Beyond the Valley of the Genitals:

Using eye-tracking to analyze sexual arousal and desire in women and men

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ABSTRACT

Beyond the Valley of the Genitals: Using eye tracking to analyze sexual arousal and desire in women and men

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Traditional models of sexual arousal and desire in humans have focused on either physiological measures (Kaplan, 1974; Masters & Johnson), or on self-report (ex.Derogatis & Melisaratos, 1979). However, some have also proposed that cognitive processes play a key role in connecting both arousal and desire. It is unknown if a stimulus is deemed sexually salient at a low processing level (i.e., at the level of sensation), or if more higher-level cognitive processing (i.e., perception, recognition) is required to generate a sexual response to the stimuli, or a combination of both. In addition, are there gender differences to this perception of sexual stimuli. Therefore, the aim of this thesis was to use cognitive measures that target low level and high level processing tasks to examine whether eye-tracking methodology could reveal patterns that constitute a more objective assessment of sexual arousal and desire. The results indicate that low level tasks, which used timed response tasks with visual sexual stimuli, created a delay effect predominantly in men, and to a lesser extent in women. When women were subjectively aroused (as assessed using the SADI; Toledano & Pfaus, 2006) the observed level of cognitive delay increased (i.e., latency to respond to stimuli). However, low level processing does not produce a sexually induced cognitive delay effect in women. This finding suggests a reflexive response in women that is not sufficient to impose a cognitive delay. In contrast, using high level processing tasks that exposed participants to viewing sexual stimuli for longer durations (specifically, viewing nude versus clothed images, viewing high versus low arousal images, and viewing an erotic movie) lead to gender distinct patterns of eye movements concordant with reported levels of subjective arousal. Interestingly, women shown specific eye movement patterns when viewing images that they rate as highly arousing (in comparison to low arousing images). Together, these data suggest that women may require longer exposure to sexual stimuli in order to engage and sustain desire, which can then produce concordant results with self-reported arousal.

Keywords: Cognition, Eye tracking, Visual Sexual Stimuli, Sexually induced cognitive delay.

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CONTRIBUTION OF AUTHORS

This dissertation consists of a general introduction, five experimental chapters, and a general discussion. All sections were written with general feedback from my supervisors, Dr. Aaron Johnson and Dr. Jim Pfaus. Several undergraduate students contributed to the collection of data. The co-authorships are defined below.

Chapter 2: Attention Capture by Sexually Relevant Stimuli: Evidence from the Emotional Saccadic Stroop Task.
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Chapter 3: Using a Mixed Saccade Task to Explore Attention Capture by Sexual Imagery
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Chapter 4: Visibility of Sexual Features Influences Eye Movements
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Chapter 5: Eye-Tracking of Erotic Images: high and low arousal and valence
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Chapter 6: Effects of Menstrual Cycle on Scan Path Patterns While Viewing Erotic Videos
Lucia Farisello, Karine Elalouf, Jacob Applebaum, Aaron. P. Johnson, James G. Pfaus

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Chapter 1: Introduction

In many species, including humans, sexual arousal is typically defined as an objective and physiological genital response to sexual stimulation, whereas sexual desire refers to wanting or craving sexual activity and the behavior individuals engage in to seek out or otherwise work for sexual activity, whether alone or with others (Pfaus, 1999). Somewhere in between lies the notion of subjective sexual arousal, in which people make conscious assessments of their overall state of sexual arousal. This can reflect genital responses, especially erections in men, but also be influenced by other autonomic sensations, such as heart rate, breathing rate, sweating, etc., as the body prepares itself for action. It is unclear at present how these pieces fit together in one's overall sense of sexual excitement. Does one always precede another? Do they build on, or amplify one another? Is there a critical threshold for autonomic stimulation that must be reached before subjective awareness of arousal or desire occurs? Do these aspects of sexual excitement activate different brain regions, which are then summed together elsewhere to provide conscious awareness of a whole state of sexual arousal or desire?

Elucidating the differences between sexual arousal and desire has gained interest since the changes made to the Female Sexual Disorders section of the Diagnostic and Statistical Manual-5 (DSM-5; APA, 2013). The DSM-IV (APA, 2000) criteria of sexual dysfunction allowed for separate diagnoses of disorders of arousal (sexual arousal disorder, or SAD) and desire (hypoactive sexual desire disorder, or HSDD). However, clinical observations of women with either disorder suggested that both components appeared to a greater or lesser degree. Accordingly, it was suggested for the DSM-5 that the delineation between arousal and desire in women may be "artificial" (APA, 2013; Brotto & Smith 2014), and a new disorder combining the two was invented as female sexual interest and arousal disorder (FSIAD). This new moniker is currently the topic of heated debate between different clinical camps, and between clinicians and sexual medicine practitioners who have argued that eliminating the separation does not accurately reflect the patient populations they see (Parish et al., 2016), nor is it consistent with data showing that women can have predominant disorders of one, the other, or both (Sarin, Amsel, & Binik, 2016). Indeed, these disorders were left separate for men in the DSM-5, and separate sexual arousal and desire disorders will be coded for both men and women in the new incarnation of the International Classification of Diseases 11 (ICD-11) used as the official system of clinical diagnoses in Europe (Reed et al., 2016).

Biologically, sexual behavior is organized into excitatory and inhibitory neuroanatomical and neurochemical systems in the brain and periphery which promote physiological responding (e.g., genital engorgement, increased heart rate, pupil dilation) in response to salient incentive cues (Pfaus, 2009; Toates, 1992; 2015). Sexual incentives also activate a number of limbic and cortical structures that control the behavior made toward those incentives based on experience with them as indicators or "primes" of sexual pleasure (Georgiadis, Kringelbach, & Pfaus, 2012; Pfaus et al., 2012). Early experience with sexual pleasure sets the stage for future responses to incentive sexual stimuli, sensitizing or inhibiting responses, conditioning sexual mores, and sexual schemas, essentially setting up a template of preferred types and optimal sexual behaviors (Pfaus et al., 2012; 2016). How do they interact?

Albert Moll (1897/1919) was the first to describe the relation between physiological (genital) sexual responses, particularly 'detumescence' or 'contraction,' and psychological or 'psychical' processes, which included the drive to approach another individual. He proposed a 4-stage model of "drives" that increased autonomic excitation from rest to orgasm: tumescence drive (which induced a desire for sexual activity), voluptuous pleasure or sensation drive (produced by more and more manual or partnered genital and extragenital stimulation), voluptuous acme drive (orgasm), and detumescence drive (refractoriness). This early view of the interaction of arousal and desire was further elaborated upon by Ellis (1900) whose view of tumescence and detumescence began the linear model thinking of sexual response. While Ellis ascertains the importance of Moll's view of physiological and psychological processes, he highlighted a lack of explanation for their interaction. Masters and Johnson (1966) recast Moll's 4-stage model into their EPOR model, where tumescence was "Excitation," voluptuous sensation was "Plateau," voluptuous acme was "Orgasm," and detumescence was "Resolution." This model offered researchers a solid foundation for further exploration; however, its focus was on the progression and release of autonomic "excitement" in a mainly physiological system, which largely ignored any psychological interpretation of the response. Kaplan (1974) included sexual desire as the motivating factor that switched the human sexual response cycle on. Bancroft's circular model (1989) incorporated both physiological responses and their conscious psychological interpretation into a system of feedback loops that were influenced by things like temperament, sexual schemas, cultural conditioning, sexual attitudes, learned incentives and inhibitors. This model was one of the first to account for general affect and its interaction with cortical structures. Around the same time, the interaction between emotions and sexual function was the basis for a Barlow's (1986) cognitive – affective model of sexual function that focused on cognitive processes underlying sexual function and dysfunction. In Barlow's view, autonomic arousal prepares the body for sexual interaction and through a set of cognitive processes that focus attention, it drives attention toward incentive sexual cues. For individuals suffering from sexual dysfunction, erotic cues likely induced negative affect which inhibited responses toward sexual incentives and thereby increased attention to irrelevant cues.

Evidence from feedback system models highlights the impact that both positive and negative feedback have upon the sexual response cycle. Basson's (2005) circular sexual response model in women, includes hormones as a feedback system, as well as the interaction of arousal and desire, modified by prior experiences and expectancies. This model takes into account not only the fact that a sexual response does not necessarily occur as a series of specific physiological events, but rather, some of the responses co-occur and are magnified based on the feedback from one of the responses. Desire may not actually be pre-existing nor is it the only driving factor to engage in sexual activities. While pre-existing desire may be a motivator for autoerotic activity, it may not be the main reason for engaging in a partnered sexual experience, especially in a long-term relationship (Basson, 2000). Other reasons for initiating or being receptive to sexual activity may be for bonding with a partner or even as a means to increase the passion within a couple (Basson, 2000; Regan & Berscherd, 1996; Tiefer, 1991). Basson differentiates between "responsive" sexual arousal as well as "spontaneous" sexual arousal, with responsive desire induced by competent sexual incentives in the environment and spontaneous desire driven by hormonal or other internal events. And clearly these two interacted to produce conscious awareness of an individual's level of sexual arousal and desire. When desire is heightened, it leads to a feedback system that heightens interest and reaction to sexual stimuli, making the individual more receptive to sexual advances. This leads to further physiological and psychological arousal and attention.

1.1. Physiological/Objective Measures of Arousal

Physiological responses that denote sexual arousal can be measured objectively using various devices such as photoplethysmography, thermography, galvanic skin response, pupil size variation, heart rate variability, and fMRI for measures of neural activity related to arousal. These are typically measured in response to sets of erotic pictures of varying quality, videos of varying lengths and quality, or in response to erotic audio clips. In men and women, genital blood flow is controlled by the autonomic nervous system (Gabella, 1995; Iverson, Iverson, & Saper, 2000). The sympathetic nervous system prepares the body for what may come, (increases heart rate, dilation of pupils, bronchioles, activation of adrenal glands, constriction of blood vessels). Following activation of the sympathetic nervous system which moves blood from the core to the periphery, the parasympathetic nervous system must engage to revert the individual back to homeostasis. However, with sexual response, it is the parasympathetic nervous system which is responsible for maintaining blood in dilated cavernosal blood vessels which manifest as an erection in men, and labial/vaginal/clitoral engorgement in women. Traditionally a photoplethysmograph (strain gauge; Bancroft, Jones & Pullan, 1966; Freund, 1963; Freund, Knob & Sedlacek, 1965) has been used to measure the tumescence of the penis. The strain gauge (made up of rubber tubing, filled with mercury and fitted with electrodes) is placed around the shaft of the penis and as tumescence is achieve, the resistance against the gauge can be quantified. Studies have used this apparatus to show the physiological response to different types of sexual stimuli. Men show a category specific physiological response to their preferred sexual stimuli (Chivers, 2010; Chivers & Bailey, 2005; Chivers, Rieger, Latty & Bailey, 2004; Chivers, Seto & Blanchard, 2007; Freund, 1963; Freund, Knob & Sedlacek, 1965; Sakheim, Barlow, Beck & Abrahmson, 1987; Spape, Timmers, Yoon, Ponseti & Chivers, 2014) with heterosexual men achieving full tumescence when presented with images of women, or images of engorged labia (Spape et al., 2014). Homosexual men show the greatest objective arousal when presented with images of men and bisexual men show subjective arousal with stimuli of both men and women equally (Cerny & Janssen, 2011). While this method is effective in measuring a quantifiable change in penile circumference, it is not without its limitations. First, when an erection is achieved, initially the change occurs in penile length rather than girth, which may in fact appear as a delay in physiological response. Second, given that the cuff has to be placed on the penis, it may initiate arousal and hence the measured response may partially be due to the apparatus itself (Freund et al., 1965). However, one of the most important limitations to extending penile circumference results to psychometric implications (i.e. measure of sexual interest) may come from studies of sexual deviance. Increases in phallometric size appear to be specific to preferred stimuli, however, it does not offer information beyond the physical. Freund and colleagues (1963, 1965) believed that the physiological response of men was indicative of sexual interest given that men with pedophilic interests showed a greater penile circumference change when viewing images of younger people. Furthermore, deviant groups such as incarcerated rapists (Barbaree, Marshall & Lanthier, 1979) showed greater increases in penile circumference when viewing a video of non-consensual sex, compared to non-rapist participants as well as in non-offending participants who self-rated as likely to commit a rape (Malamuth & Check, 1983; for review of phallometry as an assessment of rape see Clegg & Fremouw, 2009). However, because this measure only offers information on the physiological response, it is not possible to know if the response was based on a preference for coercive or non-consensual sex or rather a lack of inhibition produced by the more violent stimuli which is evident in the participants who are neither convicted rapists nor score high on perceived pre-dispositions to commit rape (Barabee et al., 1979).

Photoplethysmography is also used to measure the engorgement within the vagina. A plastic, infrared light-emitting, tampon-like attachment is inserted into the vagina. As the vagina engorges and tightens, the light emitted is reduced and an inverse function is made as an increase in vasocongestion. Similar to penile strain gauges, vaginal blood volume and blood flow can be used as a rate measure. However, unlike men, women do not show a specificity of arousal based on the sex of the stimulus (Chivers, 2010; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers et al., 2007; Sakheim et al., 1987; Spape et al., 2014) and show labial engorgement and lubrication when presented with images of men or women. Although photoplethysmography offers information about vaginal engorgement, women are often unaware of their own physiological response. Blood flow to the penis may be more readily felt compared to the internal blood flow to the labia or clitoris. Furthermore, when men have an erection, resistance is felt again their clothing; a sensation not shared by women. This may be partially to blame for the lack of concordance in subjective and objective arousal by women (Chivers & Rosen, 2010). One limitation to vaginal photoplethysmography is the variability of women's internal vaginal structure, which is also affected by the position they are in while viewing erotic visual stimuli. Although there are different sized gauges, there can be incorrect readings in women who have a larger or smaller vaginal canal. Genital thermography, which measures the change in temperature to the external genitals induced by core blood coming into them, avoids the "one size does not fit all" problem. It can also be used for test-retest measurements, whereas vaginal photoplethysmography is suspect given the difficulty placing the probe in exactly the same place each time. However, thermography is in its infancy as a technique, and there is a short lag time lab between measures of internal blood flow and external heat recordings.

1.2. Subjective Measures of Sexual Arousal and Desire

Subjective ratings of sexual arousal and desire give researchers insight about more conscious-level awareness of what individuals experience in response to sexual incentives. These measures are often taken in conjunction with physiological measures of arousal. Subjective arousal is typically assessed by the individual using a variety of questionnaires or simple commands for overall assessment ("on a scale from 0 to 10, how would you rate your level of sexual arousal?). There are many scales, which attempt to address sexual functioning, such as the Derogatis Sexual Functioning Inventory (DSFI; Derogatis & Melisaratos, 1979), and the Sexual History Form (SHF; Nowinski & LoPiccolo, 1979), which assesses the frequency of sexual activity, however, do not assess sexual 'thoughts'. Others such as the Sexual Interest Questionnaire (SIQ; Harbison et al., 1984) addressed positive and negative assessments of sexual scenarios; however, it did not look at desire. In an effort to address limitations in other inventories, as well as to provide a scale with external validity, The Sexual Desire Inventory (SDI-1&2; Spector, Carey, & Steinberg, 1996) was created and validated using a 14-item scale which included questions regarding paired sexual interaction (intercourse), solitary masturbation, fantasies, and needs (Cronbach's $\alpha = .86$ for dyadic sexual desire, $\alpha = .96$ for solitary sexual desire). One scale which measures both arousal and desire is the Sexual Desire and Arousal Inventory (SADI; Toledano & Pfaus, 2006). This scale assesses subjective levels of arousal and desire at a conscious and subconscious level. The SADI is made up of a list of 54 descriptors (Cronbach's $\alpha = .91$) with word categories based on cognitive-emotional, motivational, physiological, and negative control. This may potentiate the assessment of desire ratings as motivational responses, veiled in terms that may not specifically alert participants to the subconscious processing. Participants fill out a Likert Type scale for how each word relates to their current state (from 0 = "does not describe it at all", to 5 = "describes it perfectly"). Given these different criterion of words, this questionnaire allows researchers to explore various facets of arousal and desire. This questionnaire has recently been used to assess the sexual arousal and desire ratings of women on all points of the Kinsey Scale (Kinsey, Pomeroy, & Martin, 1948) and is the first (to our knowledge) to include information of the ratings of women who identify as "mostly" homosexual or "mostly" heterosexual (i.e. Kinsey 5 or 2; Persson, Ryder, & Pfaus, 2016). This online questionnaire study revealed that heterosexual women report similar levels or arousal towards women as homosexuals do, however, heterosexuals report lower levels on the motivational dimension, indicating that although heterosexuals are aroused by women, they may not be inclined to act on it. Bisexual and heterosexual women reported higher levels of arousal and desire for men compared to homosexual women.

Subjective responses are crucial in order to understand what the participant is feeling; however, they are not without limitations including individual response bias that gives rise to sampling bias (Catania, McDermott, & Pollack, 1986). Being willing to participate in sex research studies forms a sampling bias of participants who likely have more positive attitudes about sex and sexuality, less guilt, and more sexual experience, and who feel more comfortable taking part in the research (Strassberg & Lowe, 1995). While sample biases are a reflection of comfort with sexuality, response biases are often a product of fear of judgement. Researchers have investigated this using the bogus pipeline procedure (Jones & Sigall, 1971) in which participants believe they are attached to a polygraph while answering questions. Tourangeau, Smith, and Rasinski (1997) reported that both men and women responded having more sexual partners when they believed they were attached to the polygraph. To elucidate whether this difference in response was due to the pipeline or the questions being asked face to face, researchers divided participants into three groups in which they were told that either their responses may be seen by peers, were anonymous, or were attached to a polygraph (the bogus pipeline; Alexander & Fisher, 2003). Participants were asked questions about their sexual attitudes, behaviors, and experiences. The largest differences amongst men and women was in the exposure group (peers may see the results) in which women reported a lower number of sexual partners, and a higher mean age for first time having sex (responses from men were inverted). Responses between men and women were most similar in the bogus pipeline group. This may indicate a response bias when answering self-reported questionnaires where participants may inflate or deflate their responses (specifically when they feel there may be some societally imposed judgement).

The importance of subjective responses also extends to clinical trials in which pharmaceutical companies (as well as the FDA), impose the assessment of sexually satisfying events (SSEs; Kingsberg & Althof, 2011) and sexual distress using the Sexual Distress Scale (SDS; Derogatis, Rosen, Leiblum, Burnett, & Heiman, 2002) as a signature of efficacy: increase in SSEs and decreased SDS scores. However, SSEs are typically assessed on the basis of partnered sexual encounters, which represents more a male centric model, given that women can engage in sex without desire, or have desire without engaging in sex (Basson, 2000; Basson, 2005). Men and women place importance on different attributes of sexual activity (men on the physical act, women on the context). This difference in attribution is a cognitive bias that results in sex differences in sexual response, but may well be more apparent than real when examining how sexual stimuli are processed in the brain.

1.3. Concordance of Subjective and Objective Sexual Arousal and Possible Contributing Factors

Another problem in interpretation of sexual arousal concerns the concordance between physiological and subjective measures of sexual arousal in men, but the relative lack of concordance between these two in women (Bailey, 2009; Chivers, 2005; Chivers & Bailey, 2005; Chivers & Rosen, 2010; Chivers et al., 2004; Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010; Janssen & Everaerd, 1993; Laan, Evereard, & Evers, 1995; Laan, Evereard, van der Velde, & Geer, 1995). Women show a physiological, objective response of vaginal lubrication and/or engorgement without subjectively reporting sexual arousal. This may be due, in part, to a lesser sensation of internal blood flow without any resistance against it.

Researchers have sought to explain this discordance by analyzing the role of cyclical fluctuations of estradiol, testosterone, and progesterone on women's arousal and desire (Slob, Ernste, & van der Werff ten Bosch, 1991; Stanislaw & Rice, 1988). Women self-reported a significant increase in sexual arousal, feelings, fantasies, and dreams during ovulation (Dawson, Suschinsky, & Lalumiere, 2012; Regan & Berschied, 1999). This has been theorized in both the preparation hypothesis (Bancroft & Graham, 2011; Chivers, 2005; Lann, 1994; Levin, 2003; Suschinsky & Lalumiere, 2011) and the Ovulatory Shift Hypothesis (Buss, Pillsworth & Hasleton, 2004). Physiologically, it is beneficial for a woman to be primed whenever the possibility of sexual contact may occur; and is evolutionarily adaptive for the vaginal mucosa to become lubricated whether or not sexual intercourse has been initiated. This may explain the physiological response from women which occurs in absence of subjective arousal (Bancroft & Graham, 2011; Chivers, 2005; Suschinsky & Lalumiere, 2011). This increase in arousal should motivate women to seek out intercourse during their most fertile time (desire being linked with increasing the chances of procreation; Buss, Pillsworth, & Hasleton, 2004). Furthermore, given the increased investment of pregnancy for a woman, selectivity may be dependent on fertility, specifically during ovulation (Buss et al., 2004; Dixson & Brooks, 2013; Gangestad, Thornhill, & Garver-Apgar, 2005; Penton-Voak et al., 1999). Sexual stimuli gain incentive value during ovulation increasing their salience and attention capture (Gizewski et al., 2006; Krug, Plihal, Fehm, & Born, 2000; Mass, Hölldorfer, Moll, Bauer, & Wolf, 2009; Rupp et al., 2009). This is evident in studies which suggest that when women are ovulating they rate men's facial hair (Dixson & Brooks, 2013; Penton-Voak et al., 1999), masculine features (Penton-Voak & Perrett, 2000; Thornhill & Gangestad, 1996), even the scent of facially symmetrical men (Gangestad, Thornhill, & Garver-Apgar, 2005) as more arousing. Exotic dancers earn more tips during ovulation compared to non-cycling women or those on oral contraception (Miller, Tybur, & Jordan, 2007). This may partially be due to the demeanor of a woman changing during high fertility days, with more smiling, eye contact, and physical closeness to men during ovulation.

Ovulatory states do not appear to explain the lack of gender preference for heterosexual women nor the physiological response in absence of a subjective arousal. In a study by Slob and colleagues (1996), women who were ovulating reported higher levels of subjective arousal when presented with sexual imagery, compared to non-ovulating women, however, physiological responses were not different between groups. Similarly, in an eye tracking study, Rupp and Wallen (2007) showed that ovulating women paid more attention (as demonstrated with fixation times on regions of interest: ROI) to the body ROI of images, whereas women who were not ovulating paid more attention to contextual cues. This attention was not sex specific as both groups fixated on the genitals of images of both men, and women. Furthermore, even when presented with different genre of movies (exercise, masturbation, couple sex), objective arousal was not more gender specific during the follicular phase (Bossio, Suschinsky, Puts, & Chivers, 2013; Suschinsky, Bossio, & Chivers, 2014), even though this should be a time when male sexual cues should be more salient. What seems to be more of a determinant of both objective and subjective ratings of arousal (specifically for women) is the inclusion of penetrative sex (Suschinsky et al., 2014) or an erect penis (Spape, Timmers, Yoon, Ponseti, & Chivers, 2014).

This may suggest that the depiction of intercourse (or a representation of the possibility to engage in the act, i.e. erect penis) is what is arousing to women. Furthermore, it may suggest a woman's proclivity to immerse herself into the movie.

Neural correlates have also been used as a means to reconcile this discordance between objective and subjective measures of sexual arousal. Studies of functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) have collected data of neurological activation upon presentation of sexual stimuli (for a meta-analysis see Fonteille & Stoléru, 2011; Stoléru, Fonteille, Cornélis, Joyal, & Moulier, 2012; Sylva et al., 2013). Several studies have found category specificity for preferred versus non-preferred sexual stimuli in which brain regions such as the extra striate visual cortex is activated in men (example see: Arnow et al., 2002; Beauregard, Levesque, & Bourgouin, 2001; Bocher et al., 2001) and women (Park et al., 2001) upon presentation of engaging imagery; the amygdala (Beuregard et al., 2001; Ferretti et al., 2005; Hamann, Herman, Nolan, & Wallen, 2004; Karama et al., 2002; Maravilla et al., 2000; Stark et al., 2005; Walter et al., 2008) activated in emotionally salient experiences; the orbitofrontal cortex (Karama et al., 2002, Ishai, 2007, Aharon et al., 2001; O'Doherty, Critchley, Deuchmann, & Dolan, 2003) which is activated upon seeing faces of the preferred sexual stimulus, likely in a reward inducing effect. Similarly, studies have shown activation of the nucleus accumbens in both men and women (Hamann et al., 2004; Stark et al., 2005; Walter et al., 2008), and the hippocampus (Ferretti et al., Stark et al., 2005). Safron and collegues, (2007) found that heterosexual and homosexual men showed a strong overall response to their preferred sexual stimulus with less activation when presented with their non-preferred stimulus. Furthermore, when this methodology was extended to homosexual and heterosexual women (Sylva et al., 2013), again women showed less specificity and similar brain activation was achieved for their preferred and non-preferred sexual stimuli.

Although the studies mentioned above found sex differences in concordance and specificity, one important and potential methodological flaw suggested by Parada et al. (2016) is the short duration of the stimuli. Typically, visual sexual stimuli in the form of videos are presented for <3 minutes. Although this is generally sufficient to alter genital arousal, it may not be sufficient to alter subjective arousal (specifically in women). Moreover, many studies did not assess subjective arousal during the presentation of stimuli (Stoléru et al., 2012). In an effort to circumvent these issues, Parada et al. (2016) used 5-minute video clips and asked participants to continuously rate their subjective arousal. Their findings suggested that brain activation is consistent between the sexes, with the only difference arising in the increased activation in the lateral occipital cortex in women and decreased activation in men; which the researchers believe to not be of significant importance in terms of sexual arousal but likely an artifact. While fMRI allows for using the same methodology between the sexes, brain region activation may occur from different provocations (i.e. amygdala and most of the limbic system is activated in any strong emotional response regardless of sexual content; Walter et al., 2008). While the amygdala has been implicated in highly emotionally salient events, researchers Georgiadis and Holstege (2005) noted lessened activity in the right amygdala during tactile stimulation of the penis. Likewise, several studies have shown that the orbitofrontal cortex (OFC) is activated; however, whether this is sexual or not has been debated (Fonteille & Stoléru, 2011). Studies have shown that the OFC is activated when viewing attractive faces (Ishai, 2007; O'Doherty et al., 2003), also, lateral activation of the OFC has been shown in several studies (Aharon et al., 2001; Karama et al., 2002; Kim et al., 2006; Tsujimura et al., 2006) which is associated with an inhibitory response to sexual stimuli (Stoléru et al., 2003). The parietal cortex is activated when participants view sexual imagery, however, this has also been seen in during tactile stimulation (Georgiadis & Holstege, 2005) and conversely, studies have shown deactivation in this area (Rauch et al., 1999; Tsujimura et al., 2006). Although Parada and collegues found that subjective sexual arousal reports were similar for men and women, they did not address responses to the participants' sexual preference.

Although neural imaging is a useful tool for understanding sexual arousal, there are still limitations which may not allow a clear indication of the various intricacies of subjective arousal. Although these studies offer information on cortical activation, they do not address the cognitive functions behind it. Further, what has not been fully explored in fMRI studies is whether this is an appropriate means for studying desire. Recently, one study has explored brain region activation in individuals with problematic hypersexual behavior (PHB; Seok &Wand Sohn, 2015). Individuals with PHB showed increased activation of brain regions consistent with cognition, emotion, and sexual behavior (specifically the prefrontal cortex and subcortical regions). Neural imaging gives information on brain region activation; however, it does not offer further information of the underlying cognitive processes activated when presented with sexual stimuli.

1.4. Information Processing

Given the limitations of the aforementioned perspectives, perhaps a cognitive approach could offer more information on sex differences in concordance and discordance between subjective and objective arousal, and a potentially objective assessment of sexual desire. Cognitive aspects of sexual response have been examined previously under the rubric of the Information Processing Model (IPM; Everaerd, 1995; Janssen, Everaerd, Spiering, & Janssen, 2000; Laan & Everaerd, 1995; Massaro & Cowan, 1999). Researchers have found that there are unconscious (automatic) and conscious (controlled) cognitive processes when being confronted with sexual stimuli. The automaticity of cognitive engagement with sexual stimuli allows a certain level of subconscious processing of sexual imagery in contrast to neutral stimuli (Geer & Bellard, 1996; Geer, Judice, & Jackson, 1994; Geer & Melton, 1997). The emotional salience of sexual stimuli allows for a subconscious processing (Geer & Bellard, 1996; Geer, Judice, & Jackson, 1994; Geer & Melton, 1997) which is so captivating that it produces a bias within the attentional system (Geer & Bellard, 1996). This bias results in limited attention to other tasks and produces what Geer and Bellard (1996) have termed a Sexual Content Induced Delay (SCID).

This SCID has been shown in lexical tasks where participants were required to make a decision on whether presented strings of letters were actual words (Geer & Bellard, 1996). Words consisted of neutral, romantic, and sexual content presenting different levels of interference which resulted in longer latency times for decision making when presented with sexual words (men and women) or romantic words (women). Other early processing studies include modification of the original Stroop Task (MacLeod, 1992; Stroop, 1935) to include sexual stimuli. Stroop Tasks have been used in anxiety research and have consistently found an interference effect for participants based on their specific anxiety ranging from social anxiety (Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heimberg, & Hope, 1993), PTSD (McNally, Kaspi, Riemann, & Zeitlin, 1990), and rape victims (Foa, Feske, Murdock, Kozak, & McCarthy, 1991). The Stroop task has further been modified to include sexual imagery, specifically, O'Ciardha and Gormley (2012) presented color tinted images of bathing suit clad adults (men and women) and children, with neutral images consisting of images of cats, to homosexual and heterosexual men. Participants were delayed in their task when presented with their preferred sexual content.

