. Event-Related Potentials

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.

2.5.4. Startle Reflex Modulation

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 [28]).

3. Results

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 1. Demographic characteristics of study participants.

Variable	N	(%)
<i>Marital Status</i>		
Married	1	1.9
Never Married	39	75
De Facto/Living with a partner	12	23.1
Widowed	0	0
Divorced/Separated	0	0
<i>Highest Level of Completed Education</i>		
Primary School	0	0
Secondary School completed	22	42.3
Secondary School not completed	0	0
Trade Qualification	1	1.9
University or other Tertiary Study	29	55.8
Other	0	0
<i>Work</i>		
Full time	0	0
Part time	7	13.5
Unemployed	0	0
Working in the home/home duties	0	0
Retired	0	0
Student	45	86.5
Other		
<i>Country of Birth</i>		
Australia	47	90.4
Other	5	9.6
<i>Ethnicity *</i>		
African	1	1.9
Asian	2	3.8
Caucasian	47	90.4
Aboriginal or Torres Strait Islander	0	0
Other	1	1.9

* Not all sum due to non-responders.

3.2. Self-Reported Pornography Use and Self-Monitoring

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 2. Porn hours per year and Snyder Total score split by group.

Variable	Low Porn Use (N = 18)		Medium Porn Use (N = 14)		High Porn Use (N = 20)	
	Mean	SD	Mean	SD	Mean	SD
Age	20.8	3	20.7	2.2	22	3.5
Hours of Porn Viewed per Year	6.5	2.9	31	7.7	110.4	62.8
Snyder Total Score	10.2	3.1	9.9	4.1	12	3.3

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).