Beyond this automaticity, there is a controlled, higher processing which may involve the activation of existing sexual cognitive schemas. Once the stimulus is processed, it can be contrasted with a memory or belief system (sexual schema) and if the stimulus is recalled as something that is sexually rewarding, physiological arousal may occur. Furthermore, upon this assessment, a subjective feeling of arousal may occur. This higher order processing is what is required in order to "feel" sexually aroused. Sex differences have been reported for controlled aspect of sexual attention. For example, longer dwell times have been reported for heterosexual men when viewing images of their preferred stimulus (women), whereas women show no difference when presented with their preferred (man) or non-preferred (women) images (Lykins, Meana, & Struss, 2008; Tsujimura et al., 2009; Nummenmma et al., 2012). Both men and women are captivated by faces, however, when sexually salient body regions (chest, pubic area) are visible, participants' attention is quickly drawn away from the face (Dixson, Grimshaw, Linklater, & Dixson, 2011; Elias & Krupp, 2007; Lykins, Meana, & Struss, 2008; Nummenmma et al., 2012; Tsujimura et al., 2009). In order to further assess the implications of emotional valence on attention, Carvalho, Pereira, Barreto and Nobre (2016) manipulated participants' emotions (positive, negative, neutral) prior to viewing an erotic video. Researchers found that mood did not directly impact eye movement patterns (measured in dwell time and pupil size, on specific regions of interest).

Although responses to sexual stimuli are often viewed as positive, researchers have also found both ambivalent and negative responses. For example, Peterson and Janssen (2007) used vaginal pulse amplitudes and penile strain gauges as a means to assess to what extent positive, negative, and ambivalent response (defined as co-occurring positive, neutral, and negative affect), predict subjective arousal, desire, and genital response. Participants in that study viewed erotic films which included consensual heterosexual intercourse as well as coercive sexual acts, with genital responses being recorded throughout. The coercive film was less physiologically arousing for both men and women. Positive affect was the best predictor of subjective arousal and desire in women. Negative affect was a better predictor of physiological arousal for women than subjective arousal, suggesting that women were showing physiological but not subjective arousal. Other studies found similar results suggesting that positive affect was linked with an increase in response (physiological and subjective) in men (Koukounas & McCabe, 2001; Nobre et al., 2004), however, there have been mixed results in studies of women. While some studies found that positive affect increased subjective but not objective arousal (Laan, Everaerd, Van Bellen, & Hanewald, 1994); others found no change in subjective or objective responses in women (Laan, Everaerd, Van Berlo, & Rijs, 1995). Interestingly, these data combined with findings from Carvalho et al., (2016) suggest that it is the emotions elicited from the stimuli which affect the response, rather than a pre-existing emotional state (in terms of positive/negative/neutral affect). There is an interesting relation between negative affect and sexual arousal. While negative affect also promotes physiological arousal in women (but not subjective arousal), this relation is evident only in men with premature ejaculation or erectile dysfunction (Rowland, Cooper, & Slob, 1996), suggesting that this is not the usual occurrence in "healthy" men. In women, the relation between physiological arousal and negative affect appears to be part of a natural functioning of women akin to the basis of the preparation hypothesis (Bancroft & Graham, 2011; Chivers, 2005; Suschinsky & Lalumiere, 2011).

Cognitive schemas have been implicated in such sexual disorders as Persistent Genital Arousal Disorder (PGAD). Women with PGAD have reported more dysfunctional sexual belief systems such as conservatism, ageist beliefs (sex is meant to be enjoyed by younger people), as well as guilt (Carvalho, Verissimo, & Nobre, 2013**).** Interestingly, sexual conservativism is one of the main reported cognitive schemas, which often forms a cognitive dissonance (Carvalho et al., 2013), given the need to masturbates frequently. Women with PGAD report greater anxiety and catastrophizing of symptoms which in turn leads to the negative appraisal of sexual reactions which triggers a vicious cycle of heightened awareness to sexual cues prompting more anxiety and maintain this disorder (Leiblum & Chivers, 2007). These studies stress the implication of sexual schemas in interpreting sexual cues. Although men also have sexual schemes, women appear to be more affected by them. Cognition may be where the discordance in women is evident.

1.5. Eye Tracking and Response to Visual Sexual Stimuli

Within the past decade, researchers have turned to eye-tracking as a means to assess cognitive factors (i.e. attention) as a dependent measure in studies of sexual preference, arousal, and desire. Eye movement patterns offer a quantifiable measure of distraction (inability to perform a task), interest (dwell time on specific regions of interest), and attention capture (first fixation). The acuity of the human visual system is at its highest at the fovea, requiring the individual to perform eye movements (saccades) from one region of interest to another to collect information, and pause on a region to process the information (Henderson & Hollingworth, 1999; Henderson 2003). Viewing time is greater for material that is interesting and motivating (Kolers, 1976) because of this extended pause for processing and captivated attention. While the information processing model suggests that there is a delay which occurs when in the presence of sexual stimuli, researchers have only begun to explore what specifically in this stimulus is capturing the attention. Also, in order to avoid the limitations of the objective measures discussed earlier, the eye tracker may be an objective measure which can capture initial fixations indicative of autonomic processing, as well as later processing, after the individual has had time to allow pre-existing schemas to assess the content. Furthermore, eye tracking allows a moment by moment analysis of eye movement patterns throughout the length of time the stimuli are presented. This scan path allows researchers to interpret the thought processes occurring while viewing the stimuli.

Although discordance between objective and subjective arousal has been evident in women, this may be specific to the methodology used (i.e. objective measures of genital arousal). Cognitive measures of arousal and desire may give information on whether one precludes the other, or if they are inextricable (as is suggested by the DSM-5). In this thesis; experiments were selected in order to assess both early attention (low level processing) as well as later processing (high-level processing; Everaerd, 1988; Geer, Lapour & Jackson, 1993; de Jong, 2009). The cognitive tasks of Chapters 2 and 3 included a modified Stroop task, as well as a mixed saccade task, which used sexual images in order to assess the distracting effect of sexual imagery. Furthermore, in order to track later processing, three studies (Chapters 4,5,6) were designed which allowed participants longer to engage with the stimuli. Chapter 4 used the images of models fully clothed and then nude, in order to assess eye movement patterns without the distractions imposed by different individuals in different poses, lighting, etc. The images used in Chapter 4 were rated as moderate in arousal and valence. In order to assess the eye movement patterns based on arousal and valence, Chapter 5 used similar methodology; however, with images that were rated as high in arousal and valence as well as images rated low (erotic images that the participants rated as unarousing and unpleasant). Following the studies which looked at early and later processing with static imagery, a study was designed for Chapter 6 which used a video stimulus. Given that we live in a ‘moving world’, video may be more ecologically valid. Video also allows the tracking of eye movement patterns which change based on the content of the scene. Furthermore, in Chapter 6, eye movement pattern differences were analyzed based on the fluctuations of the women's menstrual cycle. The video used was a 12-minute clip edited into four clips with content ranging from clothed interaction of heterosexual couple (Clip 1), nude interaction and oral sex (Clip 2), penetrative intercourse (Clip 3) and nude cuddling (Clip 4). Taken together, these five studies allow us to assess sex differences in distraction caused by sexual stimuli at early processing, as well as eye movement patterns elicited at a higher-level processing. These studies offer some insight into the discordance experienced by women, beyond a genital response. Furthermore, by correlating a self-reported rating of sexual arousal and desire (Toledano & Pfaus, 2006) which contains physiological, motivational, evaluative, and inhibitory subscales, we can assess at which level(s) of processing desire might occur.

Chapter 2: Attention Capture by Sexually Relevant Stimuli: Evidence from the Emotional Saccadic Stroop Task.

Attention Capture by Sexually Relevant Stimuli: Evidence from the Emotional Saccadic Stroop Task.

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Abstract

The Stroop paradigm is widely used to demonstrate cognitive interference on accuracy and increased latency time for a task. Given that erotic distractors produce interference with cognitive processing, we investigated the effect of colour-tinted erotic imagery using a variation of the emotional pictorial Stroop task. Forty-six heterosexual participants (26 women, 20 men) were shown 400 tinted images (red, blue, yellow, or green) ranging in levels of explicitness (nude women, nude men, heterosexual couple having intercourse, neutral, or scrambled). To reduce the motor response variability normally observed in response time tasks, participants were required to perform a saccadic eye movement to the peripherally located coloured box that matched the tint of the presented image. Results were based on accuracy and latency to produce a saccade. The relative simplicity of the task resulted in high rates of accuracy overall; however, women were least accurate when presented with images of men. Men were significantly more accurate when presented with images of men compared to images of couples, suggesting that accuracy appears to be hindered based on preferred sexual stimuli. Sexual content induced delay (SCID; as indicated by longer latency times) was evident in participants when viewing images of their preferred sexual stimulus as well as when presented with images of couples. Bivariate correlations were run with responses from the questionnaire. For women, being in a relationship and relationship duration was positively correlated with accuracy when presented with images of couples. For men, reporting difficulty during intercourse was correlated with longer latency times when viewing images of women and couples. These data may suggest different cognitive interferences for men and women.

***Keywords*. Attention, Cognition, Stroop, Eye movements.**

Introduction

The human visual system is inundated daily with stimuli competing for our attention. Attention allocation has been used in theories of sexual response which have placed a main focus on the cognitive factors behind physiological and subjective arousal (e.g., Barlow, 1986; Dekker & Everaerd, 1989; de Jong, 2009; Spiering & Everaerd, 2007). Researchers have used the Information Processing Model (IPM) of human sexual response to erotic stimuli to highlight both automatic and controlled cognitive processing of the stimuli. Automatic processes are the immediate responses requiring no conscious effort on the viewers' part, whereas the controlled cognitive processes are subject to pre-existing sexual schemas or beliefs. In this model, all sexually-relevant features in an environment are pre-attentively selected, with attention subsequently focusing in on the preferred sexual object in a scene. Thus, the high emotional saliency of sexual stimuli may compromise the amount of attention that may be allocated to non-sexual stimuli, making it a possible source of cognitive interference (Everaerd, 1989; Geer, Lapour & Jackson, 1993; de Jong, 2009). The IPM also highlights the interaction between attention mechanisms and sexual response patterns, suggesting that if sexually relevant features are matched with pre-existing schemas already in implicit memories, then physiological arousal may occur. Furthermore, once this physiological arousal has occurred, it is the attending to this change in physiological state that may lead to a subjective rating of arousal. This view suggests that physiological arousal may be reflexive and automatic, whereas subjective arousal requires further processing.

Cognitive interference had been further explored using the Stroop task (MacLeod, 1992; Stroop, 1935). In the classic Stroop task, participants must identify the name of a word describing a colour, displayed in a colour that is either congruent or incongruent. The incongruence of the word colour and written word results in longer latency times to the correct response, as well as an increase of incorrect responses (MacLeod, 1992; Stroop, 1935). The classic Stroop has been modified into an emotional Stroop for use in anxiety research; where rather than manipulating the congruency of the word colour and written word, the words are either neutral (e.g., 'field') or emotional (e.g., 'death'). Here, participants showed a distinct interference effect when presented with emotionally salient words compared to neutral (Algom, Chajut, & Lev, 2004; Williams, Matthews, & MacLeod, 1996; Wyble, Sharma, & Bowman, 2008).

The interference effect was shown in participants with disorders ranging from social anxiety (Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heimberg, & Hope, 1993), PTSD (McNally, Kaspi, Riemann, & Zeitlin, 1990), and rape victims (Foa, Feske, Murdock, Kozak, & McCarthy, 1991). Moreover, the delay was evident in participants who reported feeling a sense of "worry" (Mattia, Heimberg, & Hope, 1993) and the effect was specific to stimuli interpreted as personally threatening to the individual (Hope et al., 1990; Mattia et al., 1993). Interestingly, participants offered a desensitization treatment showed a statistically significant decrease in latency times for threat valence words at a post-test session compared to those in the non-treatment group (Mattia et al., 1993; Watts, McKenna, Sharrock, & Trezise, 1986). This suggests that the longer latency times are in fact associated with the emotional trigger associated with the words perceived as threatening. The classic Stroop has been further modified in studies of phobias, with the use of colour tinted images (Constantine, McNally, & Hornig, 2001; Öhman, 2009; Öhman, Flykt, & Esteves, 2001; Rinck & Becker, 2006). Although the interference effect was not only limited to fear inducing images (i.e. snakes; Constantine et al., 2001) but also to other high valence images, one may suggest that fear is not the only emotion which produces a distraction. The tinted image variation of the emotional Stroop has been used to research the link between sexual interest and cognitive interference. O'Ciardha and Gormley (2012) were one of the first to present participants (homosexual and heterosexual men) colour-tinted images of bathing suit clad adults and children, or images of cats (which were used as a baseline control for latencies). Heterosexual men showed longer latencies when viewing images of adult women, whereas homosexual men showed a delay only when presented with images of adult men. Unfortunately, to our knowledge, there have not been published studies which use a sample of women. In keeping with the theory that attention is specific to what the individual finds most captivating, it can be assumed that women would behave in the same manner as men; however, this requires further investigation. Interestingly, in this study, we begin to see that interference is specific to preferred sexual content rather than to aversive (or at least non-preferred) stimuli.

Important sex differences exist in response to visual sexual imagery. The findings from eye tracking studies suggest that heterosexual men look longer at images of women, whereas heterosexual women look equally at images of men and women (Lykins, Meana, & Struss, 2008; Tsujimura et al., 2009; Nummenmma et al., 2012). Researchers have shown that men and women focus longer on the bodies in comparison to faces in static erotic images (Lykins, Meana,

& Kambe, 2006; Lykins, Meana, & Struss, 2008; Nummenmaa et al., 2012). Others have shown that men focus their attention more on the reproductive body regions (e.g., breasts and pubic region; Suschinsky, Elias & Krupp, 2007), with the breast region receiving more first fixations than other body regions (Dixson, Grimshaw, Kinlater, & Dixson, 2011). The results of these studies suggest that sexual images do attract our attention, with interesting gender differences in the allocation of attention to particular regions of the sexual images (Lykins, Meana, & Kambe, 2006; Lykins, Meana, & Struss, 2008; Tsujimura et al., 2012). Furthermore, while heterosexual men display a category specific arousal (subjective and objective) congruent with their sexual preference, heterosexual women do not (Chivers, Seto, & Blanchard, 2007; Peterson & Janssen, 2007).

Collectively, these data suggest that combining the Stroop methodology with sexual imagery should result in a sensitive test of a cognitive interference; however, there is a limitation which has not yet been addressed by researchers. Early processing of imagery occurs very quickly (Kirchner and Thorpe estimate that participants can detect scene content as quickly as 120ms), and the true effect of interference may be lost if the participant is required to disengage from the screen and press a key pad. Eye movements have less varied reaction times and faster responses (Kirchner & Thorpe, 2006). An incorporation of saccadic responses was used by Hodgson and colleagues' (2009) who used a saccadic Stroop. Participants were presented with a centrally-located coloured word (either the name of a colour "blue", "red", "yellow", "green" or a direction word, "up", "down", "left", "right") and the response was given by performing a saccade to a peripherally located coloured box that matches the colour of the presented word. Much like the manual response Stroop (Algom, Chajut, & Lev, 2004; Williams et al., 1996; Wyble, Sharma, & Bowman, 2008), when the words were congruent with the colour and/or direction of the word matched the colour location of the required square, participants showed greater accuracy and shorter latency time compared to incongruences (Hermes & Walker, 2012; Hodgson et al., 2009). This present study uses tinted images of nude men, women, and couples, with neutral, and scrambled images as a baseline. Responses will be given using a saccade towards the peripherally coloured square which matches the image (see Image 1). The hypothesis for this study is that participants will be more affected by the sexual stimuli presented in the task and as such, will produce more errors and longer latency times to saccade when presented with images of sexual content. Given what is known of specificity of reaction to sexually preferred images, men will likely show the greatest amount of interference when images of women, and couples will be presented. Women, however, may be equally affected by images of men, and women.

Method

Participants

Forty-six heterosexual participants (26 women (M_{age} 21.69, SD = 2.29) and 17 men (M_{age} 22.41, SD = 3.94) were recruited at Concordia University in Montréal, Quebec, Canada. All participants had normal (or corrected to normal) visual acuity and normal colour vision. All procedures conformed to the Tri-Council Policy Statement on ethical conduct for research involving human subjects (2010), and was approved by the Concordia University Human Research Ethics committee.

Apparatus

Stimuli were presented and data collected using a Dell Quad-Core PC running Microsoft Windows 7. Participants viewed stimuli on a linearized video monitor (Viewsonic G225fb 21" CRT, 1024 x 768 pixel resolution, 100-Hz refresh rate). A chin rest was used to stabilize head position at a distance of 70 cm from the screen. Eye position was acquired non-invasively using a video-based eye movement monitor (EyeLink 1000/2K, SR Research, Ottawa, Ontario). The EyeLink system recorded binocular eye position with a sampling resolution of 1000 Hz. All stimuli were presented using Experiment Builder (SR Research, Ottawa, Ontario).

Materials

Participants were shown 400 images retrieved from the Concordia Vision Lab's Erotic Image Database. This database contains a set of validated emotional pictures for experimental investigation of emotion and attention. We specifically used images from four different categories; three based on levels of sexual explicitness (nude women, nude men, heterosexual couple interacting sexually), as well as neutral images to act as a control. All images within the categories were equally matched for arousal level and valence prior to the study (Shilhan et al., submitted).

The original images had differing low-level visual features, specifically luminance and contrast levels. Such differences in low-level visual features are known to be salient, and control bottom-up driven attention (e.g., Henderson, 2003). To control for the low-level visual features, all the pictures were converted to grayscale (in MATLAB using the *rgb2gray* function), and subsequently matched in terms of their luminance histogram using the SHINE toolbox (Willenbockel et al, 2010). The advantage of histogram matching is that both the average luminance, and the contrast (i.e., range of luminance) are matched across all images. Thus, any difference in response to the image should be due to high-level semantic meaning in the image (i.e., sexual content), and not because of low-level discriminant features (which were normalized). With the luminance and contrast of all images normalized, images where then converted into colour in RGB space (red, blue, green, yellow).

Randomizing Image Structure via Block Scrambling.

In addition to the neutral image category, we also created a scrambled image category that was devoid of any semantic content to act as a baseline for latency to look at the appropriate colour. To create the randomized images with no specific content, a custom program was written in Mathwork's MATLAB (ver. 2015b). The program randomized the image matrix of random pictures from the sexual content categories, M, by dividing M into non-overlapping blocks of a specific size. In the current experiment, we used M=16 in the horizontal, and M=12 in the vertical on our images (size 1024 x 768 pixel). Thus, each box measured 64 x 64 pixels. This created images that had the same luminance histogram as the original content image, but had no discernable content.

Procedure

This study took place in the Vision Lab at Concordia University. Participants first provided informed consent, and were then asked to fill out a questionnaire inquiring about age, sexual orientation, sexual activity, and desire levels. Participants sat in front of the eye-tracker monitor, the height of the chinrest and chair were adjusted to get the intended camera image, without changing the Desktop Mount settings. There were adjustments made to the Desktop Mount for participants wearing glasses, depending on the shape and reflection of the glasses to minimize the reflection of infrared light source on the glasses.

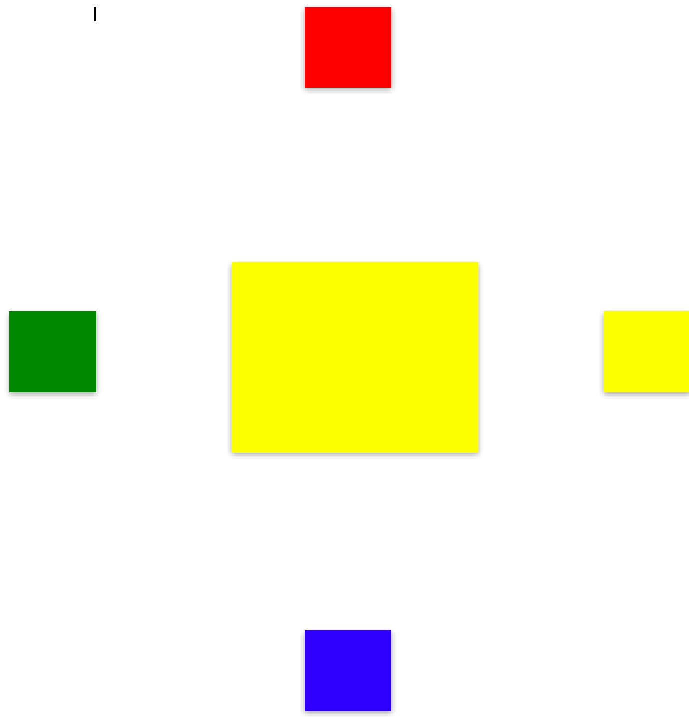
Eye-movement research requires information on the subject's point of gaze on a display of visual information. To compute this, we determined the correspondence between pupil position in the camera image and gaze position on the subject display. We did this by performing a system calibration, displaying several targets for the subject to fixate. The pupil - CR position for each target were recorded, and the set of target and pupil - CR positions were used to compute gaze positions during recording. A nine-point calibration type ("HV9") was used. The participant followed a fixation point that moved in random spots on the monitor (9 times). This was done twice followed by a validation. By running a validation immediately after each calibration, the accuracy of the system in predicting gaze position from pupil position was scored.

The instruction for the Stroop task appeared on the monitor, and the researcher read them aloud. The participant was instructed to look at the center image and saccade to the peripherally located coloured square that matched the colour of the image. The participants completed 20 practice trials consisting of a solid square in the center with no image (see image 2.1). This was followed by the image trials. Any trial in which the participant's gaze did not reach the pre-set regions of interest (the colour square + 0.5 cm surround) was considered a mistrial and was not counted. Participants were asked to perform the saccades as quickly as possible. Any saccade that took longer than one second to perform was also deemed a mistrial and not counted.

Results

A G power analysis test was run a-priori to establish the sample size. A within, between ANOVA with 2 groups and 5 measurements requires a total sample size of 32. The results for latency showed that Mauchly's Test of Sphericity was statistically significant, thus a Greenhouse-Geisser correction was applied. Certain image results violated Levene's Test of homogeneity of variance for latency (specifically, baseline, man, and woman images). Given that eye tracking latency results often violate rules for using standard *t*-tests (i.e. skewness, kurtosis, non-normal distribution, importance of including outliers as well as the disparity between the groups) it was decided to use a Bayesian analysis in addition to regular *t*-tests for post hoc latency analysis. A sequential analysis and robustness check was carried out to ensure a sufficient sample size. For male participants, a Cauchy width prior of 0.70 (default used in JASP; Rouder et al. 2009) was sufficient to show a robustness of $BF_{10} = 11.216$. A sequential analysis was run, revealing that with approximately 12 participants, the data would reveal consistent results. Similarly, for female participants, a Cauchy width prior of 0.70 was sufficient to show a robustness of $BF_{10} = 1.740$. A sequential analysis was run, revealing that with approximately 22 participants, the data would reveal consistent results. Wetzels and colleagues (2011) have used a meta-analysis in order to exemplify the extra information offered by

Image 2.1

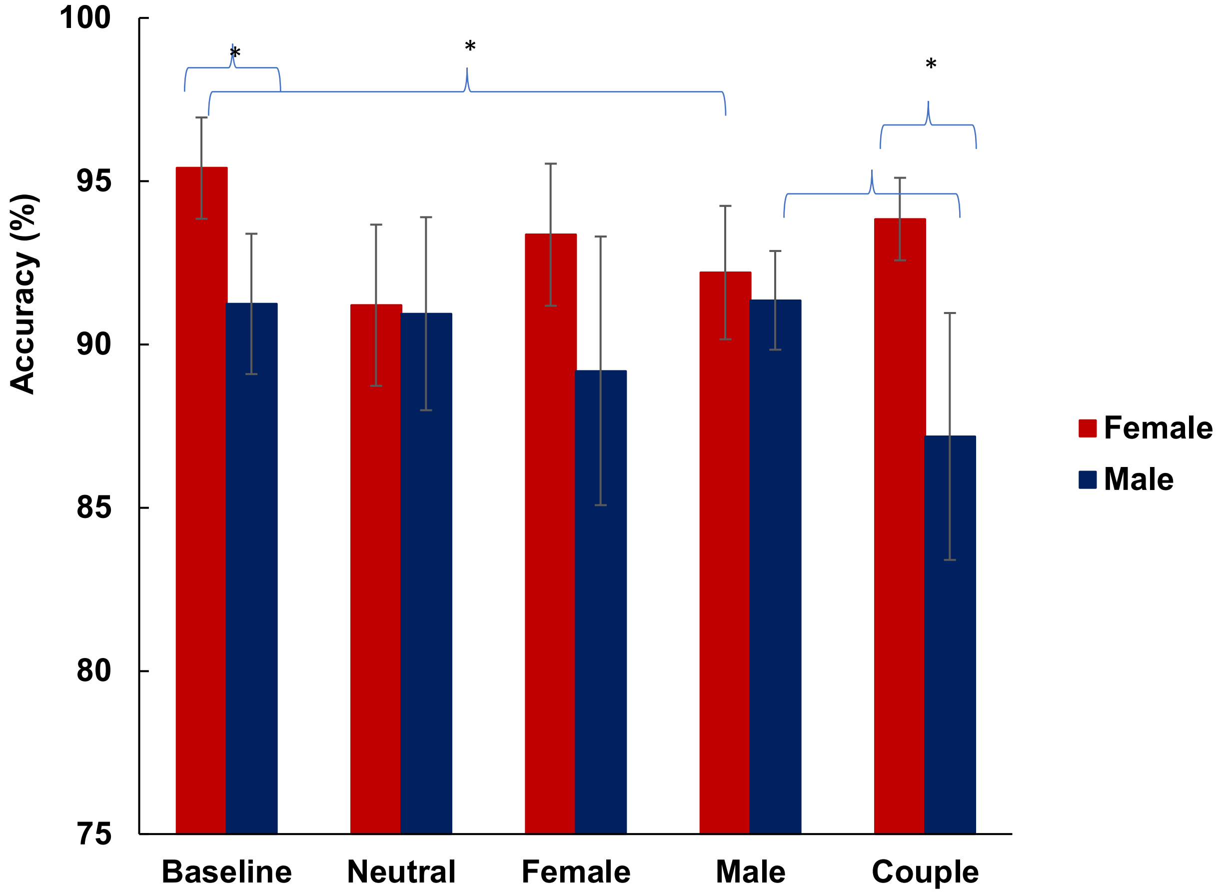


Note. An example of the Saccadic Stroop visual set-up. In the image trials, an image (nude man, nude women, couple, neutral, scrambled) appeared in the center. A correct response was an eye movement to the peripherally located target of the same colour as center image. Results were based on accuracy and latency to saccade.

Bayesian analysis. Specifically, the Bayesian factor (BF_{10}) gives information on which hypothesis (H_o= null hypothesis, H_A= alternate hypothesis) is better supported while still maintaining "prudence" without overestimating the magnitude of the effect (BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011).

Accuracy. A mixed factor ANOVA was run, with image category (baseline, neutral, woman, man, couple) as the within subject variable and participant sex as the between subject variable for accuracy. The relative simplicity of the task resulted in high rates of accuracy overall (over 87%; see Figure 2.1). In the between subjects analysis, there was a main effect of sex $F(1,40) = 5.62$, p= .02, $\eta_p^2 = .12$. A post hoc independent samples t-test revealed that at baseline, women (M = 95.29, SD = 3.84) were more accurate than men (M = 91.25, SD = 4.38), $t(40) = 3.17$, p = .003, g = 0.98 (see figure 2.1). Women were marginally more accurate in the neutral category (M = 91.01, SD = 6.13) than men (M = 90.85, SD = 6.17), though this did not reach statistical significance, $t(40) = 0.09$, p = .93, g = 0.03. There were no statistically significant differences in the woman image category between the groups (M_{women} = 93.32, SD = 5.64; M_{men} = 89.31, SD = 8.50), $t(40) = 1.84$, p = .07, g = 0.57, though it is important to note the moderate effect size, possibly indicating that there might be an approach to significance possibly due to a small sample size. When viewing images of men, women (M = 92.12, SD = 5.19) performed only slightly better than men (M = 91.40, SD = 3.06), though this did not achieve statistical significance, $t(40) = .51$, p = .61, g = 0.16. There was, however, a significant difference in performance when presented with the images of couples, where women showed a greater accuracy (M = 93.61, SD = 3.19) than men (M = 87.13, SD = 7.86), $t(40) = 3.71$, p = .001, g = 1.16. These data suggest an overall greater accuracy for women, however, the only erotic image category which provoked a greater interference effect was the couples. This may be due to the added emotional valence in an image of sexual intercourse rather than a single nude body.

Figure 2.1



Note. Accuracy shown as a percentage over five image categories. Error bars are 95% CI.

For the within subjects analysis, there was an interaction effect of sex and image category $F(4, 160) = 4.01$, $p = .003$, $\eta_p^2 = .09$. A post hoc comparison with a paired samples *t*-test, with a Bonferroni adjustment (*p* value set at .005) revealed that women were more accurate at baseline ($M = 95.29$, $SD = 3.84$) compared to neutral images ($M = 91.01$, $SD = 6.13$), $t(24) = 3.35$, $p = .003$, $g = 0.82$. Women also performed more accurately at baseline compared to when they were presented with images of men ($M = 92.12$, $SD = 5.19$), $t(24) = 3.32$, $p = .003$, $g = 0.68$. Men performed equally well in all image categories compared to baseline, however, they were more accurate when presented with images of men ($M = 91.40$, $SD = 3.06$) compared to images of couples, ($M = 87.13$, $SD = 7.86$), $t(16) = 2.97$, $p = .009$, $g = 0.70$, though this failed to meet statistical significance after the Bonferroni adjustment was applied. This suggests that accuracy appears to be hindered based on each sex's preferred sexual stimulus.

Latency. The data for latency violated normality as well as homogeneity of variance, therefore standard ANOVAs were not a valid assessment of the latency. Student *t*-tests offer limited information in a study which generates so much data, and often report comparisons as statistically significant based solely on an inflated sample size. Therefore, the use of Bayesian ANOVA and *t*-tests (JASP Team (2016). JASP (Version 0.8.0.0) to further analyze these data (Table 2.1). There was an interaction effect of image by gender $F(4, 205) = 2.93$, $p < .001$, $\eta_p^2 = .05$. Given that the test for sphericity was violated, a Greenhouse Geisser adjustment was used; with further Bayesian analysis, adding the Image by Gender interaction, increases the factor ($BF_{10} = 1.19e^5$) making the evidence against the null more compelling. Post hoc analyses (Figure 2.2) revealed that the differences between sexes was statistically significant when viewing neutral images where women showed a longer latency ($M = 531.8$, $SD = 48.89$) than men ($M = 479.5$, $SD = 40.12$), $t(40) = 3.648$, $p < .001$, $d = 1.15$ (with $BF_{10} = 39.12$; Table 2.3). Women also showed a longer latency when presented with images of men ($M = 550.4$, $SD = 38.12$) compared to male participants ($M = 465.8$, $SD = 23.72$), $t(40) = 8.12$, $p < .001$, $d = 2.55$ (with $B_{10} = 1.27e^7$). It is important to note that the baseline latency was significantly shorter than all image categories ($M_{women} = 492.0$, $SD = 109.81$; $M_{men} = 445.8$, $SD = 48.89$). This is indicative solely of researchers having achieved the intended results in which baseline scrambled images produced the least interference in comparison to all images with recognizable content.

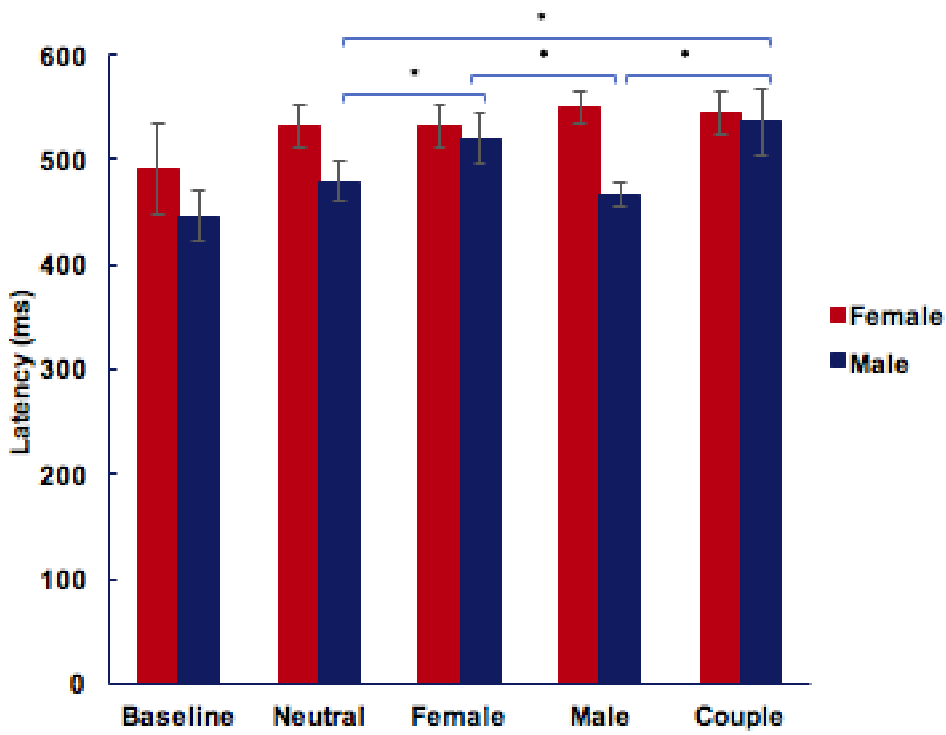
Table 2.1

Latency Model Comparison - dependent (Man and women Bayesian Repeated Measures)

Models	**BF** $_{10}$	**% error**
Null model (incl. subject)	1.000	
Image	705.682	0.406
Gender	84.635	1.047
Image + Gender	119495.013	0.872
Image + Gender + Image ✻ Gender	216364.858	1.003

Note. This compares the model against a null model therefore indicating that adding the images as well as gender adds to the interaction term. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Figure 2.2.



Note. Reaction time to saccade to the peripherally located target of the same colour as center image. Baseline scores were taken from scrambled images. Results shown in milliseconds. Error bars are 95% CI.

Table 2.2

Bayesian Independent Samples T-Test: Latency

	BF_{10}	error %
Baseline	0.856	$4.721e^{-5}$
Neutral	39.117	$5.244e^{-9}$
Women	0.366	$9.377e^{-5}$
Men	$1.272e^{+7}$	$2.394e^{-14}$
Couple	0.335	$9.000e^{-5}$

Note. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Images with erotic content were compared to neutral images which revealed that women showed no statistically significant difference between neutral images and all other images categories (Table 2.3). There was, however, a slightly longer latency when women viewed images of men (M = 550.4, SD = 38.12) compared to neutral images (M= 531.8, SD = 48.89), however, this did not achieve statistical significance $t(25) = 1.75$, $p = .059$, $d = 0.34$ (additional Bayesian analysis revealed a $B_{10} = 0.786$ indicating an increase of <2 times the chance that this was different from the null hypothesis which suggests only anecdotal evidence for the H_A; Jeffreys, 1961). A comparison of preferred versus non-preferred image content (i.e. images of women vs. images of men), showed no statistically significant difference $t(25) = 1.53$, $p = 0.14$, $d = -0.30$ (further Bayesian analysis revealed a $B_{10} = 0.58$ suggesting anecdotal evidence for the H_o which we interpret as no statistical significance). These data suggest that the Stroop interference effect for women, SCID does not appear to be closely tied to latency to produce a saccade.

Planned comparisons revealed that for men (Table 2.4), viewing neutral images (M= 479.5, SD = 40.12) produced less of an interference effect compared to images of women (M = 520.1, SD =49.29), $t(16) = -2.70$, $p = .004$, $d = -0.66$ (with further Bayesian analysis revealing $B_{10} = 3.70$ suggesting evidence in support of the H_A) as well as compared to images of couples (M = 535.6, SD = 67.98), $t(16) = -3.12$, $p = .007$, $d = -0.76$ (with further Bayesian analysis of B_{10}= 7.64, suggesting substantial evidence for the H_A).There was no statistically significant difference between neutral images and images of men, $t(16) = 1.25$, $p = .23$, $d = 0.302$ (with further Bayesian analysis of B_{10}= 0.48 suggesting anecdotal evidence for the H_o). Further comparison of preferred versus non-preferred stimuli (i.e. women/couple images vs. images of men) reveals that men showed a significantly more pronounced interference effect when presented with images of women, $t(16) = 3.91$, $p = .001$, $d = 0.95$ (BF_{10}= 31.16 suggesting very strong evidence for the H_A) as well as with images of couples, $t(16) = 3.69$, $p = .002$, $d = 0.89$ ($BF_{10} = 20.91$, suggesting strong evidence for the H_A). The data from men suggests that the interference effect is also contingent on images of preferred sexual content (i.e. images of women and couples compared to images of men). Interestingly, when women viewed images of non-preferred stimuli, their latency was similar to that of neutral images, whereas for men, the presentation of non-preferred images seems to speed up their activity. This, taken together with the greatest accuracy when men view images of men, we can interpret these results as being indicative of a decreased interference effect in men when presented with their non-preferred stimuli. Women show a similar effect; however, they do not speed up when presented with images of their non-preferred stimuli. Although the fact that women also show the least accuracy as well as longer latencies when viewing images of men, we can infer that there is an interference effect based on image preference.

Table 2.3

Women: Bayesian Paired Samples T-Test

		BF_{10}	**error %**
Baseline	- Neutral	0.399	4.235e -7
Baseline	- Women	0.363	4.317e -7
Baseline	- Men	1.112	3.392e -7
Baseline	- Couple	0.812	3.635e -7
Neutral	- Women	0.214	2.301e -4
Neutral	- Men	0.786	3.661e -7
Neutral	- Couple	0.342	3.347e -4
Women	- Men	0.579	3.914e -7
Women	- Couple	0.490	4.057e -7
Men	- Couple	0.211	2.260e -4

Note. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Table 2.4

Men: Bayesian Paired Samples T-Test

		BF_{10}	error %
Baseline	- Neutral	1.043	6.560e -5
Baseline	- Women	13.197	7.752e -7
Baseline	- Men	0.563	1.252e -5
Baseline	- Couple	11.280	6.986e -7
Neutral	- Women	3.700	2.938e -5
Neutral	- Men	0.483	3.062e -6
Neutral	- Couple	7.639	8.440e -8
Women	- Men	31.160	3.709e -7
Women	- Couple	0.467	2.900e -6
Men	- Couple	20.914	6.162e -7

Note. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Questionnaire Results and Correlations

Bivariate correlations were run with responses from the questionnaire (see Table 2.5). Specifically, main correlations of interest were relationship status, and duration, amount of sexual activity (including genital, anal, oral), amount of difficulty experienced during sexual intercourse in the past week (ranging from pain to lack of erection/lubrication, etc.), as well as subjective level of desire, and arousal on a Likert Type scale (from 0 = "none" to 5 = "high"). Women were also asked about hormonal contraceptive use. An independent samples *t*-test was run to analyze differences in desire, and arousal levels for men and women. There was no statistically significant difference in self- reported levels of desire between women ($M = 3.40$, $SD = 0.87$) and men ($M = 3.59$, $SD = 0.62$), $t(40) = -0.77$, $p = .45$, $g = -0.02$. Also, there was no statistically significant difference in self- reported levels of arousal in women ($M = 3.64$, $SD = 1.70$) and men ($M = 3.23$, $SD = 2.08$), $t(40) = 0.69$, $p = .49$, $g = 0.01$. These data suggest that both sexes' subjective ratings of arousal and desire elicited was the same. For women, desire was negatively correlated with latency of neutral images $r(25) = -0.40$, $p < .05$. Further analysis showed that although contraceptive use was correlated with higher reported levels of desire $r(25) = 0.48$, $p < .05$, and arousal $r(25) = 0.51$, $p < .05$, it was not correlated with latency times or accuracy for any image category. Interestingly, women who reported using contraceptives also reported greater total amount of sexual activity (including oral, anal, and vaginal sex). Women who reported being in a relationship were also more accurate when presented with images of couples $r(25) = 0.51$, $p < .05$ and length of relationship was also correlated with accuracy when presented with images of couples $r(25) = 0.62$, $p < .01$. This may suggest that the saliency of the couple images was decreased by being in a long-term relationship and as such may have produced less interference.

For men, desire was negatively correlated with latency times for images of men, $r(17) = -0.53$, $p < .05$, possibly indicating that a higher level of desire may contribute to the increased speed when presented with images of men given the lack of interest in that specific content. For men, reported levels of difficulty during intercourse was correlated with longer latency times when viewing images of women $r(17) = 0.50$, $p < .05$ and couples $r(17) = 0.50$, $p < .05$. Reporting sexual difficulties was also correlated with less accuracy when men were presented with images of men, $r(17) = -.50$, $p < .05$. These data may suggest a hyper-awareness to images

Table 2.5.

Correlation Matrix

	Baseline	Neutral	Women	Men	Couple	AccBaseline	AccNeutral	AccWomen	AccMen	AccCouple	Diff_time	difficulty	relationship	duration	Desire	Arousal	Contraceptive
Baseline	—	-0.637 ***	-0.322	-0.399 *	-0.467 *	0.174	0.043	0.198	0.409 *	0.162	0.289	0.080	0.113	-0.061	0.335	0.205	0.166
Neutral		—	-0.146	0.378	0.063	-0.292	0.181	-0.160	-0.313	-0.025	-0.233	-0.046	0.164	0.293	-0.403 *	-0.226	-0.099
Women			—	-0.204	0.267	-0.105	0.012	0.076	0.008	-0.181	-0.161	0.069	-0.166	-0.286	-0.038	-0.379	-0.271
Men				—	-0.276	-0.104	0.040	-0.023	0.206	0.003	0.092	0.368	0.247	0.193	-0.081	-0.169	0.022
Couple					—	-0.108	-0.038	-0.220	-0.423 *	-0.115	-0.161	-0.271	-0.256	-0.099	-0.181	0.156	-0.190
AccBaseline						—	0.214	0.537 **	0.442 *	0.084	0.111	-0.056	-0.268	-0.248	0.109	0.158	0.295
AccNeutral							—	0.607 **	0.500 *	0.353	0.030	-0.100	0.267	0.242	0.130	0.046	0.357
AccWomen								—	0.690 ***	0.613 **	0.139	0.084	0.255	0.265	0.151	0.199	0.279
AccMan									—	0.248	0.139	0.121	0.230	0.118	0.222	0.032	0.240
AccCouple										—	0.095	0.139	0.506 **	0.621 ***	0.293	0.285	0.036
Diff_time											—	0.663 ***	0.283	0.165	0.198	0.328	0.249
difficulty												—	0.249	0.027	0.073	-0.126	-0.189
relationship													—	0.858 ***	0.307	0.254	0.354
duration														—	0.248	0.397 *	0.327
Desire															—	0.525 **	0.481 *
Arousal																—	0.508 **
Contraceptive																	—

Note. Women correlations based on questionnaire response. Acc = accuracy. * p < .05, ** p < .01, *** p < .001

Pearson Correlations

	Baseline	Neutral	Women	Man	Couple	AccBaseline	AccNeutral	AccWomen	AccMan	AccCouple	Difficult_time	difficulty	relationship	duration	Desire	Arousal
Baseline	—	-0.300	-0.570 *	-0.137	-0.713 **	0.088	-0.069	-0.274	0.112	0.242	-0.146	-0.168	-0.445	-0.260	0.024	-0.008
Neutral		—	0.049	0.047	0.134	0.087	-0.232	0.001	-0.218	-0.375	0.151	0.107	0.093	0.022	-0.192	-0.188
Women			—	-0.127	0.634 **	-0.185	0.410	0.264	-0.056	-0.328	0.502 *	0.434	0.086	-0.116	0.473	0.052
Man				—	-0.285	0.055	0.166	0.378	0.280	0.300	-0.354	-0.213	0.172	0.273	-0.529 *	0.262
Couple					—	0.052	0.282	0.251	-0.034	-0.067	0.503 *	0.416	0.244	0.002	0.336	-0.026
AccBaseline						—	0.445	0.405	0.637 **	0.546 *	-0.202	-0.207	-0.029	-0.088	-0.299	-0.079
AccNeutral							—	0.626 **	0.592 *	0.320	0.074	0.075	-0.230	-0.274	0.091	-0.120
AccWomen								—	0.592 *	0.421	-0.218	-0.219	-0.062	-0.085	-0.394	-0.138
AccMan									—	0.753 ***	-0.518 *	-0.530 *	0.008	-0.076	-0.303	0.289
AccCouple										—	-0.487 *	-0.488 *	-0.100	-0.133	-0.238	0.243
Difficult_time											—	0.945 ***	-0.215	-0.245	0.592 *	-0.169
difficulty												—	-0.184	-0.171	0.573 *	-0.213
relationship													—	0.927 ***	-0.276	0.587 *
duration														—	-0.415	0.545 *
Desire															—	-0.212
Arousal																—

Note. Man correlations based on questionnaire response. Acc = accuracy. * p < .05, ** p < .01, *** p < .001

reflective of the sexual difficulty, particularly because desire in men, as well as proper sexual functioning, appear to manifest cognitively with a decrease in latency time as well as an increase in accuracy all of which are indicative of lesser cognitive interference.

Discussion

The aim of this study was to elucidate the effects of SCID using sexual imagery and eye movement as a response to a Stroop task. It was hypothesized that participants would show a greater interference (as measured by accuracy, and latency to perform a saccade) when presented with sexual imagery. Specifically, it was hypothesized that men would show a greater SCID based on sexually preferred images (i.e. images of women, and couples), whereas women would not show this specificity. The results of this study seem to indicate that sexual imagery does capture attention when used as a distractor in the emotive Stroop task and as such, does produce a sexual induced cognitive delay in both men and women. Given the simplicity of this task, accuracy was quite high, however, women showed category specificity with lower accuracy in the man image category as well as a longer latency when presented with images of men. Together these data suggest a considerable interference effect when presented with images of their preferred sexual stimulus. This was evident in men; however, the evidence of interference was associated with greater accuracy when presented with their non-preferred images (i.e. images of men) and the least accuracy when presented with images of couples. Men showed longer latencies when being presented with their preferred images (women, and couples). Consistent with the original Stroop literature, men showed a category specific sexual content induced delay (O'Ciardha & Gormley, 2012) but also manifest an improvement in task performance when presented with their non-preferred stimulus which was not seen with women. This may imply that although women did show some preference specificity, it may not be as clear-cut as men.

Although previous research has shown that SCID is evident in women, these studies were comprised of lexical tasks, rather than image related tasks (Conaglen, 2001; Geer & Bellard, 1996; Geer & Melton, 1997). It is important to note that in the O'Ciardha and Gormley (2012) study, there were no women participants. It is therefore unknown if their findings would have been consistent if women had participated. Women in this study showed a category specific error rate; however, it is important to note that this was not evident in latency times. As such, the less pronounced effects in women (as compared to men) may be due to the different processing required for lexical compared to image tasks. Image processing occurs very rapidly (~120ms; Kirchner & Thorpe, 2006) compared to semantic word processing (~200ms; Chanceaux et al., 2012), therefore this research allows for further information regarding the IPM. The increased latency times, in men, apparent for the sexual imagery rather than the neutral or baseline images, allow us to infer that there is an early processing system in which cognitively, men are immediately aware of and affected by sexual stimuli (Barlow, 1986; Dekker & Everaerd, 1989; de Jong, 2009; Spiering & Everaerd, 2007), however, this may not be as pronounced in women.

The saccadic Stroop task, combines both the automatic and controlled attention implicated in the IPM (Everaerd & Laan, 1995; Geer & Bellard, 1996; Geer et al., 1994; Geer & Melton, 1997; Janssen, Everaerd, Spiering, & Janssen, 2000; Laan & Everaerd, 1995; Massaro, 1993) in which the viewer is processing the content at a level of early processing but then is further impacted with later processing which allows for them to carry out the task. As was stated previously, once higher order processing in engaged, it allows sexual schemas and beliefs to affect the task. This may be evidenced in the men who reported sexual difficulties, but also in women who are in relationships. For these women, the ease at which they completed the task when images of couples were presented may indicate a familiarity or added comfort level with this category. Similar to studies of social anxiety, and phobias (Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heimberg, & Hope, 1993), men who reported experiencing sexual difficulty, showed less accuracy when presented with images of men as well as a longer latency times when viewing images of women, and couples. This may be similar to studies of social anxiety and phobia in which participants show a heightened sensitization to images that engage their emotions. It may be that images of other men trigger a comparison whereas images of women and couples allow the man to recall a dissatisfying situation. Although it was anticipated that women would not show an image category specificity given previous research that suggests that women do not show the same specificity of preference as men do (Chivers, Seto, & Blanchard, 2007; Peterson & Janssen, 2007) this was not the case. Similar to previous research which suggests that an erect penis captivates a women attention (Spape, Timmers, Yoon, Ponseti, & Chivers, 2014), women in this study were particularly affected by images of men, and couples (which also showed a man with an erect penis engaging in some form of sexual contact). Furthermore, although Conaglen (2004) found that SCID was more evident when desire levels were low, this was only the case for men who reported low levels of desire, and only when they were presented with images of nude men. For women, desire was negatively correlated with latency of neutral images but not for the images with sexual content. These data suggest that desire may be implicated in opposite way in an image task, as opposed to a lexical task. This may be due to the earlier processing of imagery, specifically images presented at such a high speed (~500 ms). The further processing of semantic content of a sentence requires may be more salient to someone with an aversive response. It is important to note, however, that no participant responded with unusually low desire levels. It may be interesting to test a clinical population of participants with desire disorders to further understand whether desire levels are positively or negatively correlated with SCID.

One limitation to this study is the relative simplicity of it, resulted in a high accuracy overall, and possibly did not allow for accurate interpretation of the influence of each category of image. Furthermore, it was not anticipated that men and women would report a moderate level of arousal and desire. Given the fact that the images are presented on the monitor rapidly, we believed it would not influence levels of arousal or desire and as such only three questions were asked concerning both states. A more accurate test of subjective arousal and desire such as the Sexual Arousal and Desire Inventory (SADI, Toledano & Pfaus, 2006) would be a more accurate measure of arousal and desire. Furthermore, exploration into the correlation between sexual difficulty and accuracy and latency results for men is something that should be further explored, possibly offering a more cognitive interpretation of sexual disorders.

This study is one of the first (to our knowledge) to include women participants, with sexual images as stimuli to explore SCID. Given that imagery is more ecologically valid, this study allows for early inferences of SCID effects in women based on sexual imagery. Also, the fact that early processing showed specificity of delay in men and women suggests that the lack of specificity other researchers have found may be due to a later processing and further interpretation by the participant.

Chapter 3: Using a Mixed Saccade Task to Explore Attention Capture by Sexual Imagery

Using a Mixed Saccade Task to Explore Attention Capture by Sexual Imagery

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Abstract

The anti-saccade task has been used extensively in research of neuro-cognitive disorders, as it can be used to elucidate deficits in the attention allocation and neural mechanisms of eye movement control. Specifically, it is used to investigate the ability to suppress the automatic urge to make an eye movement towards a target (i.e., a prosaccade), and instead, program and initiate an eye movement away from the target (i.e., an anti-saccade). Here, we investigated if sexual imagery would capture attention, and thus cause a decrease in accuracy, and/or increase in latency. Furthermore, we explored whether the participants' subjective arousal state would affect this allocation of attention. In this study, sexual stimuli were presented to participants who had been primed with either a pornographic video or a neutral video. The pornographic videos were used to increase subjective ratings of sexual arousal prior to performing the task. Participants then completed the task with results assessed based on accuracy and latency for a pro- and anti-saccade. Men showed no difference in performing the task based on priming. Men were less accurate when performing the pro-saccade when presented with images that were of men, or low valence, but were more accurate when presented with preferred images (i.e. women, couples). The average accuracy for men was lowest in the anti-saccade task when presented with images of women. Conversely, women's reaction times were not dependent on the image content but rather on the priming state. A third, unanticipated group was created for women who had viewed the pornographic movie but reported feeling unaroused. Overall, women showed main differences in accuracy and latency based on priming rather than image content. Women in the porn primed group which reported feeling aroused, were much slower than women in the neutral group. and slower than those in the pornography-primed unaroused group. The women in the pornography-aroused group were slower throughout the entire task, irrespective of image. The neutral and pornography-unaroused groups had similar results, suggesting that state arousal is what may be causing the SCID in women.

***Key Words*: Cognition, Anti-Saccade, Inhibitory Control, Priming**

Introduction

Cognitive models of sexual arousal, such as the Information Processing Model (IPM; Everaerd, 1995; Laan & Everaerd, 1995; Janssen et al., 2000, Massaro & Cowan, 2005), have been used to investigate the distracting effect of sexual stimuli on automatic and controlled attention processes (Janssen et al. 2000; Spiering et al., 2006). Unlike controlled processes, automatic processes require no thought or effort from the individual. The complexities of sexual arousal involve an interplay of both this bottom up, automatic processing, and a top down, controlled process. Studies exploring the IPM have revealed that the emotional saliency of sexual imagery allows it to be processed subconsciously (Geer & Bellard, 1996; Geer, Judice, & Jackson, 1994; Geer & Melton, 1997), and as such, may be more effective in producing a bias of attention (Geer & Melton, 1997). This bias may be an evolutionary adaptation making mate location and selection a priority (Rinck & Becker, 2006). The bias towards sexual stimuli results in a compromise of available attentional resources that can be allocated to other tasks, resulting in what researchers have termed a sexual content induced delay (SCID; Geer & Bellard, 1996). The SCID has been researched extensively with the use of timed lexical tasks which used words of varying sexual salience (neutral, romantic, erotic) and non-words (letter strings not related to any English word; Geer and Bellard, 1996) are presented to participants who must decide whether the stimulus was in fact a word. Women showed the greatest level of SCID when presented with erotic words compared to other words, as well as longer latency time when presented with romantic words compared to neutral words. Men did not show a content-specific difference between word types. This was also evident in another lexical task which used semantic priming sentences that were either sexual or neutral ending in a double entendre word (i.e. “Inside her, she could feel his prick” or “He experienced the needle’s prick”) followed by a target word or non-word (Geer & Melton, 1997). The target words were either an erotic or neutral word related to the sentence (ending in “prick” followed by a target word either “penis” or “blood”) or a letter string. Men and women showed longer reading times for sentences with erotic content compared to neutral content. Women again seemed to be more affected by the SCID with decision times being longer when presented with either erotic sentences or erotic word targets. The SCID may be correlated with sexual desire (Conaglen, 2004) given that men and women who rate desire levels as low, were much slower to respond to the sexual words.

While researchers believe that this may be indicative of an aversive reaction to sexual stimuli (Conaglen, 2004), this may require further analyses based on state versus trait levels of desire.

A cognitive test which incorporates both autonomic and controlled attentional processes may be required in order to elucidate the influence of desire (as well as subjective arousal). Researchers studying cognition in a non-sexual context have used the anti-saccade or mixed saccade task as a gold star example of inhibiting an automatic response and controlling the behaviour in a required way (Munoz & Everling, 2004). This test modality may be extended to sex research given that it will allow the separation of excitatory and inhibitory mechanisms involved in cognitive processing of sexual stimuli. Because both the suppression and the redirection of the saccade must be accomplished, executive cognitive control is critical in this task (Hallett, 1978). When combined together, a behavioural paradigm that contains both pro- and anti-saccade behaviour is referred to as a mixed-saccade task (Hallett, 1978). The mixed-saccade task has been used extensively in vision research to investigate the neural mechanisms for eye movement control (reviewed in Munoz & Everling, 2004), in particular with individuals with cognitive deficits.

The suppression of the involuntary saccade may be influenced by the saliency of a stimulus (programming and redirection of the saccade in the opposite direction to the salient target). In order to study both involuntary and controlled eye movements with respect to image content, Kissler and Keil (2008) used a variation of the mixed-saccade task using emotionally salient pictures (i.e., pleasant, unpleasant, neutral) as the stimuli. They observed that latency to initiate a saccade was longer in the anti-saccade task in both the pleasant and unpleasant conditions. They interpreted this finding as indicating that the emotional saliency (whether negative or positive) may render the anti-saccade more difficult to accomplish, given the bias of attention created by this saliency. There was also a higher error rate for the anti-saccade task when emotional images were used (Kissler & Keil, 2008). The latencies for the pro-saccade were shorter for the emotional images (pleasant and unpleasant), when compared to the neutral images. This would indicate that the emotionally salient stimuli may facilitate the involuntary pro-saccade further. These findings were consistent with previous research results that showed that visual stimuli of emotional content are fixated upon for longer periods of time (Calvo & Lang, 2005), and are attended more frequently than neutral images (Fecteau & Munoz, 2006).

This present study uses the mixed saccade task, with a priming component. The images used are of varying sexual activity which had been previously rated on arousal and valence (high and low; Shilhan et al., *submitted*). Participants were primed with a neutral or pornographic video in order to elucidate if the delay was caused by the image content or the individual's arousal state. Since sexual imagery provokes a delay in task completion due to the SCID (Geer & Bellard, 1996; Geer & Melton, 1997), we hypothesise that the anti-saccade task will be impeded on both the ability to supress the involuntary, reflexive saccade and also the voluntary decision to saccade in the opposite direction specifically when images rated high in arousal and valence will be presented. Given that SCID in lexical tasks was more pronounced in women, it is unknown if that will carry over to sexual imagery. Furthermore, given that there has been extensive research showing that women show a physiological response to images of men and women (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers et al., 2010), we hypothesize that women will not show a specificity as to which images affect their responses, while men will be more affected by images of women and couples. We hypothesise that the level of subjective arousal will be fundamental in the delay; participants who rate high in subjective arousal (i.e. those in the pornography primed group) will produce more errors as well as having longer latency times.

Method

Participants

There were 71 undergraduate participants (49 women, 22 men; M_{age}= 23.54, SD = 4.75). from Concordia University in Montreal, QC, Canada. There were no specific exclusion criteria, other than participants must not be afflicted with a neurological disorder (e.g., epilepsy), or psychiatric pathology that impedes the anti-saccade portion of the task (e.g., schizophrenia). Participants were required to fall within the categories of exclusively heterosexual or predominantly heterosexual and only incidentally homosexual as assessed on the Kinsey Scale (e.g., 0 or 1; Kinsey, Pomeroy, & Martin, 1948). All procedures conformed to the Canadian Tri-Council Panel on Research Ethics, and were approved by the Concordia University Human Research Ethics Committee.

Materials

Images. The participants were shown 400 images retrieved from the Concordia Sexual Image Dataset (Shilhan et al., *submitted*) and the International affective picture system (IAPS;

Lang, Bradley, & Cuthbert, 2008). The Concordia Sexual Image Dataset contains sexual images of varying content, rated on arousal and valence. Neutral images were taken from the IAPS database, which contains a set of normative stimuli for experimental investigation of emotion and attention. We specifically used images from six different categories; four of which were sexual: women, man, couples, low valence, and two which were non-sexual: neutral-people, neutral-objects to act as control images. All images within the categories were matched for arousal level. Low valence images were considered high in sexual content, however, had been rated as not arousing and not part of preferred stimuli (most of the images depicted predominantly homosexual man/women content).

Priming videos

Pornographic videos. In order to increase the level of subjective arousal reported by the primed group, participants were left alone in the testing room for 15 minutes, and were instructed to select any video from a list of erotic adult videos organized by genre: including homosexual and heterosexual, fetish, mild, hard-core, etc. Subjective arousal levels were then assessed with the Sexual Arousal and Desire Inventory (SADI; Toledano & Pfaus, 2006).

Neutral video. Participants in the neutral video were shown 15 minutes of Bob Ross' The Joy of Painting Mystic Mountain (Season 20, Episode 1, 1990). This video was selected based on a small sample of students whom rated it as highly enjoyable, but not sexually arousing.