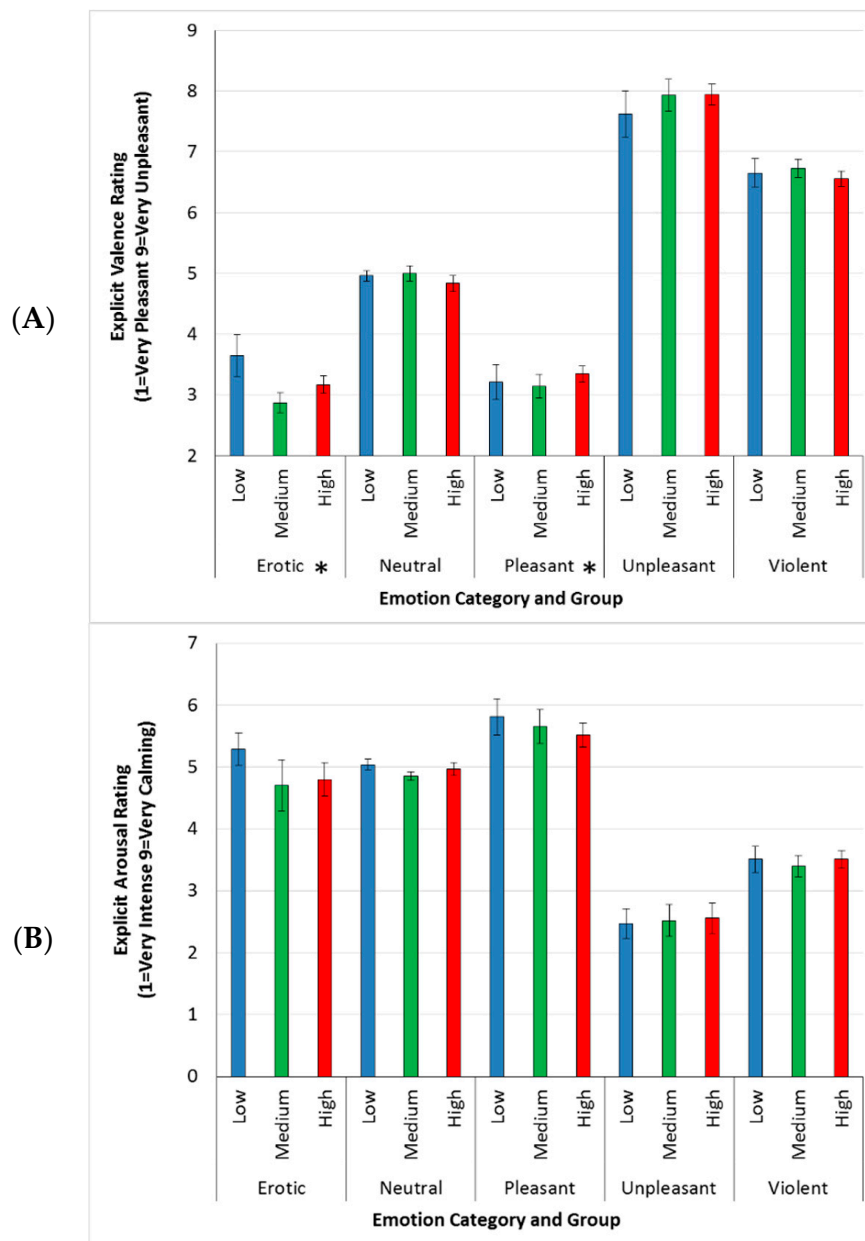


Figure 1. Explicit Valence (A) and Arousal (B) ratings for each emotion category across all groups. A significant *Group* interaction occurred for valence ratings in the “Erotic” and “Pleasant” categories (marked by asterisks).

3.4. 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.

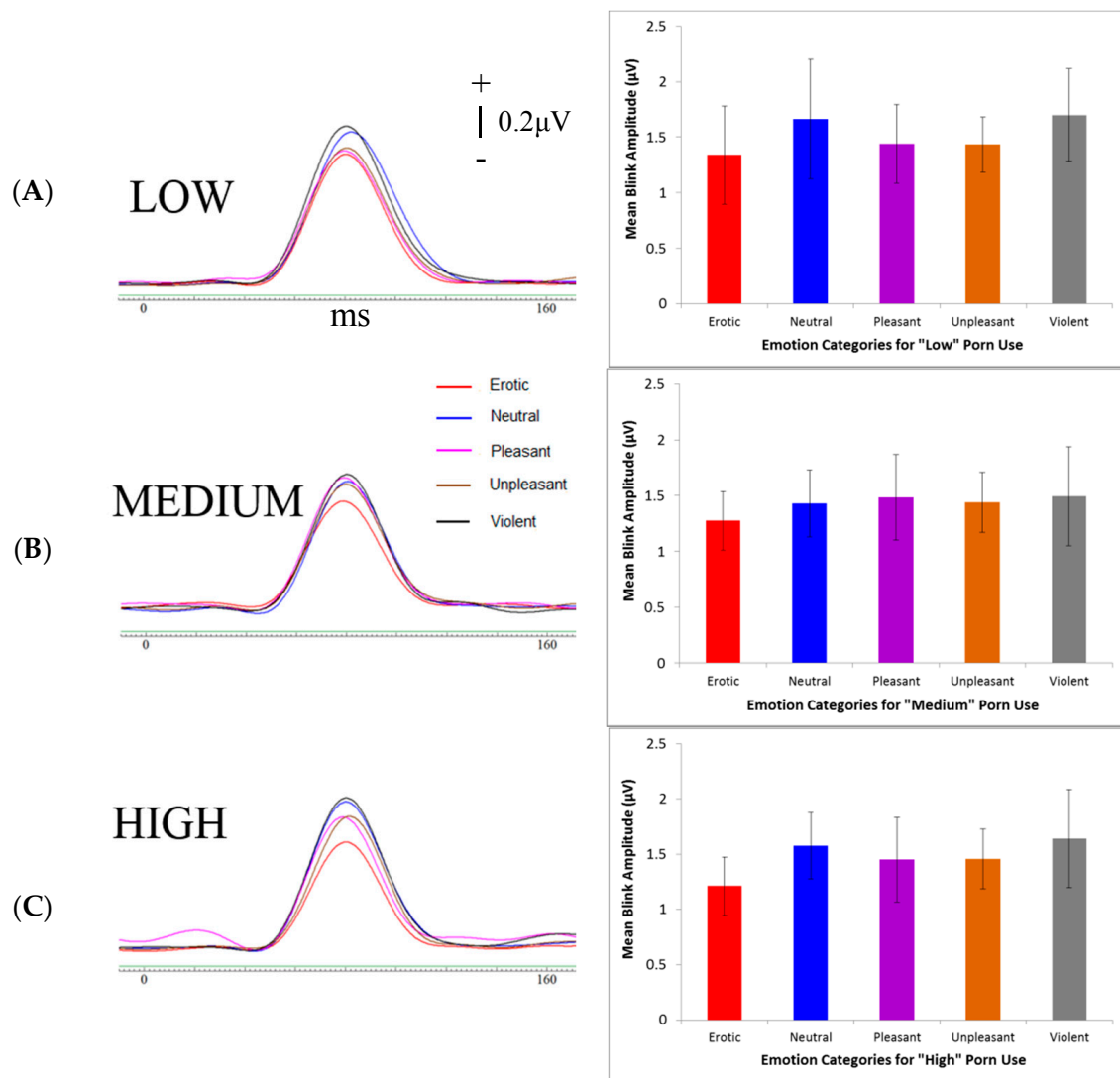


Figure 2. Startle-elicited eye blink responses (left) and column graphs (right) for Low (A), Medium (B), and High (C) porn use groups.

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).

Electrode Sites	Emotion Category	Time (ms)	F	p-Value
AF7/AF8	Unpleasant vs. Violent	250	3.236	0.048
		484	5.682	0.006
		563	3.454	0.04
P5/P6	Unpleasant vs. Violent	563	3.454	0.04
		719	3.938	0.026
		797	3.472	0.039
		875	4.258	0.02