Questionnaires

Concordia Questionnaire. This questionnaire includes a list of demographic questions, sexual preference (assessed with the Kinsey scale; Kinsey, Pomeroy, & Martin, 1948), sexual activity (with and without a partner). Participants were also asked about the amount of pornography they use, as well as preferred genre.

Sexual Arousal and Desire Inventory (SADI). This questionnaire assesses subjective levels of arousal and desire (Cronbach's α = .91; Toledano & Pfaus, 2006). The SADI is made up of a list of 54 descriptors with word categories based on cognitive-emotional, motivational, physiological, and negative control. Participants fill out a Likert Type scale for how each word relates to their current state (from 0 = "does not describe it at all", to 5 = "describes it perfectly"). Any participants in the pornography groups who reported their average rating less than three (moderate) on the motivational factors (indicator of desire) were removed from the group.

Furthermore, participants were also asked three questions based on their state of arousal (1. I feel aroused, 2. My body feels aroused, 3. I will likely engage in sexual activity). Any participants who responded “no” to these questions were also removed. Conversely anyone in the neutral priming group who reported feeling aroused (same criteria) were excluded. There were 17 women in the porn primed group who violated these criteria and therefore the “porn-unaroused” group was created. All men in the pornography group reported feeling subjectively aroused. No participants were removed from the neutral primed group.

Apparatus

Stimuli were presented and data collected using a Dell Quad-Core PC running Microsoft Windows 7. Participants viewed stimuli on a linearized video monitor (View sonic G225fb 21” CRT, 1024 x 768 pixel resolution, 100-Hz refresh rate). A chin rest was used to stabilize head position at a distance of 70 cm from the screen. Eye position was acquired non-invasively using a video-based eye movement monitor (Eyelink 1000/2K, SR Research, Ottawa, Ontario). The Eyelink system recorded binocular eye position with a sampling resolution of 1000 Hz. That is, the eye position is monitored every 1ms.

Procedure

This study took place in the Vision Lab of Concordia University. Participants first provided informed consent, and were then asked to fill out a questionnaire inquiring about age, sexual orientation, sexual activity, and desire levels.

Participants sat in front of the eye-tracker monitor, the height of the chinrest and chair were adjusted to get the intended camera image, without changing the Desktop Mount settings. There were adjustments made to the Desktop Mount for participants wearing glasses, depending on the shape and reflection of the glasses to minimize the reflection of infra-red light source on the glasses. Eye-movement research requires information on the subject's point of gaze on a display of visual information. To compute this, researchers need to determine the correspondence between pupil position in the camera image and gaze position on the subject display. We do this by performing a system calibration, displaying several targets for the subject to fixate. The pupil - CR position for each target is recorded, and the set of target and pupil - CR positions is used to compute gaze positions during recording. A nine-point calibration type (“HV9”) is used. The participant must follow a fixation point that moves in random spots on the monitor (9 times). This is done twice followed by a validation. By running a validation immediately after each calibration, the accuracy of the system in predicting gaze position from pupil position is scored. If performance is poor, the calibration should be immediately repeated. If performance is adequate, then the study may begin.

The instruction for the anti-saccade task appeared on the monitor, and the researcher explained them as well. The participant was instructed to look at the fixation point at the center of the screen. This fixation square would appear in either red or green and was positioned at the center of the image for 500ms. If the square was green, participants were instructed to perform a pro-saccade (i.e., look towards the target); however, if the square was red, the participants were instructed to perform an anti-saccade (i.e., look away from the target). The participants were asked to perform the saccade as quickly and accurately as possible when the image was presented. The target was presented 5 degrees of visual angle (or ~200 pixels) into the periphery. Participants were unaware of whether it would appear on the right or left side of the monitor, as position was randomized (and counterbalanced) across trials. In total, participants viewed 400 images (80 of each category) randomly presented to the participant. There were an equal number of pro and anti-saccade trials. All images were presented once as a saccade and once as an anti-saccade.

Saccades were performed in a linear left or right fashion. Any eye movement outside a 1° radius of the fixation point was counted as a saccade. Eye movements were completed by reaching a point of 5° past the fixation point. Any trial in which the participant's gaze did not reach this point was counted as a mistrial and was not counted. Participants were asked to perform the saccades as quickly as possible. Any saccade that took longer than one second to perform was also deemed a mistrial, and not counted. Mistrials were presented again until adequately performed. Results were calculated based on latency to perform the saccade (counted in milliseconds) as well as accuracy.

Results

Data Analysis Summary

All statistical analyses were conducted using MATLAB (ver. 2012a, The Math works, MA). All participants completed the study to its entirety and no data was excluded. A G- power analysis was run a-priori to establish the sample size. A mixed ANOVA with 3 groups and 6 measurements requires a total sample size of 36. For the men, a mixed ANOVA with 2 groups and 6 measurements requires a total sample size of 28 (22 males therefore Power = 0.9197).

The data for latency was found to violate normality as well as homogeneity of variance, therefore ANOVAs were not a valid assessment of latency. Student *t*-tests offer limited information in a study which generates so much data, and often report comparisons as statistically significant based solely on an inflated sample size. Given that eye tracking latency results often violate rules for using standard *t*-tests (i.e. skewness, kurtosis, non-normal distribution, importance of including outliers) it was decided to use a Bayesian analysis in addition to regular *t*-tests for post hoc latency analysis (JASP Team (2016). JASP (Version 0.8.0.0); Kruschke, 2013; Wetzels et al., 2011). Bayesian analysis is used in similar circumstances as a *t*-test, however is not affected by outliers nor disparate group sample sizes. Wetzels and colleagues (2011) conducted a meta-analysis in order to exemplify the extra information offered by Bayesian analysis. Specifically, the Bayesian factor (BF_{10}) gives information on which hypothesis (H_o= null hypothesis, H_A= alternate hypothesis) is better supported while still maintaining "prudence" without overestimating the magnitude of the effect (BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011). A robustness check and sequential analysis were carried out to ensure a sufficient sample size. For male participants, a Cauchy width prior of 0.70 (default used in JASP; Rouder et al., 2009) was sufficient to show a robustness of BF_{10} = 1205.65. A sequential analysis was run, revealing that with approximately 15 participants, the data would reveal consistent results. Similarly, for female participants, a Cauchy width prior of 0.70 was sufficient to show a robustness of BF_{01} = 6.546. A sequential analysis was run, revealing that with approximately 22 participants, the data would reveal consistent results.

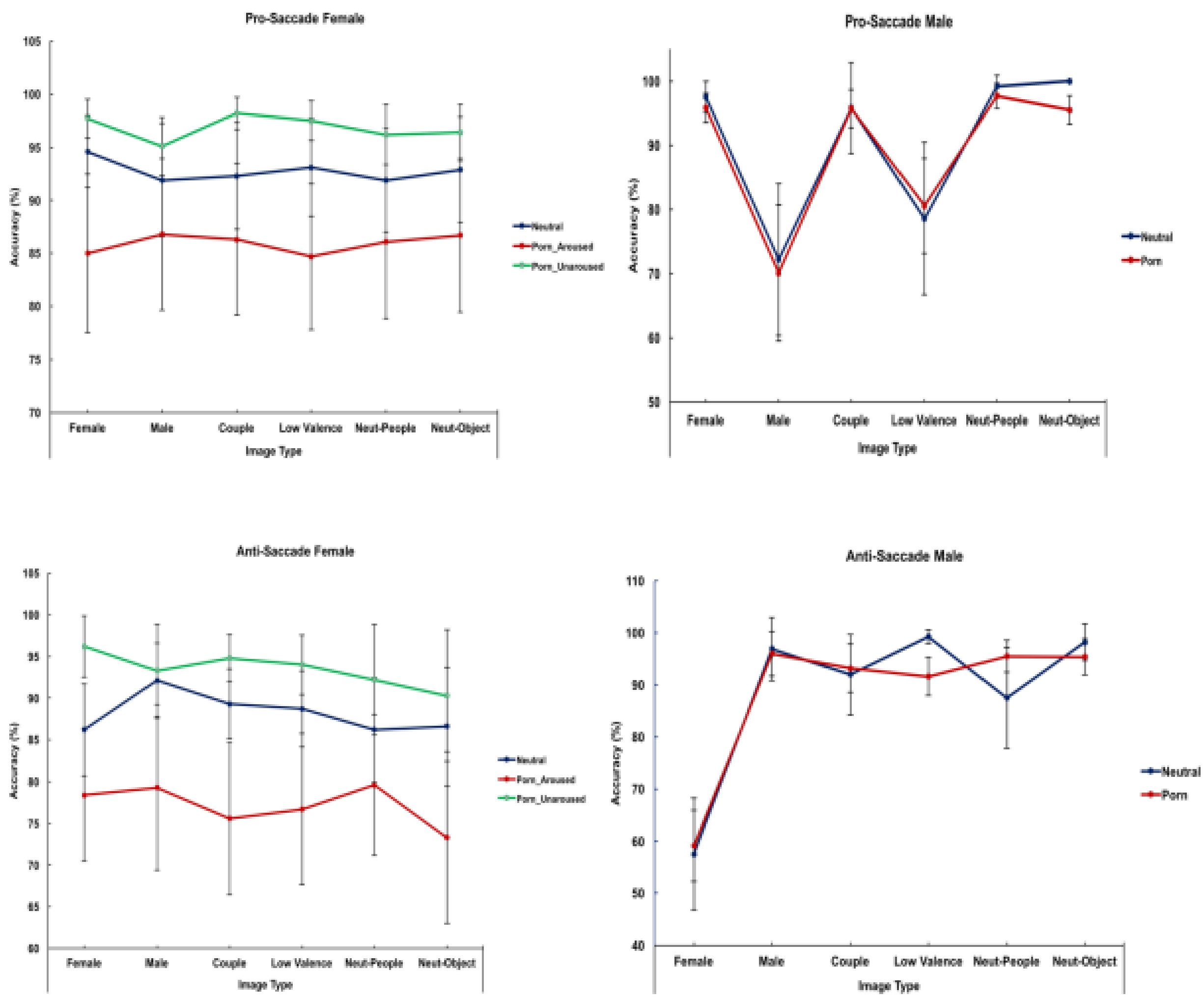
Accuracy. Accuracy was calculated as the average number of correct trials, averaged across participants, given as a proportion (Figure 3.1.). A mixed factorial ANOVA was carried out with accuracy as the dependent variable and priming, task, and image as the independent variables, with planned post-hoc dependent *t*-tests used to investigate within group differences for each image type, with Cohen's *d* used as a measure of effect size. Priming refers to the pre-trial movie exposure (women: porn-aroused, porn-unaroused, neutral; men: porn, neutral). There was a main effect of task, $F(1, 1140) = 16.631$, $p < .001$, $\eta_p^2 = .01$, such that participants were more accurate when performing a pro-saccade rather than an anti-saccade, $t(94) = 4.644$, *p*

$<.001$, $g = 1.56$, however, this is to be expected given the extra level of difficulty in performing an anti-saccade.

Women. Women (n = 49), were divided into three groups based on priming video and rating of subjective arousal. The subgroups were: neutral (n = 24; watched a neutral video and rated subjective arousal prior to task as low); porn-aroused (n = 17; watched a pornographic video before task, rated subjective arousal as high), porn-unaroused (n = 8; watched a pornographic video, rated subjective arousal as low). There was a main effect of prime, $F(2, 1140) = 33.85$, $p < .001$, $\eta_p^2 = .06$. Follow-up post hoc comparisons with an independent samples *t*-test showed that overall, women in the neutral primed group were more accurate than women in the porn aroused group, $t(39) = 6.04$, $p < .001$, $g = 0.32$, as well as more accurate than the porn-unaroused group, $t(30) = 3.36$, $p = .01$, $g = 0.27$. The porn-unaroused group was significantly more accurate than the porn aroused group, $t(23)= 6.69$, $p < .001$, $g = 0.56$, indicating that subjective arousal may be causing the increase in errors overall. There was a main effect of task $F(1, 1140) = 16.63$, $p < .001$, $\eta^2 = 0.14$, with further post hoc comparisons indicating that women performed better in the pro-saccade task $t(1174) = 4.65$, $p < .001$, $d = 0.27$. The pattern of porn-aroused primed group making more errors than the neutral primed group was evident; however, there was no effect of image for women, $F(5, 1140) = 0.25$, $p = .94$, $\eta_p^2 = .001$. Together, these data suggest that for women, accuracy is related more to self-reported arousal rather than image content. Interestingly, the porn primed group who reported feeling unaroused, was the group that was most accurate in both tasks. This may indicate a lesser interest to the visual stimuli.

Figure 3.1.

Accuracy results pro-saccade and anti-saccade.



Note. Error bars are 95% CI.

Men. Men (n = 22) were divided into two groups based on priming video and rating of subjective arousal. The subgroups were: neutral (n = 8; watched a neutral video and rated subjective arousal prior to task as low); porn (n = 14; watched a pornographic video before task, rated subjective arousal as high). For men, there was no main effect of priming, $F(1,240) = 1.15$, $p = .28$, $\eta_p^2 = .01$; however, there was a main effect of image on accuracy, $F(5, 240) = 23.439$, $p < .001$, η_p^2 *.33*. This we interpreted as men showing more interference based on the image content rather than their state of arousal. In the pro-saccade, specific image categories produced higher error rates: images of men resulted in the lowest accuracy scores when compared to images of women, $t(20) = -6.24$, $p < .001$, g = -2.66, couples, $t(20) = -5.78$, p < .001, g = -2.46, neutral-people, $t(20) = -6.72$, p < .001, g = -3.00 and neutral-objects, $t(20) = -6.43$, $p < .001$, g = -2.88. Preferred images such as women and couples were among the images with the highest accuracy; however, it is interesting to note that neutral images of people were as well. This would suggest that accuracy in the pro-saccade component of the mixed saccade task may be contingent upon the positive valence of the image. We make this interpretation as the low valence and images of men (i.e., non-preferred) produced the highest error rates. There was an interaction effect of image * task, $F(5,240) = 48.239$, $p < .001$, $\eta_p^2 = .50$. In the anti-saccade task, images of women produced the lowest accuracy rates, when compared to all other image categories combined, $t(20) = 16.42$, $p < .001$, $g = 7.34$. There were two notable between group differences for images, specifically the low valence images during which the men in the neutral group were significantly more accurate than the porn primed group, $t(9) = 3.01$, $p = 0.01$, g =2.01, as well as the neutral-people images where men in the porn primed group were more accurate $t(9) = 2.17$, $p = 0.04$, $g = 1.45$. Accuracy, may be affected primarily by the image content; however, once they are subjectively aroused, low valence (and sexual explicitness) becomes more salient.

Latency. Latency was calculated in milliseconds (ms) between onset of stimulus and initiation of the saccade (Figure 3.2). All trials (correct and incorrect) were included in the analysis as this was a means to assess the latency to disengage from the image and perform the task. Given the fact that data violated several of the assumptions of ANOVAs, as well as the inclusion of outliers, the Bayesian Estimates Supersedes *t*-test (BEST: Kruschke, 2013) was used. The BEST is not affected by outliers and estimates the difference between the groups, with a 95% Highest Density Interval (HDI) which if it includes 0, should be considered as not statistically significant.

Women Pro-Saccade

A mixed factorial ANOVA was run between priming groups (neutral, porn aroused, porn unaroused) as the between subject variable and image category as the within subjects' variable. For the pro-saccade task, there was a between subjects main effect of Prime $F(2,97) = 4.90$, $p = .009$, $\eta^2 = 0.09$ (with further Bayesian analysis revealing a $BF_{10} = 3.78$, suggesting substantial evidence for the H_A).

Neutral versus Porn. There was a between subjects main effect of Prime $F(1, 82) = 7.80$, $p = .006$, $\eta^2 = 0.09$ (with further Bayesian analysis revealing a $BF_{10} = 5.07$, suggesting substantial evidence for the H_A; Table 3.2). Independent samples *t*-tests revealed there was a statistically significant difference when viewing images of women, $t(82) = -2.02$, $p = .047$, $d = -0.44$ (with further Bayesian analysis revealing a $BF_{10} = 1.32$, suggesting anecdotal evidence for the H_A). There was a statistically significant difference when viewing images of couples, $t(82) = -2.75$, p = .007, d = -0.61 (with further Bayesian analysis revealing a $BF_{10} = 5.664$, suggesting substantial evidence for the H_A). There was a statistically significant difference when viewing low valence images, $t(82) = -2.41$, $p = .02$, $d = -0.53$ (with further Bayesian analysis revealing a $BF_{10} = 2.76$, suggesting anecdotal evidence for the H_A). There were no statistically significant differences when viewing images of men, $t(82) = -1.72$, $p = .09$, $d = -0.38$ (with further Bayesian analysis revealing a $BF_{10} = 0.82$, suggesting anecdotal evidence for the H_o), neutral people images, $t(82) = -1.71$, $p = .09$, $d = -0.38$ (with further Bayesian analysis revealing a $BF_{10} = 0.28$, suggesting anecdotal evidence for the H_o), nor when viewing neutral object images, $t(82) = -1.66$, $p = .10$, $d = -0.37$ (with further Bayesian analysis revealing a $BF_{10} = 0.78$, suggesting anecdotal evidence for the H_o). There were significant within subjects effect of image content by prime $F(5,410) = 0.88$, $p = .49$, $\eta^2 = 0.01$. These data suggest that there are significant differences based on priming but not based on image content. The women that were primed with pornography and reported feeling sexually aroused showed longer latencies when viewing certain images. Interestingly, the difference was not evident when viewing their preferred sexual stimulus (i.e. men). These differences were not evident in the non-sexual images suggesting that higher levels of arousal create a sexual content induced delay.

Porn Aroused Versus Porn Unaroused. There was a main effect of prime, $F(1,50) = 4.70$, $p = .03$, $\eta^2 = 0.09$ (with further Bayesian analysis revealing a $BF_{10} = 1.69$, suggesting anecdotal evidence for the H_A). Independent samples t-tests were run in order to elucidate group differences. There were no differences when viewing images of women, $t(50) = 1.44$, $p = .16$, $d = 0.43$ (with further Bayesian analysis revealing a $BF_{10} = 0.68$, suggesting anecdotal evidence for the H_o). There was no statistically significant difference when viewing images of men, $t(50) = 1.76$, $p = .08$, $d = 0.53$, however the $BF_{10} = 1.02$, which suggests no evidence for either the H_A or H_o. This was a similar finding when viewing images of neutral people, $t(50) = 1.86$, $p = .07$, $d = 0.56$ ($BF_{10} = 1.17$). There was no statistically significant difference when viewing images of couples, $t(50) = 0.91$, $p = .37$, $d = 0.27$ (with further Bayesian analysis revealing a $BF_{10} = 0.41$, suggesting anecdotal evidence for the H_o), nor with neutral object images, $t(50) = 1.30$, $p = .20$, $d = 0.39$ (with further Bayesian analysis revealing a $BF_{10} = 0.41$, suggesting anecdotal evidence for the H_o). There was a marginally significant difference when viewing low valence images, $t(50) = 2.02$, $p = .05$, $d = 0.61$ (with further Bayesian analysis revealing a $BF_{10} = 1.49$, suggesting anecdotal evidence for the H_A). These data suggest that there are not many differences between the two porn primed groups in terms of image category, $F(5,250) = 1.40$, $p = .22$, $\eta^2 = 0.003$.

Neutral versus Porn Unaroused. There were no between subjects effects of Prime, $F(1,62) = 0.29$, $p = .60$, $\eta^2 = 0.001$ (with further Bayesian analysis revealing a $BF_{10} = 0.26$, suggesting anecdotal evidence for H_o), nor any within subjects effects of image category, $F(5,310) = 0.79$, $p = .55$, $\eta^2 = 0.01$ (with further Bayesian analysis revealing a $BF_{10} = 0.03$), suggesting anecdotal evidence for the H_o). These data suggest that similarities in arousal ratings produce similar latency times. There were no evident differences based on prime nor image content.

Women Anti-Saccade

There was no effect of image category, $F(5,485) = 0.28$, $p = .92$, $\eta^2 = 0.003$ (with further Bayesian analysis revealing a $BF_{10} = 0.003$, suggesting anecdotal evidence for the H_o). There was a between sample main effect of Prime, $F(2,97) = 4.10$, $p = .02$, $\eta^2 = 0.08$ (with further Bayesian analysis revealing a $BF_{10} = 1.23$, suggesting anecdotal evidence for the H_A).

Neutral versus Porn. There was a main effect of Prime, $F(1,82) = 6.42$, $p = .01$, $\eta^2 = 0.07$ (with further Bayesian analysis revealing $BF_{10} = 1.86$, suggesting anecdotal evidence for the

H_A). These data suggest that the differences in performance are based on the priming group rather than the image content.

Porn Aroused versus Porn Unaroused. There was no effect of image category, $F(5,250) = 0.20$, $p = .98$, $\eta^2 = 0.003$ (with further Bayesian analysis revealing $BF_{10} = 0.01$, suggesting anecdotal evidence for the H_o). There was no effect of Prime, $F(1,50) = 3.28$, $p = .08$, $\eta^2 = 0.06$, (with further Bayesian analysis revealing $BF_{10} = 0.70$, suggesting anecdotal evidence for the H_o). These data suggest no significant differences between the two porn primed groups.

Neutral versus Porn Unaroused. There was no effect of image category, $F(5,310) = 0.70$, $p = .66$, $\eta^2 = 0.01$ (with further Bayesian analysis revealing $BF_{10} = 0.04$, suggesting anecdotal evidence for the H_o). There was no effect of Prime, $F(1,62) = 0.30$, $p = .58$, $\eta^2 = 0.005$ (with further Bayesian analysis revealing $BF_{10} = 0.24$, suggesting anecdotal evidence for the H_o). These data suggest no conclusive differences between the neutral and porn unaroused groups.

Men Pro-Saccade

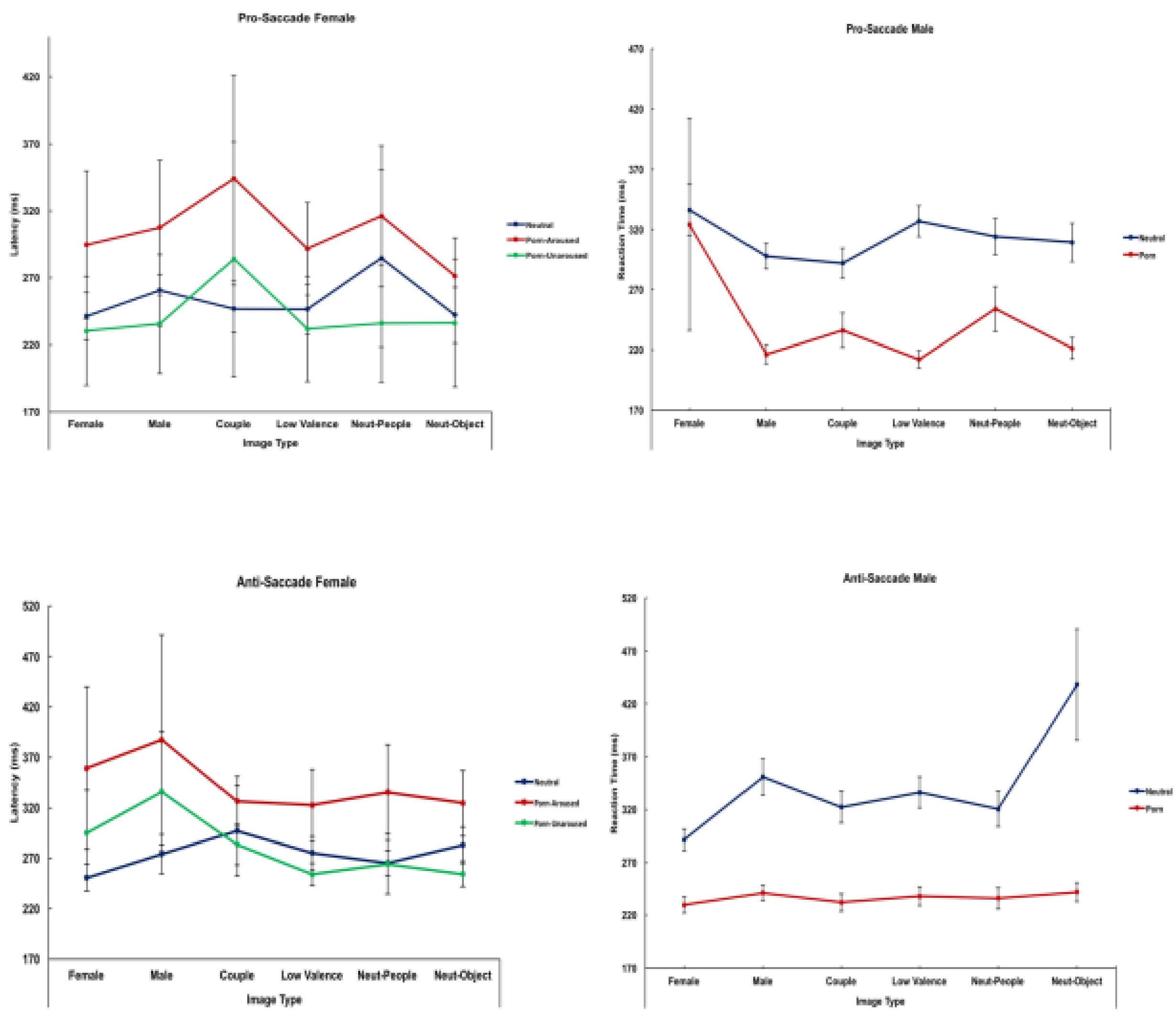
There was a main effect of Prime, $F(1,20) = 5.903$, $p = .02$, $\eta^2 = 0.23$ (with further Bayesian analysis revealing $BF_{10} = 2.86$, suggesting anecdotal evidence for the H_A). While there did not appear to be a significant Interaction effect of Prime * Image Category, $F(5, 100) = 0.16$, $p = .98$, $\eta^2 = 0.01$, further Bayesian analysis ($BF_{10} = 3.06$) suggests substantial evidence for the H_A. Independent samples t-tests were run in order to elucidate the group differences. There was no statistically significant difference when participants viewed images of women, $t(20) = 1.08$, $p = .29$, $d = 0.48$ (with further Bayesian analysis revealing $BF_{10} = 0.60$, suggesting anecdotal evidence for the H_o). Men in the neutral prime group showed a longer latency when presented with images of men compared to porn primed men, $t(20) = 2.48$, $p = .02$, $d = 1.10$ (with further Bayesian analysis revealing $BF_{10} = 2.94$, suggesting anecdotal evidence for the H_A). Neutral primed men showed a longer latency when presented with images of couples, $t(20) = 2.42$, $p = .03$, $d = 1.07$ (with further Bayesian analysis revealing $BF_{10} = 2.66$, suggesting anecdotal evidence for the H_A) as well as when presented with low valence images, $t(20) = 2.46$, $p = .02$, $d = 1.09$ (with further Bayesian analysis revealing $BF_{10} = 2.82$, suggesting anecdotal evidence for the H_A). Men in the neutral prime group also showed a longer latency to images of neutral people, $t(20) = 2.38$, $p = .03$, $d = 1.06$ (with further Bayesian analysis revealing $BF_{10} = 2.54$, suggesting anecdotal evidence for the H_A). Finally the neutral prime group showed a longer latency when presented with neutral objects, while t-test revealed no statistically significant difference, $t(20) = 1.81$, $p = .09$, $d = .80$; further Bayesian analysis revealing $BF_{10} = 1.19$, suggesting anecdotal evidence for the H_A.

Men Anti-Saccade

The was a main effect of Prime, $F(1,20) = 8.94$, $p = .007$, $\eta^2 = 0.31$ (with further Bayesian analysis revealing a $BF_{10} = 10.25$, suggesting substantial evidence for the H_A). Men in the neutral prime group showed a longer latency in all image categories. Men in the neutral prime group showed a longer latency when presented with images of women, $t(20) = 2.38$, $p = .03$, $d = 1.06$ (with further Bayesian analysis revealing a $BF_{10} = 2.54$, suggesting anecdotal evidence for the H_A). Men in the neutral primed group showed a longer latency when presented with man images compared to the porn primed group, $t(20) = 2.15$, $p = .04$, $d = 0.95$ (with further Bayesian analysis revealing a $BF_{10} = 1.84$, suggesting anecdotal evidence for the H_A). Neutral primed men also showed a longer latency when presented with low valence images compared to porn primed, $t(20) = 2.64$, $p = .02$, $d = 1.17$ (with further Bayesian analysis revealing a $BF_{10} = 3.70$, suggesting substantial evidence for the H_A). While men in the neutral prime group showed a longer latency when viewing neutral object images compared to porn primed group, $t(20) = 2.18$, $p = .04$, $d = 0.97$ (with further Bayesian analysis revealing a $BF_{10} = 1.90$, suggesting anecdotal evidence for the H_A); there was no statistically significant difference when presented with images of neutral people $t(20) = 1.74$, $p = .10$, $d = 0.77$ (with further Bayesian analysis revealing a $BF_{10} = 1.10$, suggesting anecdotal evidence for the H_A).

Figure 3.2.

Latencies for pro-saccade and anti-saccade.



Note. Latencies shown in milliseconds (ms). Error bars are 95% CI.

Correlations

Correlations were run for latencies (table 3.3 women, table 3.4 men) and accuracy (Table 3.4, table 3.6 men) with results from the questionnaire. For full results see Table 3.3. For women, hormonal contraceptives use was correlated was accuracy in the anti-saccade task with low valence images $r(48) = 0.47$, $p < .05$, and images of neutral objects, $r(48) = 0.44$, $p < .05$. Relationship duration was a stronger predictor of task performance, such that women in longer relationships showed a shorter latency during the pro-saccade when presented with images of couples, $r(48) = -0.46$, $p < .05$, and low valence images, $r(48) = -0.49$, $p < .05$; suggesting more interest in these images. Women in a relationship also showed more accuracy during the pro-saccade to images of women, $r(48) = 0.44$, $p < .05$, images of couples, $r(48) = 0.48$, $p < .05$, and low valence images, $r(48) = 0.42$, $p < .05$. In the anti-saccade, relationship duration was correlated with increased accuracy in man images, $r(48) = 0.42$, $p < .5$, couples, $r(48) = 0.41$, $p <.05$, and neutral objects, $r(48) = 0.48$, $p < .05$. This may indicate that women in relationships are less affected by the images possibly because of more sexual interaction with a partner.