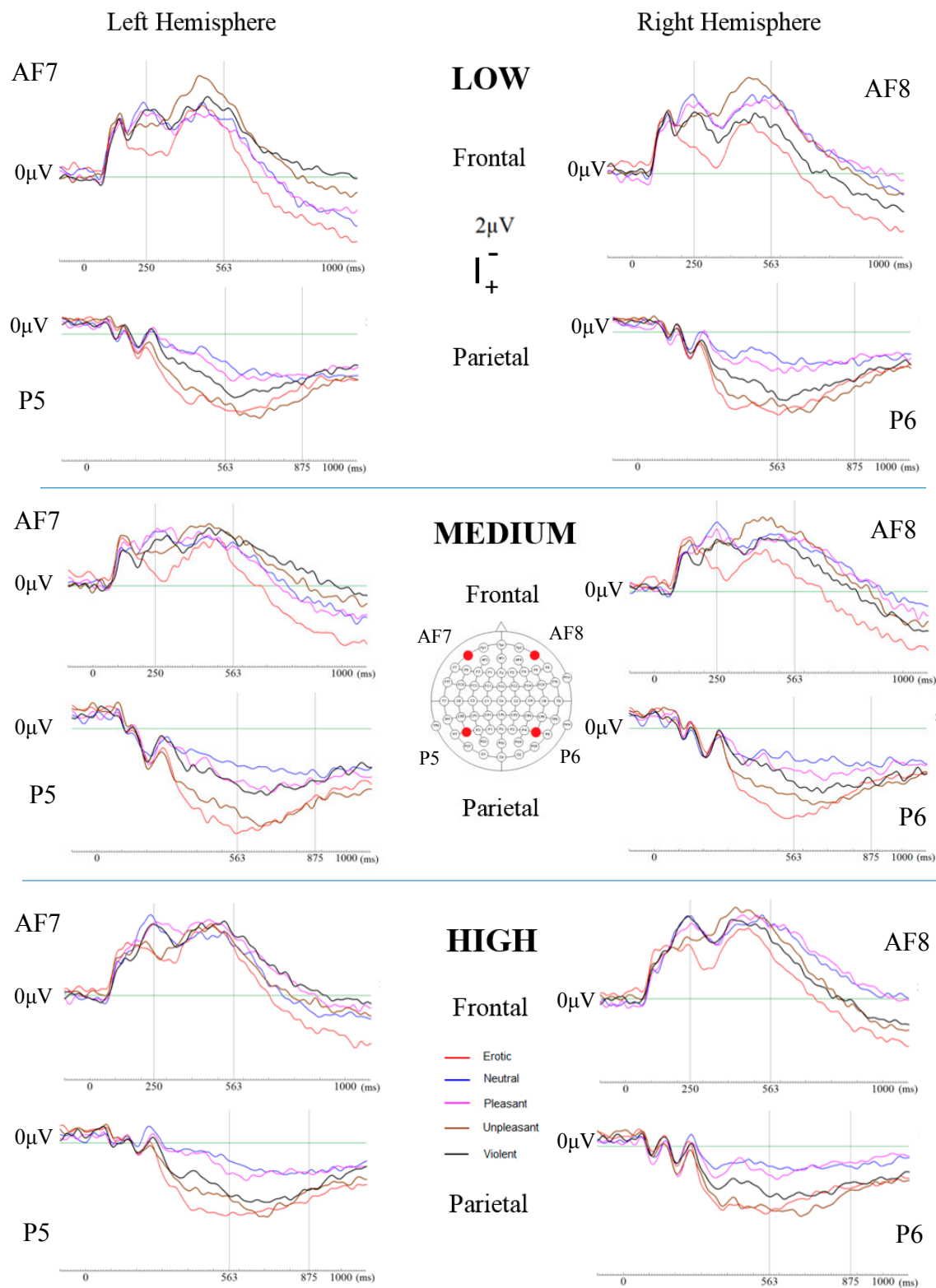


Figure 3. ERPs at frontal (AF7/AF8) and parietal (P5/P6) locations across all emotion categories for Low, Medium, and High porn use groups. Note significant group effects for “Unpleasant” vs. “Violent” emotion categories 250–563 ms in frontal areas of the brain and between 563–875 ms in parietal regions.

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 [57]) and relates to subcortical brain structures, e.g., [29]. 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.

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 [58] 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 [3,7,8]. It is the authors’ contention that this effect may account for the results observed.

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 et al. [59], 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 [60,61]). 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 [58]. 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.

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 [32,42,43]. 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 [41]. 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 [41,42].

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.

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 [7,8] 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 [62,63]. 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 [64].

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 [65], the Pornography Craving Questionnaire [66], the Pornography Consumption Effects Scale [67], and the Problematic Pornography Use Scale [68], 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 [69]) 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.

Acknowledgments: The authors want to thank Ross Fulham for his highly appreciated help with EEG and startle data processing. He is an amazing person with invaluable knowledge, expertise and skill.

Author Contributions: Sajeew Kunaharan, Sean Halpin, Thiagarajan Sitharthan, Shannon Bosshard and Peter Walla conceived and designed the experiments; Sajeew Kunaharan performed the experiments; Sajeew Kunaharan and Peter Walla analysed the data; Sajeew Kunaharan, Sean Halpin and Peter Walla contributed materials/analysis tools; Sajeew Kunaharan and Peter Walla wrote the paper; Sean Halpin, Thiagarajan Sitharthan and Shannon Bosshard provided writing input and feedback including comments and suggestions. All authors contributed substantially to the work reported.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Harkness, E.L.; Mullan, B.; Blaszczyński, A. The Association between Internet Pornography Consumption and Sexual Risk Behavior in Heterosexual Adult Australian Residents. In Proceedings of the Australasian Society of Behavioural Health and Medicine, Auckland, New Zealand, 12–14 February 2014.
2. Fisher, W.A.; Barak, A. Internet pornography: A social psychological perspective on internet sexuality. *J. Sex. Res.* **2001**, *38*, 312–323. [[CrossRef](#)]
3. Kühn, S.; Gallinat, J. Brain structure and functional connectivity associated with pornography consumption: The brain on porn. *JAMA Psychiatry* **2014**, *71*, 827–834. [[CrossRef](#)] [[PubMed](#)]
4. Cooper, A. Sexuality and the Internet: Surfing into the new millennium. *CyberPsychol. Behav.* **1998**, *1*, 187–193. [[CrossRef](#)]
5. Reid, R.C.; Carpenter, B.N.; Hook, J.N.; Garos, S.; Manning, J.C.; Gilliland, R.; Cooper, E.B.; McKittrick, H.; Davtian, M.; Fong, T. Report of findings in a DSM-5 field trial for hypersexual disorder. *J. Sex. Med.* **2012**, *9*, 2868–2877. [[CrossRef](#)] [[PubMed](#)]
6. Allen, M.; Emmers, T.; Gebhardt, L.; Giery, M.A. Exposure to Pornography and Acceptance of Rape Myths. *J. Commun.* **1995**, *45*, 5–26. [[CrossRef](#)]
7. Prause, N.; Steele, V.R.; Staley, C.; Sabatinelli, D. Late positive potential to explicit sexual images associated with the number of sexual intercourse partners. *Soc. Cogn. Affect. Neurosc.* **2015**, *10*, 93–100. [[CrossRef](#)] [[PubMed](#)]
8. Prause, N.; Steele, V.R.; Staley, C.; Sabatinelli, D.; Hajcak, G. Modulation of late positive potentials by sexual images in problem users and controls inconsistent with “porn addiction”. *Biol. Psychol.* **2015**, *109*, 192–199. [[CrossRef](#)] [[PubMed](#)]
9. Roberts, A.; Yang, M.; Ullrich, S.; Zhang, T.; Coid, J.; King, R.; Murphy, R. Men's pornography consumption in the UK: Prevalence and associated problem behaviour. *Arch. Sex. Behav.* **2015**, 16360.
10. Buzzell, T.; Foss, D.; Middleton, Z. Explaining use of online pornography: A test of self-control theory and opportunities for deviance. *J. Crim. Justice Pop. Cult.* **2006**, *13*, 96–116.