For men, reported difficulties during sex were correlated with accuracy in the pro-saccade when presented with images of men, $r(21) = -0.75$, $p < .05$, as well as images of couples, $r(21) = -0.71$, $p <$,05. These negative correlations may be indicative of existing schemas being salient when presented with the task (specifically those images that represent themselves or the act of intercourse). Furthermore, men were negatively affected by the images of neutral people which included couples that were not engaging in sexual contact, $r(21) = 0.77$, $p < .01$.

Table 3.1

Women Latency

	Women_LAT_P	Men_LAT_P	Couple_LAT_P	LowVal_LAT_P	NeutP_LAT_P	NeutO_LAT_P	Women_LAT_A	Men_LAT_A	Couple_LAT_A	LowVal_LAT_A	NeutP_LAT_A	NeutO_LAT_A	Hconta	RelDur	Difficulty	AE	AP	AM	AN	Body Feels Aroused	Sexually Aroused	Engage in Sexual Activity
Women_LAT_P	—	0.687 ***	0.813 ***	0.901 ***	0.331	0.551 **	0.786 ***	0.544 **	0.118	0.754 ***	0.655 ***	0.097	-0.291	-0.389	0.030	0.087	0.119	0.137	0.146	0.159	0.057	-0.013
Men_LAT_P		—	0.696 ***	0.684 ***	0.351	0.463 *	0.638 ***	0.411 *	0.648 ***	0.658 ***	0.532 **	0.617 ***	-0.058	-0.372	-0.104	-0.067	-0.035	-0.051	0.080	0.094	-0.077	-0.089
Couple_LAT_P			—	0.743 ***	0.367	0.321	0.610 ***	0.421 *	0.119	0.973 ***	0.449 *	0.136	-0.296	-0.460 *	-0.124	-0.103	-0.072	-0.103	-0.008	-0.011	-0.087	-0.094
LowVal_LAT_P				—	0.372	0.747 ***	0.819 ***	0.462 *	0.098	0.643 ***	0.629 ***	0.174	-0.286	-0.492 *	0.094	0.071	0.049	0.041	0.248	0.178	-0.053	-0.092
NeutP_LAT_P					—	0.082	0.279	0.134	-0.033	0.341	0.256	0.201	0.038	-0.242	-0.141	-0.177	-0.136	-0.152	-0.102	-0.060	-0.145	-0.127
NeutO_LAT_P						—	0.668 ***	0.376	0.129	0.223	0.548 **	0.280	-0.026	-0.252	0.374	-0.021	-0.061	-0.065	0.322	0.084	-0.172	-0.162
Women_LAT_A							—	0.512 **	0.292	0.552 **	0.804 ***	0.338	-0.205	-0.210	0.233	0.125	0.165	0.137	0.278	0.191	0.070	0.074
Men_LAT_A								—	0.223	0.408 *	0.505 **	-0.005	-0.163	-0.080	0.008	0.332	0.453 *	0.330	0.063	0.454 *	0.416 *	0.455 *
Couple_LAT_A									—	0.142	0.244	0.845 ***	-0.113	0.097	-0.005	-0.006	0.088	0.022	0.002	0.134	0.096	0.098
LowVal_LAT_A										—	0.420 *	0.134	-0.366	-0.402	-0.037	-0.108	-0.038	-0.068	-0.059	-0.004	-0.038	-0.066
NeutP_LAT_A											—	0.286	-0.006	-0.163	0.266	0.298	0.365	0.376	0.409 *	0.423 *	0.297	0.201
NeutO_LAT_A												—	0.004	0.027	0.109	-0.232	-0.178	-0.223	0.046	-0.106	-0.230	-0.152
Hconta													—	0.092	-0.408 *	-0.110	-0.135	-0.132	-0.034	-0.109	-0.139	-0.055
RelDur														—	0.232	-0.019	0.031	-0.044	-0.100	-0.171	-0.030	0.123
Difficulty															—	0.014	0.036	0.083	0.300	0.095	0.032	-0.141
AE																—	0.933 ***	0.915 ***	0.515 **	0.864 ***	0.737 ***	0.822 ***
AP																	—	0.929 ***	0.501 **	0.888 ***	0.777 ***	0.863 ***
AM																		—	0.531 **	0.843 ***	0.803 ***	0.743 ***
AN																			—	0.454 *	0.116	0.358
Body Feels Aroused																				—	0.817 ***	0.687 ***
Sexually Aroused																					—	0.674 ***
Engage in Sexual Activity																						—

* p < .05, ** p < .01, *** p < .001

Table 3.2

Women accuracy

	Women_ACC_P	Man_ACC_P	Couple_ACC_P	LowVal_ACC_P	NeutP_ACC_P	NeutO_ACC_P	Women_ACC_A	Man_ACC_A	Couple_ACC_A	LowVal_ACC_A	NeutP_ACC_A	NeutO_ACC_A	Hconta	RelDur	Difficulty	AE	AP	AM	AN	Body Feels Aroused	Sexually Aroused	Engage in Sexual Activity
Women_ACC_P	—	0.808 ***	0.839 ***	0.835 ***	0.845 ***	0.765 ***	0.435 *	0.581 **	0.639 ***	0.860 ***	0.529 **	0.731 ***	0.362	0.441 *	-0.073	0.079	0.058	0.190	0.022	-0.030	0.146	0.045
Man_ACC_P		—	0.977 ***	0.975 ***	0.949 ***	0.948 ***	0.742 ***	0.815 ***	0.850 ***	0.863 ***	0.809 ***	0.734 ***	0.282	0.412	-0.362	-0.067	-0.098	0.008	-0.201	-0.259	0.002	0.004
Couple_ACC_P			—	0.981 ***	0.962 ***	0.951 ***	0.727 ***	0.835 ***	0.846 ***	0.873 ***	0.824 ***	0.796 ***	0.296	0.480 *	-0.340	0.007	-0.043	0.063	-0.145	-0.222	0.040	0.074
LowVal_ACC_P				—	0.960 ***	0.967 ***	0.719 ***	0.812 ***	0.785 ***	0.890 ***	0.797 ***	0.789 ***	0.361	0.419 *	-0.354	0.042	-0.014	0.096	-0.125	-0.173	0.063	0.077
NeutP_ACC_P					—	0.950 ***	0.636 ***	0.827 ***	0.822 ***	0.879 ***	0.737 ***	0.752 ***	0.278	0.350	-0.281	0.115	0.067	0.219	-0.049	-0.080	0.156	0.099
NeutO_ACC_P						—	0.700 ***	0.808 ***	0.764 ***	0.850 ***	0.773 ***	0.706 ***	0.274	0.324	-0.399 *	0.079	0.003	0.138	-0.170	-0.132	0.124	0.067
Women_ACC_A							—	0.600 ***	0.675 ***	0.637 ***	0.808 ***	0.705 ***	0.265	0.335	-0.336	-0.353	-0.433 *	-0.357	-0.152	-0.547 **	-0.421 *	-0.311
Man_ACC_A								—	0.842 ***	0.690 ***	0.707 ***	0.573 **	0.174	0.416 *	-0.359	0.072	0.034	0.167	-0.099	-0.164	0.115	0.151
Couple_ACC_A									—	0.734 ***	0.785 ***	0.615 ***	0.106	0.415 *	-0.322	-0.096	-0.152	-0.048	-0.151	-0.312	-0.096	-0.081
LowVal_ACC_A										—	0.671 ***	0.725 ***	0.427 *	0.337	-0.193	0.003	-0.117	0.043	0.071	-0.169	-0.035	-0.073
NeutP_ACC_A											—	0.695 ***	0.153	0.319	-0.402 *	-0.199	-0.281	-0.202	-0.189	-0.473 *	-0.219	-0.095
NeutO_ACC_A												—	0.441 *	0.476 *	-0.129	0.022	-0.072	0.037	0.067	-0.237	-0.081	-0.024
Hconta													—	0.092	-0.408 *	-0.110	-0.135	-0.132	-0.034	-0.109	-0.139	-0.055
RelDur														—	0.232	-0.019	0.031	-0.044	-0.100	-0.171	-0.030	0.123
Difficulty															—	0.014	0.036	0.083	0.300	0.095	0.032	-0.141
AE																—	0.933 ***	0.915 ***	0.515 **	0.864 ***	0.737 ***	0.822 ***
AP																	—	0.929 ***	0.501 **	0.888 ***	0.777 ***	0.863 ***
AM																		—	0.531 **	0.843 ***	0.803 ***	0.743 ***
AN																			—	0.454 *	0.116	0.358
Body Feels Aroused																				—	0.817 ***	0.687 ***
Sexually Aroused																					—	0.674 ***
Engage in Sexual Activity																						—

* p < .05, ** p < .01, *** p < .001

Table 3.3

Men Latency

	Women_LAT_P	Man_LAT_P	Couple_LAT_P	LowVal_LAT_P	NeutP_LAT_P	NeutO_LAT_P	Women_LAT_A	Man_LAT_A	Couple_LAT_A	LowVal_LAT_A	NeutP_LAT_A	NeutO_LAT_A	RelDur	Difficulty	AE	AP	AM	AN	Body Feels Aroused	Sexually Aroused	Engage in Sexual Activity
Women_LAT_P	—	0.531	0.683 *	0.632 *	0.745 *	0.598	0.608	0.659 *	0.612	0.534	0.560	0.425	-0.090	-0.609	-0.339	-0.347	-0.347	-0.073	-0.343	-0.352	-0.367
Man_LAT_P		—	0.966 ***	0.868 **	0.877 ***	0.871 **	0.947 ***	0.947 ***	0.892 ***	0.900 ***	0.858 **	0.771 **	-0.294	-0.320	-0.030	-0.049	-0.074	-0.122	-0.020	-0.059	-0.123
Couple_LAT_P			—	0.930 ***	0.939 ***	0.912 ***	0.977 ***	0.963 ***	0.936 ***	0.896 ***	0.893 ***	0.730 *	-0.369	-0.378	-0.068	-0.086	-0.112	-0.043	-0.085	-0.131	-0.185
LowVal_LAT_P				—	0.968 ***	0.976 ***	0.941 ***	0.904 ***	0.987 ***	0.917 ***	0.974 ***	0.477	-0.427	-0.474	-0.215	-0.229	-0.254	0.106	-0.270	-0.326	-0.357
NeutP_LAT_P					—	0.962 ***	0.909 ***	0.939 ***	0.970 ***	0.904 ***	0.944 ***	0.565	-0.351	-0.496	-0.278	-0.290	-0.298	-0.031	-0.284	-0.302	-0.327
NeutO_LAT_P						—	0.921 ***	0.911 ***	0.973 ***	0.958 ***	0.995 ***	0.468	-0.343	-0.452	-0.290	-0.307	-0.340	0.054	-0.305	-0.342	-0.412
Women_LAT_A							—	0.925 ***	0.937 ***	0.920 ***	0.909 ***	0.624	-0.413	-0.422	-0.056	-0.070	-0.108	0.118	-0.121	-0.208	-0.251
Man_LAT_A								—	0.944 ***	0.923 ***	0.884 ***	0.763 *	-0.311	-0.437	-0.253	-0.267	-0.271	-0.082	-0.251	-0.255	-0.283
Couple_LAT_A									—	0.942 ***	0.963 ***	0.560	-0.452	-0.491	-0.242	-0.254	-0.266	0.099	-0.312	-0.343	-0.352
LowVal_LAT_A										—	0.949 ***	0.534	-0.324	-0.546	-0.299	-0.316	-0.347	0.122	-0.373	-0.406	-0.464
NeutP_LAT_A											—	0.423	-0.316	-0.438	-0.287	-0.308	-0.348	0.043	-0.297	-0.340	-0.429
NeutO_LAT_A												—	-0.413	-0.042	0.157	0.143	0.167	-0.313	0.180	0.240	0.236
RelDur													—	0.147	-0.643	-0.639	-0.677	-0.766 *	-0.103	-0.100	-0.391
Difficulty														—	0.556	0.551	0.540	-0.420	0.808 **	0.840 **	0.753 *
AE															—	0.998 ***	0.982 ***	0.102	0.854 **	0.812 **	0.831 **
AP																—	0.990 ***	0.131	0.846 **	0.800 **	0.842 **
AM																	—	0.129	0.822 **	0.794 **	0.880 ***
AN																		—	-0.351	-0.456	-0.269
Body Feels Aroused																			—	0.968 ***	0.895 ***
Sexually Aroused																				—	0.926 ***
Engage in Sexual Activity																					—

* p < .05, ** p < .01, *** p < .001

Table 3.4

Men Accuracy

	Women_ACC_P	Man_ACC_P	Couple_ACC_P	LowVal_ACC_P	NeutP_ACC_P	NeutO_ACC_P	Women_ACC_A	Man_ACC_A	Couple_ACC_A	LowVal_ACC_A	NeutP_ACC_A	NeutO_ACC_A	RelDur	Difficulty	AE	AP	AM	AN	Body Feels Aroused	Sexually Aroused	Engage in Sexual Activity
Women_ACC_P	—	-0.197	0.326	0.474	0.390	0.479	-0.036	-0.192	0.495	0.234	0.082	0.474	0.127	-0.147	-0.339	-0.376	-0.372	-0.316	-0.337	-0.160	-0.290
Man_ACC_P		—	-0.615	0.263	-0.663 *	-0.164	-0.100	-0.268	-0.469	-0.067	-0.416	-0.158	-0.158	-0.752 *	-0.259	-0.250	-0.224	0.199	-0.432	-0.440	-0.345
Couple_ACC_P			—	0.012	0.075	0.126	-0.594	0.207	0.390	-0.207	0.420	0.192	-0.091	-0.714 *	-0.086	-0.103	-0.162	0.120	-0.068	-0.138	-0.247
LowVal_ACC_P				—	-0.170	-0.137	-0.275	0.154	0.359	-0.043	0.227	-0.025	-0.399	-0.298	-0.138	-0.164	-0.203	0.106	-0.266	-0.186	-0.316
NeutP_ACC_P					—	0.561	0.311	0.274	0.124	0.388	-0.127	0.194	0.378	0.773 **	0.273	0.243	0.241	-0.658 *	0.516	0.650 *	0.496
NeutO_ACC_P						—	-0.156	0.087	-0.055	0.593	-0.525	0.582	-0.206	0.157	0.085	0.068	0.127	-0.404	0.113	0.251	0.286
Women_ACC_A							—	-0.319	0.177	0.235	0.048	-0.037	0.428	0.326	0.024	0.043	0.108	-0.318	0.168	0.263	0.346
Man_ACC_A								—	-0.168	-0.087	0.107	-0.347	-0.123	0.531	0.466	0.446	0.389	-0.415	0.713 *	0.657 *	0.489
Couple_ACC_A									—	0.301	0.386	0.285	-0.180	0.048	-0.269	-0.266	-0.253	0.119	-0.281	-0.224	-0.207
LowVal_ACC_A										—	-0.434	0.135	-0.393	0.111	0.214	0.210	0.273	-0.116	0.119	0.200	0.317
NeutP_ACC_A											—	-0.269	-0.148	0.156	0.284	0.284	0.233	0.279	0.196	0.143	0.079
NeutO_ACC_A												—	-0.141	-0.053	-0.422	-0.406	-0.318	-0.039	-0.427	-0.266	-0.126
RelDur													—	0.147	-0.643	-0.639	-0.677	-0.766 *	-0.103	-0.100	-0.391
Difficulty														—	0.556	0.551	0.540	-0.420	0.808 **	0.840 **	0.753 *
AE															—	0.998 ***	0.982 ***	0.102	0.854 **	0.812 **	0.831 **
AP																—	0.990 ***	0.131	0.846 **	0.800 **	0.842 **
AM																	—	0.129	0.822 **	0.794 **	0.880 ***
AN																		—	-0.351	-0.456	-0.269
Body Feels Aroused																			—	0.968 ***	0.895 ***
Sexually Aroused																				—	0.926 ***
Engage in Sexual Activity																					—

* p < .05, ** p < .01, *** p < .001

Discussion

The aim of the current study was to use a cognitive test which incorporates both automatic and controlled attentional processes in order to elucidate the influence of desire (as well as subjective arousal). It was hypothesized that participants in the porn primed groups, having experience higher levels of arousal before beginning the task, would show higher error rates as well as increased latency when exposed to sexual stimuli. While the hypothesis was mostly supported, there were important differences in the findings between the two sexes. Specifically, while men and women showed an effect of priming, the results were opposite. Similar to Geer and Melton's (1997) study, men that were primed with the pornographic movie showed decreased latency times at which they performed the task, whereas women showed an increase in reaction times. It is important to note that this was only observed in the women that reported being aroused by the pornographic movie. The women primed with the movie, but whom reported not being aroused reacted similarly to the women in the neutral movie priming. Although researchers had not intended to have a group that had been primed with pornography and was not aroused, this serendipitous finding further allowed us to infer that for women, the images themselves were not the cause of the SCID, but rather, it is their arousal state that is more crucial. Women in the porn-unaroused group were consistently faster than the other groups (~30ms). This may be indicative that the women in the porn-unaroused group were not sufficiently affected by visual sexual stimuli, although further research is required to investigate this claim. The images were on the screen for a short duration (500ms), and as such, likely were not the source of arousal for women. Again, the fact that the women that were primed with the pornography but did not report being aroused behaved similarly to the neutral group would suggest that it is the subjective rating of arousal that is contributing to the SCID. As previously mentioned, Conaglen (2004) found that it was participants who rated the lowest in sexual desire which showed the greatest level of SCID. In this study, women showed the opposite effect. The greatest amount of SCID was evident in women who had watched the pornographic film and reported feeling aroused. Men in the pornography primed group were consistently faster than those in the neutral primed group. Although this seems counterintuitive, it might be due to either a ceiling effect of arousal, or possibly an attempt to control or decrease the arousal that was felt in response to the movie in the laboratory setting. The feedback from the physiological arousal while the participant remained fully clothed may in fact have contributed to either a distraction for men (hence not paying as close attention to the images on the screen). However, it is more likely that there been an inclination to complete the task faster, and thereby avoid further physiological arousal. This was, to a certain extent, similar to the findings of Geer and Melton's (1997) study using erotic sentences in which men responded much faster to sexual content in the reading task.

The different types of image category were an important factor in error rates for men. There were few differences in accuracy rates between the porn and neutral group suggesting that accuracy was dependent upon image type rather than the effect of priming. Specifically, men made less errors in the pro-saccade when the images were of women or couples. Men made the most errors in the anti-saccade task when presented with images of women. This could be due to the men having difficulty disengaging attention from the images of women. This finding can also be interpreted as there was an arousal response to the specific picture, particularly for those images of preferred sexual stimuli (i.e., opposite sex stimulus images). Interestingly, the women showed no specific pattern of error based on the category of image. This is interesting because prior research has shown that women report being aroused by both their preferred and non-preferred sexual stimuli (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers et al., 2010).

Applying these results to the information processing model, it is important to note that there may be demonstrated sex differences in this system at the most basic cognitive levels. Researchers have previously shown that SCID occurs at an early stage of processing (Everaerd, 1995; Geer & Bellard, 1996; Geer & Melton, 1997; Janssen & Everaerd, 1993; Janssen et al., 2000; Laan & Everaerd, 1995; Massaro & Cowan, 1993), the findings in the current study suggest that this is not the case for women. SCID has only been evident in women while using lexical tasks which are not directly comparable to image tasks. The similarities in women in the porn-unaroused group and the neutral group suggest that it may be the higher processing that is involved in feeling subjectively aroused that may be causing the SCID. This higher cognitive processing might explain findings of previous research which highlight the discordance between objective ratings of sexual arousal, and subjective rating, specifically in women. Although these ratings are closely tied together for men, this has been demonstrated to not be the case for women (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers et al., 2010).

Instead, women's subjective arousal appears to be less dependent on the response to physiological arousal, and instead more a psychological interpretation which comes about after a higher processing of emotions. This is likely why women in the two porn primed groups behaved so differently. Those who reported subjective arousal, showed evidence of SCID with both decreased reaction times as well as higher error rates. Furthermore, while it is often preferred to directly compare the results of men and women, it is interesting to note that even when aroused, women showed different results than men. While men showed a reactionary pattern to specific images, women were less reactive to the images but rather to their own overall arousal state. While it has been well documented that women prefer a more varied array of visual stimuli, it is interesting to note that the same patterns were also evident in the neutral images.

While we assume that men were reacting to the specific images based on the arousal that was triggered, it is not possible to know this for sure without having measured post-test levels of arousal. Although the SADI was completed by participants after viewing the movie, there was not a follow up after the task. This makes it difficult to know the effect of the task itself on arousal. Also, while the images used were from a validated data set (rated on arousal and valence; Shilhan et al., submitted), the images were not validated by the participants and as such, there may be individual differences that affected the reactions to the photos.

Chapter 4: Visibility of Sexual Features Influences Eye Movements

Visibility of Sexual Features Influences Eye Movements

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Abstract

Previous researchers have shown that the initial fixation is to the face when viewing clothed individuals. However, viewing the same image without clothing (i.e., nude) introduces potentially more salient regions of interest, as the visual system is biased towards sexual stimuli. Further, it is unclear whether this bias of attention toward sexual features is gender specific. To investigate these questions, heterosexual participants were shown images of the same men and women, presented with and without clothing. Eye tracking was used to assess saccades and fixation duration within three standardized regions of interest (face, chest, pelvic). In addition, we investigated the pattern of the scan path from one region of interest to the next, to see if the order of viewing the regions differed between individuals. Men dwelled longer on the chest and pelvic region when viewing images of women, irrespective of whether the image was clothed or nude. Men's initial fixations were to the image's face for both clothed and nude images, with a shorter fixation duration on the face of the nude women, thus moving eyes faster to the chest region in nude images. Women showed an initial fixation to the face only when it was a clothed image. However, when a nude image was presented, the initial fixation was on the pelvic area of the images of men and the chest of the women. Women observers also looked at sexual regions (i.e., chest and pelvic area) of nude men and women equally. Men and women also differed in their scan path. When viewing clothed images of either gender, women observers scanned all regions of interest, however men limited their gaze to face and chest. When viewing nude images of either gender, women showed minimal attention to facial features, whereas men often returned to the face. Together, our findings suggest that in comparison to man observers, the bias for sexual imagery is more evident and fluid in women.

***Keywords*: Sexual imagery, Arousal, Eye tracking, Cognition**

Introduction

Although there does not seem to be a significant difference between men and women's interest in visual sexual stimuli (reviewed in Rupp & Wallen, 2009), sex differences arise in terms of the preferred content (e.g., camera angles, direction of gaze, intercourse versus oral sex; Rupp & Wallen, 2009, Shilhan et al., submitted) as well as the response it elicits. Physiological (objective), and subjective arousal in men seem to be concordant, and specific to their self-reported preferred sexual stimulus (i.e., in heterosexual men, images of women; Chivers, 2005; Chivers & Bailey, 2005; Chivers, Rieger, Latty, & Bailey, 2004; Chivers, Seto, & Blanchard, 2007; Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010), such that when men report "feeling" sexually aroused, the physiological response of an erection is usually present. Women show physiological arousal to both their preferred and non-preferred stimuli (i.e., images of men and women); however, show a discordance between their subjective and objective sexual arousal states such that they may shows signs of physical arousal (i.e., vaginal engorgement, lubrication) without the subjective feeling of arousal (Chivers & Bailey, 2005). While this concordance versus discordance has been well documented, it is unclear what happens at the cognitive level to possibly account for these sex differences.

Researchers who use the Information Processing Model (IPM; Geer & Bellard, 1996; Geer & Melton, 1997, Williams, Matthews & MacLeod, 1996) ascertain that attention to sexual stimuli is a two-part process; primarily, information is attend to in an automatic, bottom up manner, with little processing required. Following this initial state, attention is further engaged, allowing the processing to be weighed against existing sexual schemas, in a top-down process (Geer & Bellard, 1996; Geer & Melton, 1997, Williams, Matthews & MacLeod, 1996). It is at this higher processing that subjective sexual arousal is evaluated and may initiate physiological arousal. This understanding of a cognitive bias towards sexually salient stimuli has further developed a scientific interest in eye movements as an objective measure of sexual interest. Eye movement scan path analysis may give researchers an insight into the relation between arousal, interest and attention.

The acuity of the human visual system is at its highest at the fovea, requiring the individual to perform saccades from one region of interest to another to collect information, as well as fixating on a region in order to further process the information (Henderson 2003; Henderson & Hollingworth, 1999). Given this necessity to pause for information retrieval, viewing time is greater for material that is interesting and motivating (Kolers, 1976). By extension, when viewing sexual stimuli, interest can be determined by fixation duration as well as number of fixations. The bottom up processing when viewing sexual stimuli would entail initial fixation to be on the most salient sexual region before the top down processing affected by social stigma, emotion or memory can affect the eye movements. In more intimate settings, or when viewing erotic stimuli, a nude body may convey signals of sexual receptivity, arousal, interest and (according to evolutionary psychologists) traits indicative of mate viability (Buss, 1989) such as breast size and waist to hip (WTH) ratios (Dixson, Grimshaw, Linklater & Dixon, 2011 a,b; Garza, Heredia, Cieslicka, 2016). In contrast to non-erotic images, both men and women attended to the body in erotic images and more to the face and scenery in the non-erotic images (as measured with more frequent fixations and longer dwell times; Lykins, Meana,& Kambe, 2006). The duration and location of first fixations has been also been used as a measure of interest in men (Hall, Hogue & Guo, 2011; Fromberger et al., 2012) with initial fixations landing more frequently on the preferred stimulus (i.e. adult women) when presented simultaneously with a non-preferred stimulus (i.e. children, men). Interestingly, women did not show a preference specific response (Hall, Hogue & Guo, 2011). This would suggest that women's gaze may not be initially directed towards an arousing stimulus.

Although the aforementioned studies have demonstrated that eye movement patterns give us an indication of sexual preference and interest, they did not investigate how attention and subsequent eye movements change when viewing either clothed or nude images. To investigate this, a recent study by Nummenmaa and colleagues (2012) tracked eye movements when participants looked at clothed and nude images of same and opposite sex individuals. Men rated images of women as higher in arousal and valence compared to images of men; however, women participants did not rate the images. Eye movement patterns were quantified for fixation duration (dwell time) on face, chest, and pelvic regions of interest (ROI). When viewing clothed images, participants' (men and women) initial attention was directed towards the face in the image; however, when viewing an image containing a nude model, the attention was drawn towards the image's body, as shown by longer fixations in the chest and pelvic region. This seems very intuitive given that if a nude body is available for judging arousal cues, the face may become less salient. Overall, for men, fixation duration was longer on the body region of nude women compared to the body of the nude man. Women did not show a difference in fixation duration on nude bodies of either sex. Women did, however, dwell longer on the face ROI of men (clothed and nude) than images of women, and dwelled less on face ROI of nude images. Men showed more specificity, with longer fixation duration on the faces of nude men compared to clothed men (possibly as a means to distract from exposed pelvic region), and longer on the face of clothed women compared to images of nude women. Researchers found interesting results at the pelvic ROI, such that men dwelled equally long at the pelvic region of nude men and women as well as clothed images. Women dwelled longer at the nude pelvic ROI of men, and showed no significant difference in dwell time of clothed images (man or woman). The findings of this study were the first to show that there are differentiating patterns of eye movement based on participant sex as well as image content (sex of the model in the image). However, one critical limitation of the study was that the images that were used were not of the same nude/clothed person, but of different people in various poses. Thus, it is difficult to contrast the eye movements between two individuals that have different poses; for example, an image of a slim man dressed in a suit compared to a nude, muscular man in a suggestive pose. Also, while fixation durations offer a great deal of information on attention (longer dwell times being indication of sustained attention), time to initial fixation within the ROIs may offer information on the early processing part of the IPM (Geer & Bellard, 1996; Geer & Melton, 1997, Williams, Matthews & MacLeod, 1996) which is reflexive and automatic.

The aim of this study is to use eye tracking methodology with sexual imagery to assess eye movement patterns while looking at sexual stimuli specifically, looking at nude and clothed images of the same people. This study uses similar methodology to the Nummenmaa and colleagues (2012) study, but uses images that contained the same individual model in the same pose – fully clothed and nude. By holding the model in the image constant, it is possible to analyze how the pattern of eye movements vary when viewing models fully clothed and nude, and across both sexes of models. We hypothesize that men and women show an initial fixation and will dwell longer on faces of clothed images, however, when the images are nude, men will show a preference specificity with first fixations and longer dwell times on the sexual ROIs of women models. Women will likely not show preference specificity, however, we anticipated initial fixations and longer dwell times on sexual ROIs of both sexes.

Method

Participants

A total of 115 undergraduate participants (85 women, 30 men) from Concordia University, Montreal, QC., Canada participated in this study. The age of participants ranged from 18 to 43 (Median = 22). All of the participants gave informed consent, and received either cash compensation (10$), or a participation credit for the Psychology Participant Pool. For the basis of the current thesis, only participants that were self-identified as exclusively heterosexual using the Kinsey Scale (Kinsey, Pomeroy, & Martin, 1948) were used in the study. Consequently, only the data from 80 participants (60 women, 20 men) were retained for data analysis.