11. Hilton, D.L., Jr.; Watts, C. Pornography addiction: A neuroscience perspective. *Surg. Neurol. Int.* **2011**, *2*, 19. [\[PubMed\]](#)
12. Mancini, C.; Reckdenwald, A.; Beauregard, E. Pornographic exposure over the life course and the severity of sexual offenses: Imitation and cathartic effects. *J. Crim. Justice* **2012**, *40*, 21–30. [\[CrossRef\]](#)
13. Seto, M.C. *Psychophysiological assessment of paraphilic sexual interests* In *The Psychophysiology of Sex*; Janssen, E., Ed.; University of Indiana Press: Bloomington, IN, USA, 2007; pp. 475–491.
14. Steele, V.R.; Staley, C.; Fong, T.; Prause, N. Sexual desire, not hypersexuality, is related to neurophysiological responses elicited by sexual images. *Socioaffect. Neurosci. Psychol.* **2013**, *3*, 20770. [\[CrossRef\]](#) [\[PubMed\]](#)
15. Vega, V.; Malamuth, N.M. Predicting sexual aggression: The role of pornography in the context of general and specific risk factors. *Aggress. Behav.* **2007**, *33*, 104–117. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Wright, P.J.; Tokunaga, R.S.; Kraus, A. A Meta-Analysis of Pornography Consumption and Actual Acts of Sexual Aggression in General Population Studies. *J. Commun.* **2015**, *66*, 183–205. [\[CrossRef\]](#)
17. Paolucci, E.O.; Genuis, M.; Violato, C. A meta-analysis of the published research on the effects of pornography. *Med. Mind Adolesc.* **1997**, *72*, 1–2.
18. Johnson, S.A. The role of pornography in sexual offenses: Information for law enforcement & forensic psychologists. *Int. J. Emerg. Ment. Health Hum. Resil.* **2015**, *17*, 239–242.
19. Hald, G.M.; Malamuth, N.M.; Yuen, C. Pornography and attitudes supporting violence against women: Revisiting the relationship in nonexperimental studies. *Aggress. Behav.* **2010**, *36*, 14–20. [\[CrossRef\]](#) [\[PubMed\]](#)
20. Ferguson, C.J.; Hartley, R.D. The pleasure is momentary...the expense damnable? The influence of pornography on rape and sexual assault. *Aggress. Violent Behav.* **2009**, *14*, 323–329. [\[CrossRef\]](#)
21. Szymanski, D.M.; Stewart-Richardson, D.N. Psychological, relational, and sexual correlates of pornography use on young adult heterosexual men in romantic relationships. *J. Men's Stud.* **2014**, *22*, 64–82. [\[CrossRef\]](#)
22. Conner, S.R. Frequency of Pornography Use Is Indirectly Associated with Lower Relationship Confidence through Depression Symptoms and Physical Assault among Chinese Young Adults. Master's Thesis, Kansas State University, Manhattan, KS, USA, 2014.
23. Park, B.Y.; Wilson, G.; Berger, J.; Christman, M.; Reina, B.; Bishop, F.; Klam, W.P.; Doan, A.P. Is Internet Pornography Causing Sexual Dysfunctions? A Review with Clinical Reports. *Behav. Sci.* **2016**, *6*, 17. [\[CrossRef\]](#) [\[PubMed\]](#)
24. Mavratzakis, A.; Herbert, C.; Walla, P. Emotional facial expressions evoke faster orienting responses, but weaker emotional responses at neural and behavioral levels compared to scenes: A simultaneous EEG and facial EMG study. *Neuroimage* **2016**, *124*, 931–946. [\[CrossRef\]](#) [\[PubMed\]](#)
25. Linden, D.E. The P300: Where in the brain is it produced and what does it tell us? *Neuroscientist* **2005**, *11*, 563–576. [\[CrossRef\]](#) [\[PubMed\]](#)
26. Voon, V.; Mole, T.B.; Banca, P.; Porter, L.; Morris, L.; Mitchell, S.; Lapa, T.R.; Karr, J.; Harrison, N.A.; Potenza, M.N.; et al. Neural correlates of sexual cue reactivity in individuals with and without compulsive sexual behaviours. *PLoS ONE* **2014**, *9*, e102419. [\[CrossRef\]](#) [\[PubMed\]](#)
27. Minnix, J.A.; Versace, F.; Robinson, J.D.; Lam, C.Y.; Engelmann, J.M.; Cui, Y.; Borwn, V.L.; Cinciripini, P.M. The late positive potential (LPP) in response to varying types of emotional and cigarette stimuli in smokers: A content comparison. *Int. J. Psychophysiol.* **2013**, *89*, 18–25. [\[CrossRef\]](#) [\[PubMed\]](#)
28. Mavratzakis, A.; Molloy, E.; Walla, P. Modulation of the startle reflex during brief and sustained exposure to emotional pictures. *Psychology* **2013**, *4*, 389–395. [\[CrossRef\]](#)
29. Lang, P.J.; Bradley, M.M.; Cuthbert, B.N. Emotion, attention, and the startle reflex. *Psychol. Rev.* **1990**, *97*, 377–395. [\[CrossRef\]](#) [\[PubMed\]](#)
30. Patrick, C.J.; Bradley, M.M.; Lang, P.J. Emotion in the criminal psychopath: Startle reflex modulation. *J. Abnorm. Psychol.* **1993**, *102*, 82–92. [\[CrossRef\]](#) [\[PubMed\]](#)
31. Lyons, G.S.; Walla, P.; Arthur-Kelly, M. Towards improved ways of knowing children with profound multiple disabilities: Introducing startle reflex modulation. *Dev. Neurorehabil.* **2013**, *16*, 340–344. [\[CrossRef\]](#) [\[PubMed\]](#)
32. Ehrlichman, H.; Brown Kuhl, S.; Zhu, J.; Wrrenburg, S. Startle reflex modulation by pleasant and unpleasant odors in a between-subjects design. *Psychophysiology* **1997**, *34*, 726–729. [\[CrossRef\]](#) [\[PubMed\]](#)
33. Dawson, M.E.; Hazlett, E.A.; Fillion, D.L.; Nuechterlein, K.H.; Schell, A.M. Attention and schizophrenia: Impaired modulation of the startle reflex. *J. Abnorm. Psychol.* **1993**, *102*, 633–641. [\[CrossRef\]](#) [\[PubMed\]](#)
34. Grahl, A.; Greiner, U.; Walla, P. Bottle shape elicits gender-specific emotion: A startle reflex modulation study. *Psychology* **2012**, *7*, 548–554. [\[CrossRef\]](#)