Measures and Procedure

All stimuli were presented on a 21" Viewsonic G225fb Cathode Ray Tube screen (Screen resolution of 1024 x 768 pixels, 100Hz refresh rate) with a 3.2GHz Dual-Core computer running Microsoft Windows 7. Eye movements were recorded using an S2 Eye tracker (Mirametrix, Montreal) running on the same computer. The S2 eye tracker is an infra-red based video eye tracker, that is remotely located below the presentation screen. The sampling rate of the eye tracker was 60Hz, with the average spatial accuracy less than .5°, with a .03° resolution (note: these values do not reflect the manufacturers specifications from their website, but more conservative values as measured within the Concordia Vision Labs using an artificial pupil; see Ringer et al., 2014 for details). All aspects of the experiment (i.e., image presentation, eye tracking, data analysis) were conducted in parallel using the OpenGazeAndMouseAnalyzer (OGAMA) open-source software ver. 4.3 (Voßkühler, Nordmeier, Kuchinke, & Jacobs, 2008).

The stimuli were 66 digital photographs picturing frontal poses of nude and clothed individuals, which were obtained with permission from The Nude People (2013) database. The database was part of an art project created to provide images of real-to-life people with and without clothing. The images represented a mix of women (22) and men (11), over a wide age range and body types. In all images, the direction of gaze of the individual in the photograph was forward facing (i.e., looking directly at the participant). Clothed stimuli wore a variety of clothing – at least a shirt and pants or a skirt. About 15% of the clothed stimuli had logos or emblems on their clothing. Nude stimuli clearly showed the chest and genitals of the individual. Some of the image contained individuals with tattoos (4) or body piercings (2). Images from the Nude People database were chosen for two reasons. Firstly, each clothed image had a nude counterpart in the same pose. As such, analysis of how eye movements change in the presence and absence of clothing can be assessed. Secondly, compared to the previous research

(Nummenmaa et al., 2012), the images contained a wide range of body types reflecting everyday individuals. Each image was 11 x 24° of visual angle at a viewing distance of 70cm. Based on the midpoint of the image; each image was presented 10° to the left or right of fixation, with the left/right presentation being randomized across images. This was done to avoid anticipatory eye movements to a fixed location, and to address which stimulus regions receive the first fixation.

To accurately record the eye-movement data, a 9-point calibration was performed during which participants looked at 9 different fixation points on the computer screen. The calibration was accepted if the average error was equal or less than .5°, and that the maximum error was less than 1°. Each trial began with a fixation circle (1° in diameter black outer circle, .7° diameter white inner circle), which the participant was instructed to fixate to initiate the trial. Once the participant had fixated the target, they were instructed to press spacebar to initiate the trial, after which the stimulus picture appeared on the left or right hand side of the screen for 5 s. After the 5 s, a blank white screen appeared for 1000 ms, before starting the next trial. Figure 1 contained an image depicting the stimulus presentation sequence. Each participant completed 66 trials, with each stimulus being presented once in random order.

Concordia University Sexual History Questionnaire. Participants were first asked to complete an array of questions with regards to participant's sexual history, intercourse, intimacy, arousal, and sexual orientation. The responses to most questions were given via multiple response options. For the basis of the current thesis, only the data from participants that strongly identified themselves as being heterosexual (i.e., 0 or 1) were included in the analysis. The experimenter used verbal instruction to explain the details of the experiment to the participants. Participants were informed that the study was investigating eye movements while viewing pictures of clothed and nude humans. They were informed that on each trial they were going to see an image of either a clothed or nude man or women, and that they had to look at the images when the images appeared as if they were looking at a magazine or TV screen. Participants were also encouraged to ask questions before and after the experiment, and were told that if at any time they felt uncomfortable they should gesture to or verbally tell the experimenter.

Arousal and valence ratings. After the final trial, the participants were asked to view each image with the Likert type Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The participants used SAM to rate each image on valence (from 0 = unpleasant, to 6 = pleasant) and then again on arousal (from 0 = not arousing, to 6 = very arousing).

Eye movement analysis. The eye tracking data collected by the OGAMA software were analyzed using two different methods. The first approach was to create a fixation heat map (Wooding, 2002). Briefly, the locations of each eye movement fixation were identified by the Ogama software, excluding the first fixation location (which is associated with the location of the fixation target at the start of the trial). Fixation here was defined as a pause in eye movements within a region of 0.25° for a minimum of 200ms. Because stimuli images were presented on both the left and right hand side of fixation, the position of the fixations were transformed into a common Cartesian xy-coordinate, thereby allowing for the direct comparison between images. Next, participant-wise fixation heat maps were generated by convolving each fixation position with a Gaussian function, with the location of the Gaussian based on the xy-coordinate of the fixation, and the variance (i.e., sigma) being set to 1°. Finally, each fixation map (see Image 4.1) created while the participant viewed a nude image was subtracted from the counterpart fixation map created from the clothed image.

To analyze how the eye movements between clothed and nude images changed as a function of different body region, a region-of-interest (ROI) analysis was performed. Each of the ROIs were drawn around the face, chest, and pelvic-genital regions of the stimulus. Each of the ROIs subtended the same screen area (5.28%). We analyzed separately the data for fixation events that occurred within or towards each of the ROIs. The following eye movement statistics were calculated: 1) the *latency to first fixation*, that is, the time for a first fixation to land in the ROI. 2) *number of fixations* that occurred within the ROI. 3) *total dwell time* (or gaze duration) within the ROI.

Results

Data Analysis. A G power analysis test was run a priori to establish the sample size. A within, between ANOVA with 2 groups and 4 measurements requires a total sample size of 36. Given that eye tracking latency results often violate rules for using standard *t*-tests (i.e. skewness, kurtosis, non-normal distribution, importance of including outliers) it was decided to use a Bayesian analysis in addition to regular t-tests for post hoc latency analysis (JASP Team (2016). JASP (Version 0.8.0.0); Kruschke, 2013; Wetzels et al., 2011) is used in similar

Image 4.1.

Note. Heat map based on results for women. Red indicates longer dwell time.

Note. Heat map based on results for men. Red indicates longer dwell time.

circumstances as a *t*-test, however is not affected by outliers. Wetzels and colleagues (2011) have used a meta-analysis in order to exemplify the extra information offered by Bayesian analysis. Specifically, the Bayesian factor (BF_{10}) gives information on which hypothesis (H_o= null hypothesis, H_A= alternate hypothesis) is better supported while still maintaining "prudence" without overestimating the magnitude of the effect (BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, $BF_{10} > 3$ evidence for H_A; Wetzels et al., 2011). A robustness check and sequential analysis were carried out to ensure a sufficient sample size. For male participants, a Cauchy width prior of 0.70 (default used in JASP; Rouder et al. 2009) was sufficient to show a robustness of BF_{10} = 5.183. A sequential analysis was run, revealing that with approximately 15 participants, the data would reveal consistent results. Similarly, for female participants, a Cauchy width prior of 0.70 was sufficient to show a robustness of BF_{10} = 10.249. A sequential analysis was run, revealing that with approximately 30 participants, the data would reveal consistent results.

Results

Arousal and valence ratings. Although the images were not meant to be arousing to the participants, it was important that they be pleasant as to not introduce any aversion response. Ratings for clothed versus nude images were compared using an independent samples *t*-test. Women rated images of clothed women as less arousing (M = 1.61, SD = 1.47) than images of nude women (M = 1.90, SD = 1.47), $t(60)$ = 3.19, p = .001, d = 0.004. It is important to note that although there is a significant difference, the effect size is quite small. There was no difference in valence ratings for nude versus clothed women with valence ratings being quite high for images of the clothed women (M = 4.12, SD = 2.09) as well as the images of nude women (M = 4.16, SD = 2.19), $t(60)$ = -0.27, p = .78, d = - 0.07. There were no statistically significant differences in women's arousal rating of clothed (M = 1.00, SD = 0.001) versus nude images of men (M = 1.00, SD = 0.001), $t(60)$ = -0.924, p = .36, d = -0.24. Valence ratings, again, were much higher than arousal, however there was no statistically significant difference between images of clothed men (M = 3.62, SD = 2.01) and nude men (M = 3.26, SD = 2.27), $t(60)$ = 1.565, p = .12, d = 0.41. Men reported similar ratings, with no statistically significant differences between arousal ratings for images of clothed men (M = 1.00, SD = 0.001) compared to nude men (M = 1.00, SD = 0.001), $t(18)$ = -0.66, p = .51, d = -0.32. Valence ratings were higher than arousal ratings. Clothed images of men were rated as more pleasant (M = 3.87, SD = 1.39) than nude men (M =

2.15, *SD* = 1.39), $t(18) = 5.55$, $p < .001$, $d = 2.69$. Men rated images of clothed women as less arousing (*M* = 3.11, *SD* = 2.10) than nude women (*M* = 4.75, *SD* = 2.46), $t(18) = -5.264$, $p < .001$, $d = 0.7$. There were no statistically significant differences in valence ratings for images of clothed women (*M* = 5.41, *SD* = 1.40) and nude women (*M* = 5.32, *SD* = 2.03), $t(18) = 0.38$, $p = .71$, $d = 0.18$. Taken together, these results indicate that the images were considered pleasant, without being arousing.

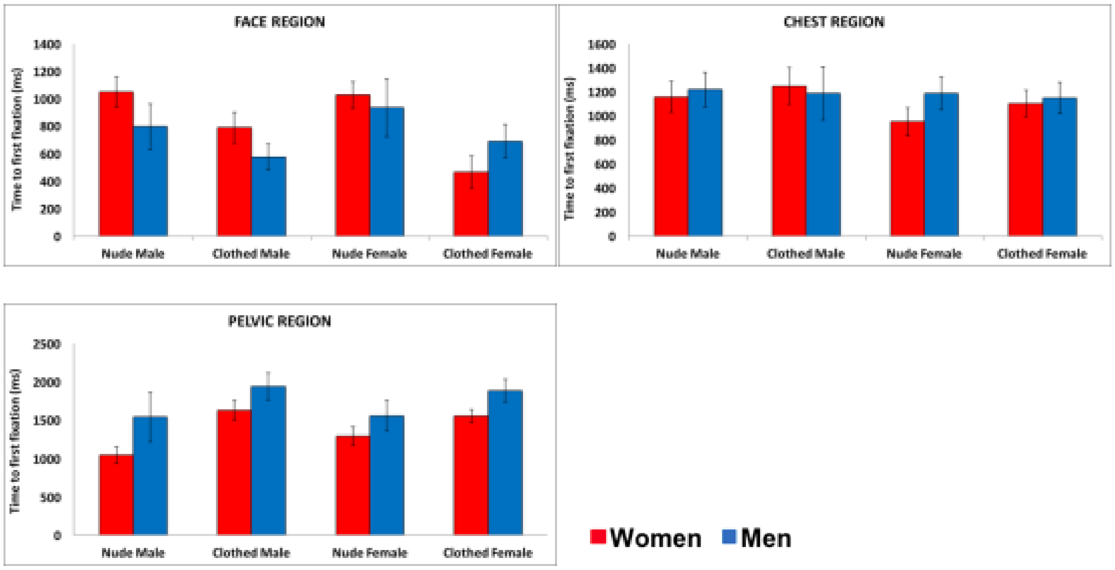
Latency to first fixation (Figure 4.1)

For full Bayesian *t*-tests (independent and paired samples) see supplemental material (Appendix 1).

Face ROI. First fixation is indicative of automatic attentional processes. When looking at the effect of image category (man/women), clothing (clothed/nude), sex (participant sex) on latency to 1st fixation in the face ROI, there was a main effect of clothing, $F(1,306) = 14.86$, $p < .001$, $\eta^2 = .16$, with post hoc analyses revealing that irrespective of image category, participants had a shorter latency to first fixation on the face ROI of the clothed images (*M* = 795.73, *SD* = 427.63) than the nude images (*M* = 1001.14, *SD* = 425.52), $t(319) = -4.31$, $p < .001$, $d = 0.48$, likely due to the limited information that is derived from a clothed body. There was a main effect of participant sex, $F(1,306) = 5.53$, $p = .02$, $\eta^2 = .02$, with men showing a shorter latency to face ROIs (*M* = 789.63, *SD* = 420.82) compared to women (*M* = 935.59, *SD* = 438.59), $t(319) = 2.62$, $p = .009$, $d = 0.34$. Repeated measures *t*-tests were run to elucidate the specific sex differences between participants, with no statistically significant difference for latency to first fixation on face ROI when viewing clothed women $t(78) = 1.095$, $p = .28$, $d = 0.24$ (with a Bayesian analysis further revealing a $BF_{10} = 0.43$, suggesting no evidence of an effect), nor when viewing images of nude women $t(78) = 0.11$, $p = .91$, $d = 0.03$ (with a Bayesian analysis further revealing a $BF_{10} = 0.26$, suggesting no evidence of an effect), or clothed men $t(78) = 1.69$, $p = .09$, $d = 0.44$ (with a Bayesian analysis further revealing a $BF_{10} = 0.87$, suggesting no evidence of an effect). There was, however, a statistically significant difference when viewing nude men such that women showed a longer latency to first fixation in the face ROI (*M* = 1049.3, *SD* = 431.3) compared to men (*M* = 767.5, *SD* = 386.6), $t(78) = 2.59$, $p = .01$, $d = 0.67$ (with a Bayesian analysis further revealing a $BF_{10} = 4.21$, suggesting substantial evidence for the H_A).

Figure 4.1.

First Fixations



Note. First fixation as a measure of reflexive automatic attention to Face, Chest, and Pelvic ROI.

Paired samples *t*-tests were run for within subject differences in latency to first fixation in the face ROI. Women (Table 4.2) looking at images of women, showed a shorter first fixation to the face ROI when looking at images of clothed women (M = 877.58, SD = 465.93) compared to nude women (M = 1026.44, SD = 377.83), $t(59) = -3.10$, $p = .003$, $d = -0.41$ (with a Bayesian analysis further revealing a BF_{10}= 10.25, suggesting evidence strong evidence for the H_A). Similarly, there was a shorter first fixation to the face ROI of clothed men (M = 789.05ms, SD = 431.96) compared to when looking at images of nude men (M = 1049.28 ms, SD = 431.25), $t(59) = -5.037$, $p < .001$, $d = -0.65$ (with a Bayesian analysis further revealing a BF_{10}= 3655.99, suggesting decisive evidence for the H_A). There was a statistically significant difference when women viewed images of clothed women compared to clothed men $t(59) = 2.064$, $p = .04$, d = 0.27 (however, it is important to note that further Bayesian analysis revealed a BF_{10}= 1.02, which suggests only anecdotal evidence for the H_A). There was no statistically significant difference when women viewed images of nude women or nude men, $t(59) = -0.43$, $p = .67$, $d = -0.06$ (with further Bayesian analysis revealing $BF_{10} = 0.15$, suggesting anecdotal evidence for the H_o). This longer latency to the face ROI when viewing nude images was expected given the added sexual saliency of the other visible erotic ROIs (i.e. breasts and pelvic) and for women participants, this does not appear to be specific to their preferred sexual stimulus.

Men showed a similar pattern to women such that the latency to first fixation on the face ROI was shorter when viewing images of clothed women (M = 751.3 ms, SD = 380.8) compared to looking at images of nude women (M= 1013.90 ms, SD = 522.6), $t(19) = -2.87$, $p = .01$, d = -0.64 (with further Bayesian analysis revealing $BF_{10} = 5.18$, suggesting substantial evidence for the H_A). However, unlike the female participants, there was no statistically significant difference for first fixation on the face ROI when men looked at nude (M = 767.50, SD = 386.6) versus clothed men (M = 614.7, SD = 272.3), $t(19) = 1.595$, $p = .13$, $d = 0.35$ (with further Bayesian analysis revealing $BF_{10} = 0.69$, suggesting anecdotal evidence for the H_A). This may indicate that the sexual ROIs of nude men offer little information to the heterosexual man, and as such the face ROI remains a source of initial attentional capture. This is further evidenced by the fact that there was a statistically significant difference when men viewed images of clothed women compared to images of men, $t(19) = 2.52$, $p = .02$, $d = 0.56$, (with further Bayesian analysis revealing $BF_{10} = 2.82$, suggesting anecdotal evidence for the H_A). There was no statistically significant difference when men viewed images of nude women or men, $t(19) = 2.00$, $p = .06$, d

= 0.45; however, with further Bayesian analysis revealing a $BF_{10} = 1.21$, suggesting anecdotal evidence for the H_A could indicate that in fact men showed a shorter latency to first fixation to the face ROI of nude men.

Chest. At the chest ROI, there was a main effect of image category, $F(1,306) = 6.07$, $p = .01$, $\eta^2 = .02$. In general, participants attended to the chest ROI of women ($M = 1044.92$, SD = 444.88) quicker than that of men ($M = 1210.84$, $SD = 567.85$), $t(322) = -2.930$, $p = .004$, $d = .32$. There was no effect of clothing, $F(1,306) = 1.885$, $p = .17$, $\eta^2 = .01$, nor an effect of sex $F(1,306) = 0.97$, $p = .32$, $\eta^2 = .003$.

Planned paired samples *t*-test comparisons for women reveled a shorter first fixation the chest ROI of nude women ($M = 951.0$, $SD = 452.6$), compared to clothed women ($M = 1102.3$, $SD = 436.2$), $t(59) = -3.76$, $p < .001$, $d = 0.49$ (with further Bayesian analysis revealing $BF_{10} = 62.59$, suggesting very strong evidence for the H_A). There were no statistically significant differences for women when viewing images of clothed men compared to nude men, $t(58) = 1.230$, $p = .22$, $d = 0.16$ (with further Bayesian analysis revealing $BF_{10} = 0.29$, suggesting anecdotal evidence for the H_o). There were statistically significant differences based on the image category for women. Women showed a shorter latency to the first fixation in the face ROI of clothed women ($M = 1102.3$, $SD = 436.2$) compared to clothed men ($M = 1247.0$, $SD = 610.4$), $t(59) = -2.34$, $p = .02$, $d = -0.30$ (however, further Bayesian analysis revealed a $BF_{10}= 1.74$, suggesting anecdotal evidence for the H_A). Women showed a shorter latency to first fixation in the chest ROI of nude women ($M = 951.0$, $SD = 452.2$) compared to nude men ($M = 1156.9$, $SD = 516.3$), $t(59) = -3.87$, $p < .001$, $d = -0.50$ (further Bayesian analysis revealed a $BF_{10}= 84.99$, suggesting very strong evidence for the H_A).

Men showed a shorter first fixation the chest ROI of nude women ($M = 991.8$, $SD = 371.2$), compared to clothed women ($M = 1199.0$, $SD = 475.0$), $t(19) = 2.66$, $p = .015$, $d = 0.58$ (further Bayesian analysis revealed a $BF_{10}= 3.58$, suggesting substantial evidence for the H_A) with no statistically significant differences when viewing images of clothed or nude men, $t(19) = -0.86$, $p = .40$, $d = -0.19$, (further Bayesian analysis revealed a $BF_{10}= 0.32$, suggesting anecdotal evidence for the H_o). This may be due to the salience of the breasts given that several images showed clothed women in décolletage. There was a statistically significant difference when viewing clothed women or clothed men $t(19) = 0.25$, $p = .80$, $d = 0.06$ (further Bayesian analysis revealed a $BF_{10}= 0.24$, suggesting anecdotal evidence for the H_o). When viewing nude images, men showed a shorter latency when viewing images of women (M = 991.8, SD = 371.2) compared to nude men (M = 1271.0, SD = 663.3), $t(20) = -2.20$, $p = .04$, $d = -0.48$ (further Bayesian analysis revealed a BF_{10}= 1.62, suggesting anecdotal evidence for the H_A).

Pelvic. At the pelvic ROI, there was an effect of clothing on latency to first fixation, $F(1,306) = 37.50$, $p = < .001$, $\eta^2 = .11$. First fixation to the pelvic ROI was longer for participants viewing clothed images (M = 1725.27, SD = 884.00) compared to nude images, (M = 1385, SD = 886.37), $t(1110) = 6.32$, $p = <.001$, $d = 0.38$. There was a main effect of sex, $F(1,306) = 36.891$, $p < .001$, $\eta^2 = .11$, with post hoc comparisons indicating that women showed a shorter first fixation to the pelvic ROI of clothed women (M = 1550.5, SD = 336.5) compared to male participants (M = 1793.3, SD = 448.8), $t(78) = -2.613$, $p = .01$, $d = -0.66$ (further Bayesian analysis revealed a BF_{10}= 4.37, suggesting substantial evidence for the H_A). Women also showed a shorter latency to first fixation in the pelvic ROI of nude women (M = 1292.1, SD = 468.9), compared to male participants (M = 1565.9, SD = 448.8), $t(78) =-2.33$, $p =.02$, $d = -0.59$ (further Bayesian analysis revealed a BF_{10}= 2.46, suggesting anecdotal evidence for the H_A) as well as when viewing clothed men, however this did not reach statistical significance, $t(78) = -1.79$, $p = .08$, $d = -0.45$ (further Bayesian analysis revealed a BF_{10}= 0.98, suggesting no evidence for the H_A). Sex differences were most evident when presented with images of nude men such that women also showed a shorter latency, (M = 1047.9, SD = 425.0) compared to men (M = 1533.1, SD = 771.4), $t(78) = -3.51$, $p < .001$, d= -0.9 (further Bayesian analysis revealed the largest BF_{10}= 38.34, suggesting very strong evidence for the H_A). There may be several reasons as to why the pelvic ROI is more likely to capture the attention of women compared to men, specifically given the information available to women when viewing the pelvic area of men. For men, there may have been a decrease in saliency of the women's pelvic ROI given the prone, casual pose of the model, with only the pubic triangle being visible, and no visual access to inner labia.

Planned paired samples *t*-tests were carried out in order to further elucidate sex differences. Women showed a longer first fixation to the pelvic ROI of clothed women (M = 1550.5, SD = 336.5) compared to nude women (M = 1292.1, SD = 468.9), $t(58) = 5.132$, $p < .001$, $d = 0.67$ (further Bayesian analysis revealed a BF_{10}= 4923, suggesting decisive evidence for the H_A). Women looking at clothed men also showed a longer first fixation to the pelvic ROI (M = 1626.7 ms, SD = 509.9) compared to when looking at nude men (M = 1047.9 ms, SD =

425.0), $t(57) = 6.935$, $p < .001$, $d = 0.91$(further Bayesian analysis revealed the largest BF_{10}= $2.83e^6$, suggesting decisive evidence for the H_A), indicating the sexual salience of the pelvic region of nude images. The BF_{10} indicates the large magnitude at which the sight of nude genitalia captures the women's initial attention. Interestingly, there was no statistically significant difference when women viewed clothed images, $t(58) = -1.28$, $p = .20$, $d = -0.17$ (further Bayesian analysis revealed the largest BF_{10}= 0.31, suggesting anecdotal evidence for the H_o). The difference was notable when women showed a longer latency to the pelvic area of nude women compared to men, $t(57) = 5.36$, $p < .001$, $d = 0.70$ (further Bayesian analysis revealed the largest BF_{10}= 10433.64, suggesting decisive evidence for the H_A).

Men also showed a specific response with latency to first fixation in the pelvic ROI such that the pelvic ROI of women appeared to be more salient. Latency to the first fixation to the pelvic region was longer when looking at clothed women (M = 1793.3, SD = 439.3) compared to nude women (M = 1857.5, SD = 503.3), $t(20) = 2.32$, $p = .03$, $d = 0.51$ (further Bayesian analysis revealed a BF_{10}= 3404.21, suggesting decisive evidence for the H_A). There were no statistically significant differences for first fixation to the pelvic region of clothed men (M = 1857.5, SD = 503.3) compared to nude men (M = 1533.1, SD = 771.4), $t(19) = 1.919$, $p = .07$, $d = 0.43$ (further Bayesian analysis revealed a BF_{10}= 1.07 , suggesting no evidence for the H_A).

There were no statistically significant differences when viewing clothed or nude women $t(20) = -0.64$, $p = .53$, $d = -0.14$ (further Bayesian analysis revealed a BF_{10}= 0.27, suggesting anecdotal evidence for the H_o), likewise there was no statistically significant difference when viewing nude women or men $t(20) = 1.78$, $p = .09$, $d = 0.39$ (further Bayesian analysis revealed a BF_{10}= 0.27, suggesting anecdotal evidence for the H_o). Unlike women, men do not appear to be as reflexively attracted to the pelvic ROI. This might be due to the neutral pose of the models, and limited view of female genitalia, making the breasts a more salient, erotic ROI.

Number of fixations (Figure 4.2)

Face. There was a main effect of clothing on number of fixation to the face ROI, $F(1,683) = 36.884$, $p < .001$, $\eta^2 = .05$, where participants made more fixations to the face ROI of clothed images, (M = 4.56, SD = 3.29) compared to nude images (M = 3.28, SD = 2.36), $t(1332) = 8.08$, $p < .001$, $d = 0.45$ (further Bayesian analysis revealed a BF_{10}= 1.2, suggesting anecdotal evidence for the H_A). There was also a main effect of sex, $F(1,683) = 27.52$, $p < .001$, $\eta^2 = .04$, with men making more fixations in the face ROI (M = 5.08, SD = 3.19) compared to women (M

= 3.42, *SD* = 2.68), $t(1332) = 9.937$, $p < .001$, $d = 0.57$ (further Bayesian analysis revealed a $BF_{10}= 3.98$, suggesting substantial evidence for the H_A). Specifically the sex differences between participants were evident when viewing nude women images in which women made less fixations (*M* = 3.11, *SD* =1.43) compared to men (*M* = 4.02, *SD* = 1.28), $t(78) = -2.57$, $p = .01$, $d = -0.65$; however, further Bayesian analysis revealed a $BF_{10}= 0.59$, suggesting anecdotal evidence for the H_o). Women made less fixations on the face ROI of nude men (*M* = 3.44, *SD* = 1.57) compared to men (*M* = 4.71, *SD* = 2.11), $t(78) = -2.88$, $p = .005$, $d = -0.75$, (further Bayesian analysis revealed a $BF_{10}= 7.98$, suggesting substantial evidence for the H_A) indicating that the face appears to be more of interest to men even when the opportunity for viewing a nude body exists..

Paired sample contrasts show that women made more fixations to the face region when looking at images of clothed women (*M* = 4.18, *SD* = 1.86) compared to nude women (*M* = 3.11, *SD* = 1.43), $t(59) = 8.32$, $p < .001$, $d = 1.07$ (further Bayesian analysis revealed a $BF_{10}= 5.76e^8$, suggesting decisive evidence for the H_A), as well as more fixations on the face ROI when presented with clothed men (*M* = 4.63, *SD* = 2.23) compared to nude men (*M* = 3.44, *SD* = 1.57), $t(59) = 6.93$, $p < .001$, $d = 0.90$ (further Bayesian analysis revealed a $BF_{10}= 3.27e^6$, suggesting decisive evidence for the H_A). Women made more fixations to the face ROI of clothed men than clothed women, $t(59) = 3.72$, $p <.001$, $d = 0.97$ (further Bayesian analysis revealed a $BF_{10}= 55.12$, suggesting very strong evidence for the H_o) as well as more in the face ROI of nude men than women $t(59) = 2.69$, $p = .009$, $d = 0.35$ (further Bayesian analysis revealed a $BF_{10}= 3.74$, suggesting substantial evidence for the H_A).

Men also made more fixations to the face ROI of clothed women compared to nude women, $t(19) = 3.92$, $p < .001$, $d = 0.88$, (further Bayesian analysis revealed a $BF_{10}= 39.32$, suggesting very strong evidence for the H_A) with no statistically significant difference between clothed and nude man images, $t(19) = 2.04$, $p = .055$, $d = 0.46$ (further Bayesian analysis revealed a $BF_{10}= 1.29$, suggesting anecdotal evidence for the H_A). Men showed more fixations to the face ROI of clothed men compared to clothed women, $t(19) = 2.19$, $p =.04$, $d = 0.49$; however, further Bayesian analysis revealed a $BF_{10}= 0.41$, suggesting no evidence for the H_A). There were no statistically significant differences when viewing images of clothed or nude men, $t(19) = -1.15$, $p =.27$, $d = -0.26$, (further Bayesian analysis revealed a $BF_{10}= 1.61$, suggesting anecdotal evidence for the H_A) again suggesting that a significant amount of information is retrieved from facial cues and within the scan path the face ROI is an region that participants returned to often.

Chest. In the chest ROI, there was a main effect of image category, $F(1,683) = 18.19$, $p < .001$, $\eta^2 = .03$, with participants making more fixations to the chest ROI of women ($M = 3.49$, $SD = 1.58$) compared to the ROI of images of men ($M = 2.85$, $SD = 1.26$), $t(322) = 4.03$, $p < .001$, $d = 0.45$. There was a main effect of clothing, $F(1, 683) = 18.80$, $p < .001$, $\eta^2 = .03$, with participants making more fixations to the chest ROI of nude images ($M = 3.37$, $SD = 1.53$) compared to clothed images ($M = 2.98$, $SD = 1.48$), $t(322) = 2.47$, $p = .015$, $d = 0.27$, which would suggest that a nude chest draws attention back to this region during the visual scan path. There was a main effect of sex, $F(1,683) = 37.98$, $p < .001$, $\eta^2 = .05$, with men making more fixations to the chest ROI ($M = 4.03$, $SD = 1.40$) compared to women participants ($M = 2.88$, SD = 1.37), $t(322) = 6.558$, $p < .001$, $d = 0.83$. Independent samples *t*-tests were run to elucidate which images were the source of the sex differences. There were differences in each of the image categories with men showing more fixations to the chest ROI of clothed women ($M = 4.16$, $SD = 1.274$) compared to women participants ($M = 2.81$, $SD = 1.26$), $t(80) = 4.230$, $p < .001$, $d = 1.07$ (further Bayesian analysis revealed a $BF_{10} = 330.53$, suggesting definitive evidence for the H_A). Men also made more fixations to the chest ROI of nude women ($M = 4.71$, $SD = 1.55$) compared to women participants ($M = 3.53$, $SD = 1.65$), $t(79) = 2.87$, $p = .005$, $d = 0.73$ (further Bayesian analysis revealed a $BF_{10} = 7.70$, suggesting substantial evidence for the H_A). Men also made more fixations to the chest of clothed men ($M = 3.624$, $SD = 1.30$) compared to women participants ($M = 2.52$, $SD = 1.26$), $t(78) = 3.38$, $p = .001$, $d = 0.87$ (further Bayesian analysis revealed a $BF_{10} = 27.22$, suggesting strong evidence for the H_A); as well as more fixations to the chest ROI of nude men ($M = 3.61$, $SD = 1.23$) compared to women participants ($M = 2.67$, $SD = 1.06$), $t(79) = 3.35$, $p = .001$, $d = 0.85$, (further Bayesian analysis revealed a $BF_{10} = 25.12$, suggesting strong evidence for the H_A) demonstrating how much more salient the chest ROI is for men.