35. Geiser, M.; Walla, P. Objective measures of emotion during virtual walks through urban neighbour-hoods. *Appl. Sci.* **2011**, *1*, 1–11. [[CrossRef](#)]
36. Walla, P.; Rosser, L.; Scharfenberger, J.; Duregger, C.; Bosshard, S. Emotion ownership: Different effects on explicit ratings and implicit responses. *Psychology* **2013**, *4*, 213–216. [[CrossRef](#)]
37. Koller, M.; Walla, P. Measuring Affective Information Processing in Information Systems and Consumer Research—Introducing Startle Reflex Modulation. In Proceedings of the 33rd International Conference on Information Systems, Orlando, FL, USA, 16–19 December 2012.
38. Walla, P.; Koller, M.; Meier, J. Consumer neuroscience to inform consumers—Physiological methods to identify attitude formation related to over-consumption and environmental damage. *Front. Hum. Neurosci.* **2014**, *8*, 304. [[CrossRef](#)] [[PubMed](#)]
39. Walla, P.; Koller, M. Emotion is not what you think it is: Startle Reflex Modulation (SRM) as a measure of affective processing in Neurols. In *Lecture Notes in Information Systems and Organization: Information Systems and Neuroscience*; Springer International Publishing: Cham, Switzerland, 2015; Volume 10, pp. 181–186.
40. Koller, M.; Walla, P. Towards alternative ways to measure attitudes related to consumption: Introducing startle reflex modulation. *J. Agric. Food Ind. Organ.* **2015**, *13*, 83–88. [[CrossRef](#)]
41. Koukounas, E.; Over, R. Changes in the magnitude of the eyeblink startle response during habituation of sexual arousal. *Behav. Res. Ther.* **2000**, *38*, 573–584. [[CrossRef](#)]
42. Jansen, D.M.; Frijda, N.H. Modulation of the acoustic startle response by film-induced fear and sexual arousal. *Psychophysiology* **1994**, *31*, 565–571. [[CrossRef](#)] [[PubMed](#)]
43. Ruiz-Padial, E.; Vila, J. Fearful and Sexual Pictures Not Consciously Seen Modulate the Startle Reflex in Human Beings. *Biol. Psychiatry* **2007**, *61*, 996–1001. [[CrossRef](#)] [[PubMed](#)]
44. Kunaharan, S.; Walla, P. Clinical Neuroscience—Towards a Better Understanding of Non-Conscious versus Conscious Processes Involved in Impulsive Aggressive Behaviours and Pornography Viewership. *Psychology* **2014**, *5*, 1963–1966. [[CrossRef](#)]
45. Wiederman, M.W.; Whitley, B.E., Jr. *Handbook for Conducting Research on Human Sexuality*; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 2002.
46. Davidson, R.J. Seven sins in the study of emotion: Correctives from affective neuroscience. *Brain Cogn.* **2003**, *52*, 129–132. [[CrossRef](#)]
47. Koukounas, E.; McCabe, M.P. Sexual and Emotional Variables Influencing Sexual Response to Erotica: A Psychophysiological Investigation. *Arch. Sex. Behav.* **2001**, *30*, 393–408. [[CrossRef](#)] [[PubMed](#)]
48. Walla, P.; Brenner, G.; Koller, M. Objective measures of emotion related to brand attitude: A new way to quantify emotion-related aspects relevant to marketing. *PLoS ONE* **2011**, *6*, e26782. [[CrossRef](#)] [[PubMed](#)]
49. Walla, P. Non-Conscious Brain Processes Revealed by Magnetoencephalography (MEG). In *Magnetoencephalography*; InTech: Rijeka, Croatia, 2011.
50. Winkielman, P.; Berridge, K.C. Unconscious Emotion. *Curr. Dir. Psychol. Sci.* **2004**, *13*, 120–123. [[CrossRef](#)]
51. Tamietto, M.; de Gelder, B. Neural bases of the non-conscious perception of emotional signals. *Nat. Rev. Neurosci.* **2010**, *11*, 697–709. [[CrossRef](#)] [[PubMed](#)]
52. LimeSurvey: An Open Source Survey Tool/LimeSurvey Project Hamburg, Gemrnay. 2012. Available online: <http://www.limesurvey.org> (accessed on 1–30 June 2015).
53. Snyder, M. Self-monitoring of expressive behavior. *J. Pers. Soc. Psychol.* **1974**, *30*, 526–537. [[CrossRef](#)]
54. Harkness, E.L.; Mullan, B.; Blaszczyński, A. Association between pornography use and sexual risk behaviors in adult consumers: A systematic review. *Cyberpsychol. Behav. Soc. Netw.* **2015**, *18*, 59–71. [[CrossRef](#)] [[PubMed](#)]
55. Lang, P.J.; Bradley, M.M.; Cuthbert, B.N. *International Affective Picture System (IAPS): Affective Ratings of Pictures and Instruction Manual*; Technical Report A-8; University of Florida: Gainesville, FL, USA, 2008.
56. Van Dongen, N.N.N.; Van Strien, J.W.; Dijkstra, K. Implicit emotion regulation in the context of viewing artworks: ERP evidence in response to pleasant and unpleasant pictures. *Brain Cogn.* **2016**, *107*, 48–54. [[CrossRef](#)] [[PubMed](#)]
57. Konorski, J. *Integrative Activity of the Brain: An Interdisciplinary Approach*; University of Chicago Press: Chicago, IL, USA, 1967.
58. Harper, C.; Hodgins, D.C. Examining correlates of problematic internet pornography use among university students. *J. Behav. Addict.* **2016**, *5*, 179–191. [[CrossRef](#)] [[PubMed](#)]