Paired samples *t*-tests revealed that women made more fixations to the chest region of nude women compared to clothed women, $t(59) = -5.482$, $p < .001$, $d = -0.71$(further Bayesian analysis revealed a $BF_{10} = 17070.59$, suggesting definitive evidence for the H_A). There were no statistically significant differences in number of fixations to the chest ROI of nude men compared to clothed men, $t(58) = -1.42$, $p = .16$, $d = -0.19$ (further Bayesian analysis revealed a $BF_{10} = 0.37$, suggesting anecdotal evidence for the H_o). Women made more fixations to the clothed chest ROI of both women, $t(59)= 3.93$, $p < .001$, $d = 0.51$ (further Bayesian analysis revealed a $BF_{10}= 103.63$, suggesting definitive evidence for the H_A), and men, $t(59) = 5.84$, $p < .001$, $d = 0.75$ (further Bayesian analysis revealed a $BF_{10}= 60877.19$, suggesting definitive evidence for the H_A).

Similarly, men made more fixations to the chest ROI of nude women in comparison to clothed women, $t(20) = -2.228$, $p = .04$, $d = -0.49$ (further Bayesian analysis revealed a $BF_{10}= 1.71$, suggesting anecdotal evidence for the H_A). There were no statistically significant differences in number of fixations to the chest ROI of men, $t(19) = 0.10$, $p = .92$, $d = 0.02$ (further Bayesian analysis revealed a $BF_{10}= 0.23$, suggesting anecdotal evidence for the H_o). Men made more fixations to the clothed chest ROI of women, $t(19) = 2.16$, $p = .04$, $d = 0.48$ (further Bayesian analysis revealed a $BF_{10}= 1.54$, suggesting anecdotal evidence for the H_A), and men, $t(20) = 3.67$, $p =.002$, $d = 0.80$ (further Bayesian analysis revealed a $BF_{10}= 24.99$, suggesting strong evidence for the H_A).

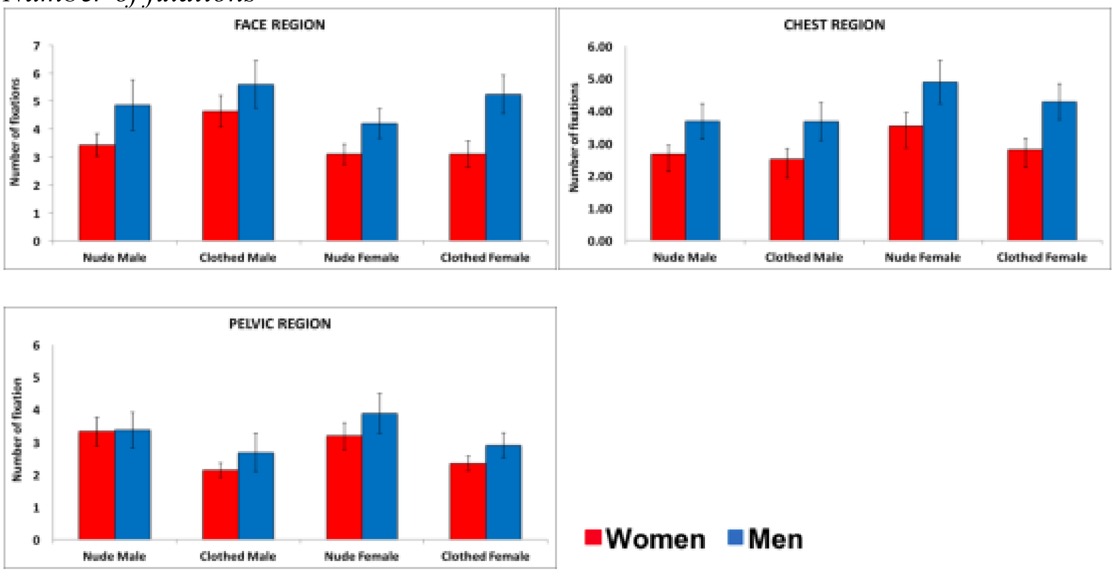
Pelvic. In the pelvic ROI, there was a main effect of clothing, $F(1,683) = 18.98$, $p < .001$, $\eta^2 = .03$, with participants making more fixations to the pelvic ROI of nude images ($M = 3.33$, $SD = 1.57$) compared to clothed images ($M = 2.38$, $SD = 0.93$), $t(317) = -6.61$, $p < .001$, $d = 0.74$, as well as a main effect of sex, $F(1, 683) = 17.463$, $p < .001$, $\eta^2= .03$, with men having more fixations to the pelvic ROI ($M = 3.16$, $SD = 1.172$) compared to women ($M = 2.75$, $SD = 1.424$), $t(317) = -2.34$, $p = .02$, $d = 0.31$. In order to further analyze sex differences, independent samples t-tests were run for each image category. There were no statistically significant differences between men and women when viewing clothed women, $t(78) = -1.07$, $p = .29$, $d = -0.27$ (further Bayesian analysis revealed a $BF_{10}= 3.21$, suggesting anecdotal evidence for the H_A); nude women $t(79) = -1.63$, $p =.11$, $d = -0.41$ (further Bayesian analysis revealed a $BF_{10}= 0.79$, suggesting anecdotal evidence for the H_A), or nude men, $t(76) = 0.11$, $p = .91$, $d = 0.03$ (further Bayesian analysis revealed a $BF_{10}= 0.26$, suggesting anecdotal evidence for the H_A). The only differences between participants was when viewing clothing men, where men made more fixations to the pelvic ROI ($M = 3.33$, $SD = 0.91$) compared to women ($M = 2.142$, $SD = 0.91$), $t(57) = -6.37$, $p < .001$, $d = -0.84$ (further Bayesian analysis revealed a $BF_{10}= 1.59$, suggesting anecdotal evidence for the H_A).

Paired samples *t*-tests revealed that women made more fixations to the pelvic ROI of nude women ($M = 3.18$, $SD = 1.61$) compared to clothed women ($M = 2.34$, $SD = 0.89$), $t(58) = -$

7.13, $p < .001$, $d = -0.93$ (further Bayesian analysis revealed a $BF_{10} = 6.32e^6$, suggesting definitive evidence for the H_A). Women also made more fixations to the pelvic ROI of nude men ($M = 3.19$, $SD = 1.61$) compared to clothed women ($M = 2.35$, $SD = 0.89$), $t(60) = -3.51$, $p < .001$, $d = 0.64$ (further Bayesian analysis revealed a $BF_{10} = 3.78e^5$, suggesting definitive evidence for the H_A). In contrasting the image category, women made more fixations to the pelvic ROI of clothed women compared to nude, $t(58) = 2.41$, $p = .02$, $d = 0.31$ (further Bayesian analysis revealed a $BF_{10} = 2.01$, suggesting anecdotal evidence for the H_A); there were no statistically significant differences when viewing clothed or nude men, $t(57) = -0.49$, $p = .63$, $d = -0.06$ (further Bayesian analysis revealed a $BF_{10} = 0.16$, suggesting anecdotal evidence for the H_o).

Men had more fixations to the pelvic region of nude women ($M = 3.83$, $SD = 1.33$) compared to clothed women ($M = 2.89$, $SD = 0.80$), $t(18) = 4.68$, $p < .001$, $d = 1.02$ (further Bayesian analysis revealed a $BF_{10} = 200.70$, suggesting definitive evidence for the H_A). Men had more fixations to the pelvic region of nude men ($M = 3.28$, $SD = 1.20$) compared to clothed men ($M = 2.63$, $SD = 1.00$), $t(19) = 2.22$, $p = .04$, $d = 0.50$ (further Bayesian analysis revealed a $BF_{10} = 1.69$, suggesting anecdotal evidence for the H_A). When presented with clothed images, men showed no difference in number of fixations to pelvic ROI of women or men, $t(20) = 1.53$, $p = .14$, $d = 0.33$ (further Bayesian analysis revealed a $BF_{10} = 0.63$, suggesting anecdotal evidence for the H_o). When presented with nude images, men made more fixations to the pelvic ROI of nude women compared to nude men $t(19) = 3.52$, $p = .002$, $d = 0.79$ (further Bayesian analysis revealed a $BF_{10} = 17.84$, suggesting strong evidence for the H_A).

Figure 4.2.
Number of fixations



Note. Number of fixations on Face, Chest, and Pelvic ROI.

Dwell time (Figure 4.3)

Face. Dwell time was measured as an indication of sustained attention in each ROI. There was a main effect of image category on dwell time to the face ROI, $F(1,683) = 9.35$, $p < .001$, $\eta^2 = .01$, with participants dwelling longer on the face ROI of images of men (M = 1396.72, SD = 1182.82) compared to images of women (M = 1190.94, SD = 1039.90), $t(1332) = -3.26$, $p = .001$, $d = 0.18$. There was a main effect of clothing, $F(1,683) = 37.57$, $p < .001$, $\eta^2 = .05$, with participants dwelling longer on the face ROI of clothed images (M = 1485.44, SD = 1171.28) compared to nude images (M = 1016.51, SD = 946.34), $t(1332) = 8.00$, $p < .001$, d = 0.44. There was a main effect of sex F(1.683) = 61.589, $p < .001$, $\eta^2 = .08$, with men dwelling longer on the face ROI (M = 1701.57, SD = 1312.71) compared to women (M = 1056.88, SD = 908.12), $t(1332) = -10.40$, $p < .001$, $d = 0.57$. Independent samples t-tests were run to analyze specific sex differences. Men dwelled longer on the face ROI of clothed women (M = 1487.95, SD = 615.36) compared to women (M = 1029.00, SD = 417.18), $t(78) = -3.98$, $p < .001$, $d = -0.97$ (further Bayesian analysis revealed a BF_{10}= 77.34, suggesting very strong evidence for the H_A). Men dwelled longer on the face ROI of nude women (M = 1111.85, SD = 490.17) compared to the women participants (M= 701.60), $t(79) = -3.98$, $p < .01$, $d = -1.01$ (further Bayesian analysis revealed a BF_{10}= 149.49, suggesting definitive evidence for the H_A), as well as clothed men (M = 1687.74, SD = 738.71) compared to women participants (M = 1209.87, SD = 524.78), $t(78) = -3.17$, $p = .002$, d =-0.82 (further Bayesian analysis revealed a BF_{10}= 15.82, suggesting strong evidence for the H_A). Men also dwelled longer on the face ROI of nude men (M = 1592.66, SD = 1187.30) compared to women participants (M = 840.68, SD = 396.77), $t(78) = -4.28$, $p < .001$, $d = -1.11$ (further Bayesian analysis revealed a BF_{10}= 381.49, suggesting definitive evidence for the H_A). The face ROI appears to sustain men's attention significantly more than it does for women.

In paired samples t-tests for dwell time on the face ROI, women showed a longer dwell time on the face ROI of clothed women compared to nude women, $t(59) = 8.50$, $p < .001$, d = 1.10 (further Bayesian analysis revealed a BF_{10}= $1.14e^9$, suggesting definitive evidence for the H_A). Women also dwelled longer on the face region of clothed men compared to nude men, $t(59) = 7.08$, $p < 0.001$, $d = 0.91$ (further Bayesian analysis revealed a BF_{10}= $5.72e^6$, suggesting definitive evidence for the H_A). When looking at clothed images, women dwelled longer on the face ROI of men, $t(59)$= -5.23, $p < .001$, $d = -0.67$ (further Bayesian analysis revealed a BF_{10}=

10.7, suggesting substantial evidence for the H_A). When looking at nude images, women dwelled longer on the man face ROI, $t(59) = -3.13$, $p = .003$, $d = -0.40$ (further Bayesian analysis revealed a $BF_{10} = 7005.06$, suggesting definitive evidence for the H_A).

Men dwelled longer on the face ROI of clothed women ($M = 1488$, $SD = 615.4$), $t(19) = 4.05$, $p < .001$, $d = 0.01$ (further Bayesian analysis revealed a $BF_{10} = 51.45$, suggesting very strong evidence for the H_A). There were no statistically significant differences when viewing images of men, $t(19) = 0.41$, $p = .69$, $d = 0.09$ (further Bayesian analysis revealed a $BF_{10} = 0.25$, suggesting anecdotal evidence for the H_o). Men dwelled longer on the face ROI of clothed men compared to clothed women, $t(19) = 2.45$, $p = .02$, $d = 0.56$ (further Bayesian analysis revealed a $BF_{10} = 2.68$, suggesting anecdotal evidence for the H_A). Men also dwelled longer on the face ROI of nude men compared to nude women, $t(19) = 2.45$, $p = .02$, $d = 0.55$ (further Bayesian analysis revealed a $BF_{10} = 2.50$, suggesting anecdotal evidence for the H_A).

Chest. In the chest ROI, there was an effect of sex, $F(1,683) = 64.744$, $p < .001$, $\eta^2 = .09$. Further independent samples *t*-tests revealed that men dwelled longer on the chest ROI of clothed women ($M = 1295.55$, $SD = 887.20$) compared to women participants ($M = 655.95$, $SD = 503.05$), $t(80) = -4.07$, $p < .001$, $d = -1.03$ (further Bayesian analysis revealed a $BF_{10} = 197.73$, suggesting definitive evidence for the H_A). Men also dwelled longer on the chest ROI of nude women ($M = 1163.27$, $SD = 526.71$) compared to women participants ($M = 716.17$, $SD = 506.67$), $t(79) = -3.37$, $p = .001$, $d = -0.85$ (further Bayesian analysis revealed a $BF_{10} = 26.56$, suggesting strong evidence for the H_A). Men dwelled longer on the chest ROI of clothed men ($M = 1111.91$, $SD = 747.10$) compared to women participants ($M = 569.80$, $SD = 531.19$), $t(78) = -3.55$, $p < .001$, $d = -0.92$ (further Bayesian analysis revealed a $BF_{10} = 43.43$, suggesting very strong evidence for the H_A), as well as longer on the chest ROI of nude men ($M = 1272.69$, $SD = 1603.20$) compared to women participants ($M = 606.38$, 511.85), $t(79) = -2.86$, $p = .005$, $d = -0.72$ (further Bayesian analysis revealed a $BF_{10} = 7.49$, suggesting substantial evidence for the H_A).

Paired sampled *t*-tests revealed that there were no statistically significant differences for dwell time on the chest ROI when women participants viewed images of clothed or nude women, $t(59) = -1.60$, $p = .11$, $d = -0.21$ (further Bayesian analysis revealed a $BF_{10} = 0.47$, suggesting anecdotal evidence for the H_o); nor when they viewed nude or clothed men, $t(58) = -1.08$, $p = .28$, $d = -0.14$ (further Bayesian analysis revealed a $BF_{10} = 0.25$, suggesting anecdotal evidence for the H_o). Women did, however, spend more time on the chest ROI of clothed women compared to clothed men, $t(59) = 2.51$, $p = .01$, $d = 0.32$ (further Bayesian analysis revealed a $BF_{10} = 2.49$, suggesting anecdotal evidence for the H_A); and also longer on the chest ROI of nude women compared to nude men, $t(59) = 2.92$, $p = .005$, $d = 0.38$ (further Bayesian analysis revealed a $BF_{10} = 6.43$, suggesting substantial evidence for the H_A).

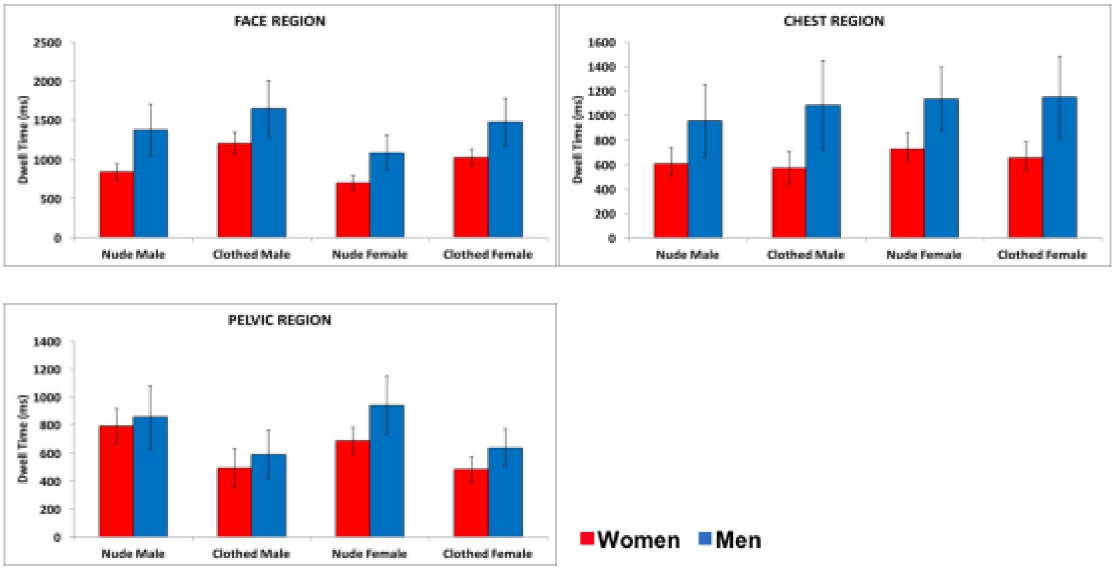
There was not a statistically significant difference when men viewed images of clothed or nude women, $t(20) = 0.97$, $p = .34$, $d = 0.21$ (further Bayesian analysis revealed a $BF_{10} = 0.35$, suggesting anecdotal evidence for the H_o), nor when viewing images of clothed or nude men, $t(19) = 1.65$, $p = .12$, $d = 0.37$ (further Bayesian analysis revealed a $BF_{10} = 0.74$, suggesting anecdotal evidence for the H_o). Men did not show a statistically significant difference when viewing images of clothed men or women, $t(19) = -0.69$, $p = .50$, $d = -0.16$ (further Bayesian analysis revealed a $BF_{10} = 0.29$, suggesting anecdotal evidence for the H_o), or when viewing nude men or women $t(20) = 0.35$, $p = .73$, $d = 0.08$ (further Bayesian analysis revealed a $BF_{10} = 0.24$, suggesting anecdotal evidence for the H_o).

Pelvic. In the pelvic ROI, there was a main effect of clothing, $F(1,683) = 26.88$, $p < .001$, $\eta^2 = .04$, with participants dwelling longer on the pelvic ROI of nude images ($M = 1009.81$, $SD = 854.81$) compared to clothed images ($M = 697.57$, $SD = 755.74$), $t(1110) = -6.31$, $p < .001$, $d = 0.39$. There was a main effect of sex, $F(1,683) = 21.60$, $p < .001$, $\eta^2 = .03$, with men dwelling longer on the pelvic ROI ($M = 1108.78$, $SD = 790.73$) than women participants ($M = 753.34$, $SD = 821.79$), $t(1110) = 6.96$, $p < .001$, $d = 0.44$. Independent samples *t*-tests revealed that men dwelled longer on the pelvic ROI of clothed women ($M = 922.92$, $SD = 996.67$) than women participants ($M = 484.77$, $SD = 345.84$), $t(78) = 2.94$, $p = .004$, $d = 0.75$ (further Bayesian analysis revealed a $BF_{10} = 9.10$, suggesting substantial evidence for the H_A). Men dwelled longer on the pelvic ROI of nude women ($M = 1035.71$, $SD = 504.71$) compared to women ($M = 689.70$, $SD = 366.46$), $t(79) = 3.36$, $p = .001$, $d = 0.85$ (further Bayesian analysis revealed a $BF_{10} = 26.11$, suggesting strong evidence for the H_A). Men also dwelled longer on the pelvic ROI of clothed men ($M = 924.79$, $SD = 1302.\ 16$) compared to women participants ($M = 493.\ 45$, $SD = 548.\ 59$), $t(78) = 2.09$, $p = .04$, $d = 0.50$; however, further Bayesian analysis revealed a $BF_{10} = 1.60$, suggesting only anecdotal evidence for the H_A. There were no statistically significant differences for men viewing the pelvic ROI of nude men ($M = 1098.93$, $SD = 03$) compared to women participants (M = 791.89, SD = 474.34), $t(76) = 1.72$, $p = .09$, $d = 0.45$ (further Bayesian analysis revealed a BF_{10}= 0.90, suggesting no evidence for the H_A).

Paired samples t-test revealed that women had a longer dwell time in the pelvic region of nude women (M = 687.71, SD = 366.5) compared to images of clothed women, (M = 689.72, SD = 366.50), $t(58) = 4.66$, $p < .001$, $d = 0.61$ (further Bayesian analysis revealed a BF_{10}= 1016.27, suggesting definitive evidence for the H_A). Women also dwelled longer on the pelvic region of nude men (M = 791.91, SD = 493.51) compared to images of clothed men (M = 493.52, SD = 548.61), $t(57) = 3.35$, $p = .001$, $d = 0.44$ (further Bayesian analysis revealed a BF_{10}= 19.51, suggesting strong evidence for the H_A). There were no statistically significant differences when viewing clothed images of women and men, $t(58) = -0.23$, $p = .82$, $d = -0.03$ (further Bayesian analysis revealed a BF_{10}= 0.15, suggesting anecdotal evidence for the H_o), nor were there any statistically significant differences when viewing nude women and men, $t(57) = -1.86$, $p = .07$, $d = -0.24$ (further Bayesian analysis revealed a BF_{10}= 0.71, suggesting anecdotal evidence for the H_o).

There were no statistically significant differences for men when viewing clothed or nude women, $t(20) = -0.71$, $p = .48$, $d = -0.16$ (further Bayesian analysis revealed a BF_{10}= 0.29, suggesting anecdotal evidence for the H_o), nor when viewing clothed or nude men, $t(19) = -1.16$, $p = .26$, $d = -0.26$ (further Bayesian analysis revealed a BF_{10}= 0.42, suggesting anecdotal evidence for the H_o). There were no significant differences when contrasting clothed women and men, $t(20) = -0.02$, p -.98, $d = -0.004$ (further Bayesian analysis revealed a BF_{10}= 0.23, suggesting anecdotal evidence for the H_o); nor nude women and men $t(19) = -0.17$, $p = .87$, $d = -0.04$ (further Bayesian analysis revealed a BF_{10}= 0.24, suggesting anecdotal evidence for the H_o).

Figure 4.3.
Dwell Time



Note. Dwell time as a measure of maintained attention, indicative of level of interest.

Discussion

The direct comparison of images (presented once clothed, then nude) allowed for a clearer interpretation of the differences of information processing between the sexes. First fixations are indicative of a bottom up, automatic processing of a stimulus before higher order processes engage. Given that the sexual regions are more clearly visible in the nude images, it was hypothesized that both men and women would fixate on the chest and pelvic regions of nude images faster than when viewing clothed images. We observed that men, when viewing a clothed or nude image (regardless of model sex), fixated on the face, then the chest, and then finally the pelvic region. Interestingly, the women's scan path for a clothed image (regardless of sex) was to first fixate on the face, and then the chest and pelvic. However, this scan path changed if the model in the image was nude. Women attended to the most sexually salient regions of the nude image (chest for women, pelvic for men) first, then proceeding to the face, suggesting that their immediate attention is towards the sexual regions of interest. Furthermore, beyond the automaticity of the first fixation, the dwell time on specific regions of interest offer information on the top down, controlled attention. The results from the first fixations, paired with longer dwell times in sexual regions when the image was that of a nude individual, may serve to support the idea that sex differences in attention towards visual sexual stimuli may be contingent upon levels of processing. Where men deduce much information from the face, women seem to be more specific to the genitals. Whether this is for an evolutionary adaptation to seeking out the most compatible mate or at least the man that may supply the greatest level of sexual pleasure, is unclear.

In comparison to previous research, we took great efforts to find images of the same model in the same pose. In previous research, Nummenmaa and colleagues (2012) demonstrated that initial attention to clothed images was on the face ROI, however, fixations were quickly drawn towards the body of the nude images. Unfortunately, it is difficult to know if the attention was captured by the nudity or the provocative positions compared to the clothed images. The importance of using the image of the same person fully clothed then nude allowed for a direct comparison of eye movement patterns based solely on the regions of interest rather than other features of the image (i.e. seductive poses, lighting differences). In the current study, men and women showed a difference in how they retrieve information from images. First fixations are indicative of the region of greatest capture of attention and as such it can be inferred that the region most salient to men was the face; whereas for women, it was the chest or penis. The present findings suggest that the facial features of the images seem to be of prime importance when looking at clothed individuals. This finding is similar to Hewig and colleagues' (2008), who showed that regardless of sex, when looking at a clothed image, attention is mostly maintained to the face region. Although it was anticipated that when a nude image was presented, the initial fixation would be on the sexual parts (chest, pelvic); however, initial fixations for men, irrespective of sex and clothing, was predominantly to the facial region of interest. This was in keeping with previous studies that highlighted the importance of facial features for human species. Gathering information from facial cues begins early in life. From approximately 4 weeks old, infants show a preference for human faces (Hainline, 1978). By 4 months, emphasis is placed on the subject's eyes (which are indicators of mood) and as language perception begins, emphasis is then placed on the subject's mouth (Kuhl & Meltzoff, 1982). Attention to facial cues is maintained throughout the lifespan. Socially anxious individuals show a hypervigilance to negative facial cues which can be assessed as dangerous (Gilboa, Schechtman et al., 1999; Mühlberger, Wieser, & Pauli, 2008; Perowne & Mansell, 2002; Wieser et al., 2009). Although this was the case for men, women showed an initial fixation on the face of both sexes only when the images were clothed. When a nude image was presented, women fixated first on the chest region of women images and pelvic region of men showing that sexual stimuli are more salient to women than men. Women were quicker to look at the chest and pelvic region of nude women and men. This was likely due to the fact that men spent more time on the facial features of all images. Both sexes had more fixations to the face of the clothed preferred sex than the nude version. Men had more fixations on the face of both sexes. The increased fixations on the face of the clothed image was likely due to the fact that there is little information that may be gathered from a clothed figure. The extent at which physical characteristics may be qualified is limited by the clothing worn. The women's chest region seemed to be more attention grabbing for both sexes compared to the pelvic area. Although this seems somewhat surprising, it is important to note that the images used are of women in a neutral pose and therefore the breasts may be more visually captivating. If the images were of more explicit poses, then there may have been more fixations and dwell times on the pubic area. Previous results have shown that when looking at similar images, the breasts capture the attention more than the pelvis (e.g., Dixson et al., 2011a,b). This is evident in the fact that men had more fixations on the nude women's breasts and women had more fixations on the nude men’s pelvic region. Again, this is possibly due to the fact that these are the areas with the most important information to the opposite sex.

One of the main limitations to the current study is the arousal and valence ratings of the images. The images used in the current study were not intended to heighten the level of sexual arousal experienced by the viewer (neutral pose, white background), therefore it remains unclear if eye movement patterns are different when images are rated as more arousing. Further research with images rated higher in sexual arousal and/or valence is required particularly given the added saliency of images depicting physiological arousal (i.e. erect penis, engorged labia). Such images have been shown previously by other researchers to elicit higher ratings of arousal in women (Spape, Timmers, Yoon, Ponseti, & Chivers, 2014) yet there still lacks the contrast of variances in arousal ratings. Although studies have incorporated images that were computer modified to have different sized breasts and areolas, there still remains the issue that computer generated images may be somewhat less ecologically valid.

The current study does, however, give an idea of the sex differences being experienced at the cognitive level which may offer some indication of why men appear more concordant in their subjective and objective levels of arousal whereas women do not. Initial fixation to the nude penis might be triggering an involuntary, early physiological response of labial engorgement. This should be further analyzed by combining similar images and scan path analyses with another physiological measure of arousal.

Chapter 5: Eye-Tracking of Erotic Images: high and low arousal and valence

Eye-Tracking of Erotic Images: high and low arousal and valence

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Abstract

The use of objective physiological measures of sexual arousal has introduced the idea that women show discordance between objective and subjective measures, as well as a lack of specificity as to what their preferred stimulus is. Conversely, men show concordant specificity in what they consider arousing, as well as concordant objective and subjective measures. While researchers are aware of this discordance in women, what lacks clarification is whether the sex differences are strictly physiological, or if the difference is occurring at the cognitive processing of sexual stimuli between the two sexes. Previous researchers have used sexual imagery to explore the cognitive processing when viewing images containing sexual content and subsequent arousal. Yet few researchers have used images rated and validated for arousal, and fewer have used eye tracking to investigate what parts of an image attract attention. This study involved participants viewing images that had previously been rated as high or low in the image's ability to evoke arousal. It was predicted that both heterosexual women and men would demonstrate objective specificity by allocating their attention to different regions within these images. We found that women showed greater attention to the face in high arousal images, while the pelvic region captured their attention regardless of whether the image was low or high arousing. Men preferred to fixate on the face in low arousal images, and the chest in the high arousal images. We conclude that there are sex differences in the allocation of attention to different parts of the sexual image, suggesting that eye tracking maybe a useful objective measurement of this attention allocation for both women and men.