59. Cuthbert, B.N.; Schupp, H.T.; Bradley, M.M.; Birbaumer, N.; Lang, P.J. Brain potentials in affective picture processing: Covariation with autonomic arousal and affective report. *Biol. Psychol.* **2000**, *52*, 95–111. [[CrossRef](#)]
60. Harmon-Jones, E.; Gable, P.A.; Peterson, C.K. The role of asymmetric frontal cortical activity in emotion-related phenomena: A review and update. *Biol. Psychol.* **2010**, *84*, 451–462. [[CrossRef](#)] [[PubMed](#)]
61. Hofman, D. The frontal laterality of emotion: A historical overview. *Neth. J. Psychol.* **2008**, *64*, 112–118. [[CrossRef](#)]
62. Hajcak, G.; MacNamara, A.; Olvet, D.M. Event-related potentials, emotion, and emotion regulation: An integrative review. *Dev. Neuropsychol.* **2010**, *35*, 129–155. [[CrossRef](#)] [[PubMed](#)]
63. Sarlo, M.; Übel, S.; Leutgeb, V.; Schienle, A. Cognitive reappraisal fails when attempting to reduce the appetitive value of food: An ERP study. *Biol. Psychol.* **2013**, *94*, 507–512. [[CrossRef](#)] [[PubMed](#)]
64. Hald, G.M. Gender differences in pornography consumption among young heterosexual Danish adults. *Arch. Sex. Behav.* **2006**, *35*, 577–585. [[CrossRef](#)] [[PubMed](#)]
65. Kalichman, S.C.; Rompa, D. Sexual Sensation Seeking and Sexual Compulsivity Scales: Validity, and Predicting HIV Risk Behavior. *J. Pers. Assess.* **1995**, *65*, 586–601. [[CrossRef](#)] [[PubMed](#)]
66. Kraus, S.; Rosenberg, H. The Pornography Craving Questionnaire: Psychometric Properties. *Arch. Sex. Behav.* **2014**, *43*, 451–462. [[CrossRef](#)] [[PubMed](#)]
67. Hald, G.M.; Malamuth, N.M. Self-perceived effects of pornography consumption. *Arch. Sex. Behav.* **2008**, *37*, 614–625. [[CrossRef](#)] [[PubMed](#)]
68. Kor, A.; Zilcha-Mano, S.; Fogel, Y.A.; Mikulincer, M.; Reid, R.C.; Potenza, M.N. Psychometric development of the Problematic Pornography Use scale. *Addict. Behav.* **2014**, *39*, 861–868. [[CrossRef](#)] [[PubMed](#)]
69. Rugg, M.D.; Mark, R.E.; Walla, P.; Schloerscheidt, A.M.; Birch, C.S.; Allan, K. Dissociation of the neural correlates of implicit and explicit memory. *Nature* **1998**, *392*, 595–598. [[CrossRef](#)] [[PubMed](#)]



© 2017 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).