***Keywords*: Sex, Arousal, Eye tracking.**

Introduction

Sexual arousal has been defined as an interplay of physiological (objective) responses with subjective arousal. Physiological sexual arousal can be quantified by measures of genital blood flow in men and women (e.g., Chivers, Rieger, Latty, & Bailey, 2004; Henson, Rubin, Henson, & Williams, 1977; Laan, & Everaerd, 1995), and psychological arousal can be measured using subjective ratings (e.g., Chivers, 2010; Laan & Everaerd, 1995; Morokoff, 1985). Although men typically display concordance between their genital and subjective responses, women typically do not (Chivers, 2010). The processing of sexual erotic images requires attention in order to activate the sympathetic nervous system and provoke genital blood flow. For this reason, an attempt to resolve the apparent sex difference in concordance has been to use an information processing model (IPM; Massaro & Cowan, 1993). The IPM proposes that a different amount of processing time is allocated to sexual stimuli compared to non-sexual stimuli (Geer & Manguno-Mire, 1996). Individuals will orient towards regions of greatest sexual saliency, and if the region elicits a sexual response the individual will instinctually maintain fixation (Singer, 1984). To assess this, researchers have turned to using cognitive measures of attention, including eye-tracking (Dixson, Grimshaw, Linklater, & Dixson, 2011a, 2011b; Fromberger et al., 2012; Nummenmaa et al., 2012).

Eye-tracking provides an objective measure of attention, defining specific regions of an image where observers look, and the distribution of time that regions of an image are looked at. Increased fixation duration is typically indicative of increased interest, salience, or increased processing of the fixated region (Knohlers, 1976; Rayner, Schotter, Masson, Potter, & Treiman, 2016). It has been proposed that specific regions of interest within erotic images clearly capture attention, as individuals look at, and fixate longer towards more salient sexually-explicit stimuli relative to less salient or neutral stimuli (Singer, 1984). Moreover, attention is further differentially allocated depending on the individual's implicit evaluation of a sexual target. If the target is evaluated as being of sexual interest, more visual attention is allocated towards the sexual cues consistent with their preference (e.g., heterosexual man looking towards a woman's chest; Price & Hanson, 2007). A similar pattern was observed in a recent study by Dawson and Chivers (2016), in which men exhibited a specific pattern of initial attention, attending to their preferred stimulus quicker, as well as sustained attention to that stimulus, whereas women exhibited a nonspecific pattern of initial attention, attending to both their preferred and non-preferred stimulus; however, they sustained attention specifically to their preferred stimulus. Thus, together, the results from these studies allow researchers to piece together early processing (as observed with first fixations) as well as later processing (as observed with dwell times).

Although men appear more consistent in allocating their attention to preferred sexual cues compared to women (e.g., Chivers, Seto, & Blanchard, 2007; Dawson & Chivers, 2016; Price & Hanson, 2007), it is possible that the type of image, and content of the sexual stimuli can influence a participant's attention. For example, sexual stimuli used in previous studies range from being computer generated (e.g., Dixson et al., 2011a, 2011b) to being contrasted with irrelevant non-sexual stimuli (e.g., animals and landscapes; Ebsworth & Lalumière, 2012; Fromberger et al., 2012; Samson & Janssen, 2014). In an attempt to improve this methodology, Nummenmaa and colleagues (2012) compared the eye-tracking responses to realistic images of clothed versus nude women and men**.** They found that while initial fixations were most often to the face region of interest (ROI), attention was quickly drawn away from the face on to the nude chest or pelvic ROIs. While men spent more time viewing the images of women compared to images of men, women participants viewed both equally. Yet this study was not without its own limitations, as the chosen images contained different models of varying attractiveness in various poses. It can be argued that it is difficult to compare a clothed woman with her arms crossed to a nude woman in a more sexually explicit pose. Such perceptual and affective characteristics of an image become relevant variables to consider when selecting visual stimuli (e.g., Marchewka, Zurawski, Jednoróg, & Grabowska, 2014; Schimmack & Derryberry, 2005; Wrase et al., 2003). Consequently, researchers have highlighted the importance of stimulus rating, and have made efforts to standardize sexual stimuli prior to their use in experiments (e.g., Prause, Moholy, & Staley, 2013; Rupp & Wallen, 2007; Spiering, Everaerd, & Laan, 2004). In response to the limitations of the Nummenmaa and colleagues study, Farisello, Johnson and Pfaus (2014) analyzed the eye movements of women and men in response to nude or clothed images of the same person, in the same body pose (i.e., facing the camera with hands on the sides of body). They found that heterosexual men rated images of women as being more arousing and pleasant, compared to images of men, and showed an initial fixation on the face region regardless of whether the woman was clothed or not. In contrast, heterosexual women rated images of men and women similarly in arousal and valence. Eye movement pattern included first fixating on the face only when the women and men were clothed; whereas when viewing a nude image, the first fixation was on the chest region of the nude women, and the pelvic region of the nude men. These patterns of eye movements in both studies (Farisello et al., 2014; Nummenmaa et al., 2012) could reflect a sex difference in processing time and interpretation. However, they could also reflect a paucity of stimulus salience that favors man interpretations of arousal, which may suggest a need for comparison between images that have been rated high in arousal and valence as well as that rated low. This may elucidate the differences in eye movement patterns dependent upon arousal.

The present study aims to compare the eye movements of heterosexual women and men in response to images, which have been rated and validated by heterosexual women and men as high or low in subjective arousal (Shilhan et al., submitted). We hypothesized that participants would show a greater degree of attentional specificity for images that had been previously rated as highly arousing, and less specificity for images previously rated as low-arousing (e.g., looking at high arousal images faster and/or for a longer period of time compared to low arousal images). However, if women are non-specific or less selective in their sexual attention, then they should process both high and low arousal images in the same way.

Method

Participants

A total of 76 (57 women, 19 men) undergraduate students from Concordia University in Montréal, QC., Canada, participated in this study. The age of the participants ranged from 18 to 45 (M = 23.27, SD = 4.40). All participants provided informed consent, and received a participation credit for the Psychology Participant Pool. Although the study was open to all sexual orientations, for the purpose of the current study, we only included those who identified as exclusively or predominately heterosexual on the Kinsey Scale (e.g., 0 or 1; Kinsey, Pomeroy, & Martin, 1948). As a result, the data from 70 participants (53 women, 17 men) were utilized in the final analysis. All procedures conformed to the Canadian Tri-Council Panel on Research Ethics, and were approved by the Concordia University Human Research Ethics Committee.

Measures

The stimuli were presented on a 21” Viewsonic G225fb Cathode Ray Tube screen (Screen resolution of 1024 x 768 pixels, 100Hz refresh rate) with a 3.2GHz Dual-Core computer running Microsoft Windows 7. Eye-movements were recorded using an S2 Eye tracker (Mirametrix, Montreal) running on the same computer. The S2 eye tracker is an infra-red based video eye tracker that is remotely located below the presentation screen. The sampling rate of the eye tracker was 60Hz, with an average spatial accuracy less than .5°, with a .03° resolution (note: these values do not reflect the manufacturers specifications from their website, but more conservative values as measured within the Concordia Vision Labs using an artificial pupil; Ringer et al., 2014). All aspects of the experiment (e.g., image presentation, eye tracking, data analysis) were conducted in parallel using the Open Gaze and Mouse Analyzer (OGAMA) open-source software (ver. 5, Voßkühler, Nordmeier, Kuchinke, & Jacobs, 2008). Briefly, OGAMA allows for the recording and analyzing of eye tracking data from slideshow eye tracking experiments, and can control the S2 eye tracker directly from the recording interface.

The stimuli were 40 digital photographs selected from the Concordia Sexual Imagery Database (Shilhan et al., *submitted*). The database includes 188 images of varying sexual explicitness. The images were previously rated on both valence and arousal by 217 undergraduate students of various ethnic backgrounds. We used the top 10 highest rated images by heterosexual men, top 10 highest rated images by heterosexual women, bottom 10 lowest rated images by heterosexual men, and bottom 10 lowest rated images by heterosexual women. These images were chosen because, in comparison to previous research (Dixson et al., 2011a, 2011b; Ebsworth & Lalumière, 2012; Fromberger et al., 2012; Nummenmaa et al., 2012), these images were taken from a validated dataset (Shilhan et al., *submitted*), rated for arousal and valence.

Demographics Questionnaire. A demographics questionnaire was administered to all participants prior to beginning the study. This was used to determine basic information such as age, ethnicity, religion, and relationship status.

Sexual Arousal and Desire Inventory (SADI). The SADI questions were administered to evaluate the subjective experience of sexual arousal and desire (Toledano & Pfaus, 2006) at the start of the experiment for a baseline measure, as well as after watching the movie. It consists of 54 item descriptors, and has four dimensions: cognitive-emotional, motivational, physiological, and negative control (Cronbach's alpha is .90). Individuals were presented with a list of descriptive words and as to rate each word on a Likert type scale based on how it reflects their current state of arousal (1 = "does not describe it at all" and 5 = "describes it perfectly").

Beck's Depression Inventory (BDI). The BDI is designed to measure the levels of depression within individuals who are at least 13 years of age. It consists of 21 multiple-choice questions designed to measure levels of depression. Each item describes a symptom the participant has been experiencing in the past week. Participants have the choice of four statements (0,1,2,3). For example, some statements that participants will choose from are “I am not particularly discouraged about the future”, “I feel discouraged about the future”, “I feel I have nothing to look forward to”, or “I feel the future is hopeless and that things cannot improve” (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The items are scored from 0 to 3, 0 indicating the least severe statement and 3 indicates the most severe. The BDI has high internal consistency (Cronbach’s α = .86: Beck et al., 1961). This was used strictly as an exclusion criterion. Any participant that scored as having depressive tendencies were excluded from the study and referred to the Counselling Department of Concordia University. This was done because depression may negatively influence arousal states (example see Lykins, Janssen, & Graham, 2006).

Procedure

The participants first completed the Concordia University Sexual History questionnaire, which targets the participant’s history, intercourse, intimacy, arousal and sexual orientation. Of these, we only analyzed the question, “What is your current sexual orientation”. Specifically, we only included those who identified as strongly heterosexual (e.g., 0 or 1) on the Kinsey Scale (Kinsey, Pomeroy, & Martin, 1948). Once the questionnaires were completed, the participants were verbally reminded that they would be viewing sexual images of both heterosexual and homosexual content. Participants were then instructed to view the images as though looking at a magazine or television screen. For accurate recordings, the participants first needed to be calibrated to a value below 40°. Each trial consisted of an initial fixation cross (1° visual angle) in the center of the screen followed by the image. The image was presented for 5 s followed again by the fixation cross. In order to continue to the next trial, the participant needed to fixate on this cross and press the spacebar.

Each participant completed 80 trials, with each image being presented once in random order (e.g., within-block randomization for high and low arousal), and once in block formation (high arousal first then low arousal). We utilized the block formation in addition to the random order, as participants may require more exposure to the stimuli for arousal to occur. After the final trial, the participants were asked to view each image with the Likert type Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The participants used SAM to rate each image on valence (from 0 = unpleasant, to 6 = pleasant) and then again on arousal (from 0 = not arousing, to 6 = very arousing). Future analysis will compare these ratings to ratings from the Concordia Sexual Imagery Database (Shilhan et al., *submitted*) to ensure concordance.

Analysis

The eye tracking data recorded by the OGAMA software was analyzed with a statistical parametric map. This map illustrated the participant's eye movements for each image (e.g., Caldara, Shou, & Miellet, 2010). To assess the variation of eye movements across images, the OGAMA software recorded each eye movement fixation and the path between them. The first fixation location was excluded, as the first fixation tends to fall at the point of the fixation cross at the start of the trial. Fixation was defined as a pause in eye movements within a region of 0.25° for a minimum of 100 ms.

Although participants viewed all images (e.g., high and low as rated by both heterosexual women and men), the statistical analyses were conducted based solely on gender congruent ratings. In order to analyze eye movements for each image, the body regions of those in the images were divided by region-of-interest (ROI). These divisions included a face ROI, chest ROI, and pelvic ROI. If more than one individual was in the image, each individual would have their own set of ROI. For these images the latency to first fixation consisted of the first fixation to fall within one of the individual's ROI (e.g., face ROI-1 versus face ROI-2), and the total dwell time was a sum of dwell time within both individual's ROI. For the total dwell time, in addition to the three ROI of interest, we analyzed the "other" region of the image. This ROI was defined as the area in the image outside of the three ROIs, with the total dwell time consisting of the total image viewing time (5000 ms) minus the total dwell time in each of the three ROI. The mean, standard deviation, confidence interval, and effect size were calculated for the following: 1) the latency to *first fixation*, defined as the first fixation to fall on the ROI. 2) *number of fixations* that occur within the ROI. 3) *total dwell time* (or fixation duration) within each ROI. A Pearson's R correlation was calculated for each variable based on arousal. Mixed factorial ANOVAs were run with time to first fixation, first fixation, and dwell time, in each region of interest (face, chest, pelvic) based on arousal rating (high vs. low) as the within subject variable and participant sex as the between subject variable. Image category was further subdivided based on the sex of the model in the image (man vs. woman). Dwell time included an added ROI labelled 'other'.

Results

Data Integrity

Prior to generating the statistics, the data set was checked for the following exclusionary factors: participants who did not strongly identify as heterosexual, participants who did not meet the required eye tracking average calibration accuracy exceeding 40 pixels (~1° of visual angle), and trials associated with faulty machinery. Outliers were not excluded, as the assumption of homogeneity of variance is often violated within vision research due to sample size. A G power analysis test was run a priori to establish the sample size. A within, between ANOVA with 2 groups and 2 measurements requires a total sample size of 54. A robustness check and sequential analysis were carried out to ensure a sufficient sample size. For men, a Cauchy width prior of 0.70 (default used in JASP; Rouder et al. 2009) was sufficient to show a robustness of $BF_{10} = 4.850$. A sequential analysis was run, revealing that with approximately 15 participants, the data would reveal consistent results. Similarly, for women, a Cauchy width prior of 0.70 was sufficient to show a robustness of $BF_{10} = 1.268e^{10}$. A sequential analysis was run, revealing that with approximately 30 participants, the data would reveal consistent results.

Current study arousal ratings vs previous ratings

An independent sample *t*-test was run in order to compare the original ratings from the CID and the current ratings. For men, there was no statistically significant difference in ratings for low arousal images, $t(16) = 0.102$, $p = .92$, $d = 0.01$, however the participants in the current study rated the low images lower than those in the CID, $t(16) = 2.44$, $p = .03$, $d = 1.22$. Women differed significantly with the CID, such that low arousal images were rated lower than the CID, $t(18) = 8.36$, $p = .0001$, $d = 3.95$ and high arousal images were rated lower than the CID, $t(18) = 3.93$, $p = .001$. Furthermore, a *t*-test was run to ensure that high arousal images were rated significantly higher than low arousal images, $t(14) = 8.14$, $p < .001$, $d = 4.35$. No single images stood out as being outside their category (i.e. no low rated image was rated high in arousal or vice versa), therefore, no results were excluded based on image rating.

Time to First Fixation (Figure 5.1)

Mixed factorial ANOVAs were run for each ROI: one with rating (high or low arousal) as the within subject variable and participant sex as the between subject variable, and the other with image sex (man or women in the image) as the within subject variable.

Face. There were so significant effects of participant sex, $F(1, 232) = 0.234$, $p = .63$, $\eta^2 = 0.001$or arousal $F(1,232) = 0.09$, $p = .77$, $\eta^2 = 0.001$ for latency to the first fixation in the face. The results of the planned paired samples t-tests revealed that women were quicker to attend to the face ROI of high arousal images compared to low arousal images, $t(94) = 2.16$, $p = .03$, $d = 0.22$. Men did not show any difference based on arousal, $t(22) = -0.53$, $p = .60$, $d = -0.11$.

When results were analyzed based on image sex, time to first fixations on the specific regions of interest were more affected. Time to first fixation to the face ROI showed a main effect of image sex, $F(1,454) = 5.92$, $p = .02$, $\eta^2 = 0.13$, where participants were faster to view the face ROI of images of men compared to images of women, $t(456) = 2.42$, $p = .03$, $d = 0.24$. This indicates that the initial reaction to the face, is not one based on arousal, but rather the sex of the model. Paired samples *t*-tests revealed that women attended to the face ROI of images of women compared to images of men, $t(130) = 2.08$, $p = .04$, $d = 0.18$; whereas men showed a trend towards faster initial fixation to the face of images of women, $t(31) = 2.00$, $p = .05$, $d = 0.35$.

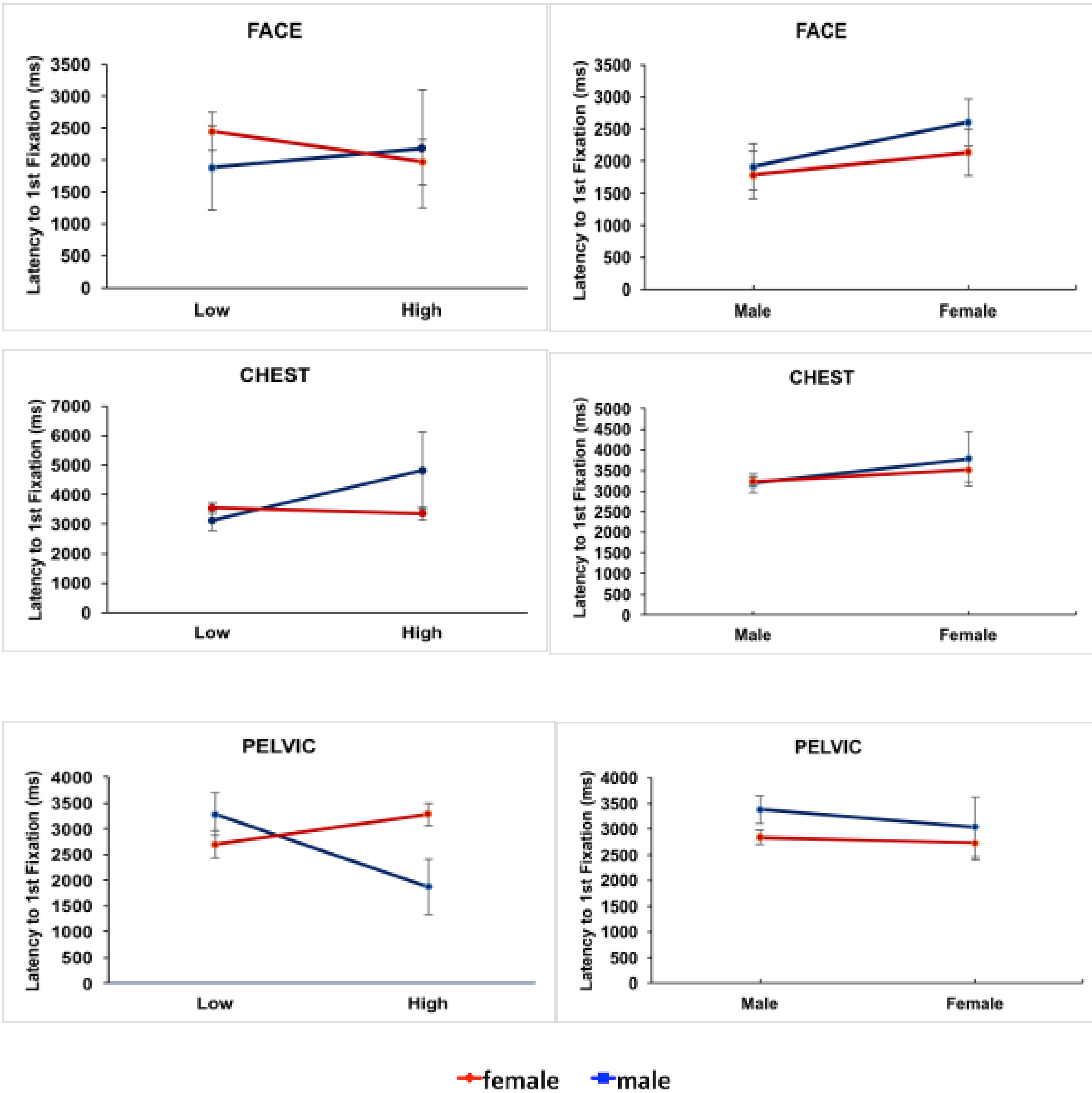
Chest. There was no effect of participant sex, $F(1,232) = 0.001$, $p = .97$, $\eta^2 = 0.001$, nor arousal, $F(1,232) = 0.19$, $p = .67$, $\eta^2 = 0.001$, for time to first fixation to the chest ROI. Based on the results of planned paired samples *t*-tests, women did not show a difference based on arousal levels, $t(94) = 1.50$, $p = .14$, $d = 0.15$, nor did men, $t(22) = -0.74$, $p = .47$, $d = -0.16$. These data suggest similar patterns for men and women participants regardless of how arousing the images are.

There was a main effect of image sex at the chest ROI $F(1,454) = 5.32$, $p = .02$, $\eta^2 = 0.01$, where participants were faster to view the chest ROI of images of men, $t(456) = 2.32$, $p = .02$, $d = .23$. Paired samples t-tests found no statistically significant differences for women, $t(130) = 1.75$, $p = .08$, $d = 0.15$, nor for men, $t(31) = 1.61$, $p = .02$, $d = .28$.

Pelvic. There was an interaction effect at the pelvic ROI, $F(1, 232) = 8.08$, $p = .005$, $\eta^2 = 0.03$. In particular, women had a shorter latency to first fixation in the low rated images, $t(116) = -2.42$, $p = .002$, $d = -0.56$, compared to men. There were no statistically significant differences for the high rated images, $t(116) = 1.59$, $p = .11$, $d = 0.37$. Furthermore, planned paired samples *t*-tests revealed that women attended to the pelvic ROI of high rated images faster that to low rated images, $t(94) = -3.11$, p = .002, $d = -0.32$; whereas men did not show any statistically significant difference based on arousal, $t(22) = 1.57$, $p = .13$, $d = 0.33$, which may suggest that

Figure 5.1

Latency to first fixation



Note. Latency to first fixation (measure of low level, automatic response) as a function of image and sex of model. Error bars are 95% CI.

women are predisposed to attending to genitalia whereas initial attention for men will be captured primarily by the face.

When analyzed based on image sex, there was a participant sex effect on time to first fixation in the pelvic ROI, $F(1,454) = 6.55$, $p = .01$, $\eta^2 = 0.01$, where overall, women attended to this region faster than man participants $t(68) = -2.89$, $p = .004$, $d = .36$. Women were quicker to attend to the pelvic ROI of images of men compared to male participants, $t(189) = -5.13$, $p < .001$, $d = 0.80$; however, paired samples *t*-tests revealed no differences for women, $t(130) = 1.05$, $p = .30$, $d = 0.09$ nor for men based on image sex, $t(31) = -0.08$, $p = .94$, $d = -0.01$. Taken together, these finding may suggest that the time to first fixation is more dependent upon the sex of the person in the image rather than how arousing it is. If first fixation is an indication of saliency and attention capture, these data suggest that a pelvic region is more salient to women than men.

Number of Fixations (Figure 5.2)

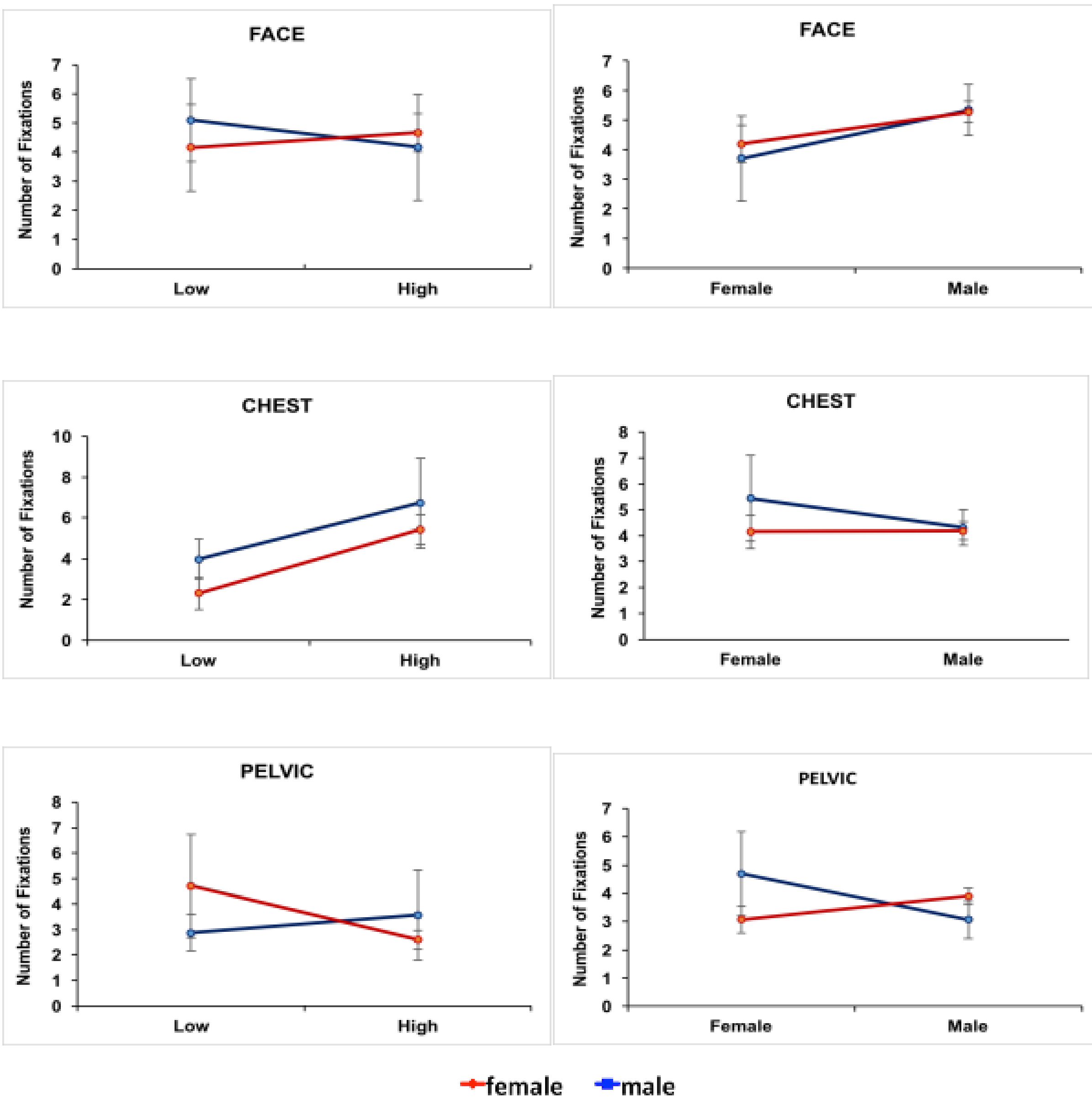
Face. There were no significant effects of participant sex, $F(1,232) = 0.001$, $p = .98$, $\eta^2 = 0.001$, or arousal $F(1,232) = 0.69$, $p = .41$, $\eta^2 = 0.003$, for number of fixations in the face ROI. When the data were analyzed by sex of the image, there was an effect of sex on the number of fixations in the face ROI, $F(1,454) = 10.03$, $p = .002$, $\eta^2 = 0.02$, where there were less fixations in the face ROI of women compared to men, $t(456) = -3.51$, $p < .001$, $d = -0.36$. Paired samples *t*-tests revealed that women made more fixations in the face ROI of men, $t(130) = 3.92$, $p < .001$, $d = 0.34$, as did male participants, $t(31) = 2.23$, $p = .03$, $d = 0.39$.

Chest. In the chest ROI, there was an effect of participant, $F(1,232) = 10.26$, $p = .002$, $\eta^2 = .04$, where men fixated on this region more than women, $t(234) = -2.83$, $p = 0.005$, $d = -0.47$. There was also an effect of arousal on the chest ROI, $F(1,232) = 39.76$, $p < .001$, $\eta^2 = 0.15$, where participants made more fixations on the chest ROI of high rated images, $t(116) = -4.28$, $p < .001$, $d = -0.99$; as well as an effect of participant sex, $F(1,232) = 10.26$, $p = .002$, $\eta^2 = 0.04$, with men performing more fixations on the chest ROI overall, compared to women, $t(234) = -2.83$, $p = .005$, $d = -0.47$. Planned paired samples *t*-tests revealed that women made more fixations in the chest ROI of high arousal images, $t(94) = -8.34$, $p < .001$, $d = -0.86$, as did men, $t(22) = -2.81$, $p = .01$, $d = -0.59$.

There was no effect of image sex on the chest ROI, $F(1,454) = 2.46$, $p = .12$, $\eta^2 = 0.01$. There were no statistically significant differences between participants based on image sex,

Figure 5.2

Number of fixations



Note. Number of fixations as a function of image and sex of model. Error bars are 95% CI.

$t(456) = 0.89$, $p = .38$, $d = 0.09$; however, men made more fixations on the chest ROI of images of men compared to women participants, $t(189) = -3.00$, p = .003, $d = -0.47$ with no statistically significant differences when viewing image of women, $t(161) = -1.60$, $p = .11$, $d = -0.32$. Paired samples t-tests revealed that women made more fixations in the chest ROI of women, $t(130) = 2.41$, $p = 2.41$, $p = .02$, $d = 0.21$, as did man participants, $t(31) = 2.55$, $p = .02$, $d = 0.45$ suggesting that the women chest area is of interest to both men and women, possible due to the increased sexual saliency of women breasts. Also, the chest area seems to be a valuable source of information for man participants.

Pelvic. There was an interaction effect at the pelvic ROI, $F(1,232) = 11.96$, $p = .001$, $\eta^2 =$ 0..05, where women fixated more often in the pelvic ROI of low rated images compared to men $t(116) = 2.66$, $p = .009$, $d = 0.62$, whereas men fixated more on the pelvic region of high rated images $t(116) = -2.21$, $p = .03$, $d = -0.51$. Paired samples t-tests revealed that women made more fixations in the low arousal images compared to high arousal, $t(94) = 5.93$, $p < .001$, $d = 0.61$; however, there were no statistically significant differences for number of fixations in the pelvic ROI based on arousal for men, $t(22) = -0.92$, $p = .37$, $d = -0.19$.

When analysing number of fixations based on image sex, there was an interaction effect of image sex and participant sex at the pelvic ROI, $F(1,454) = 38.21$, $p = .02$, $\eta^2 = 0.01$, specifically, women made more fixations at the pelvic ROI of images of men, $t(189) = 4.84$, $p < .001$, $d = 0.75$, and men made more fixations to the pelvic ROI of women, though this did not achieve statistical significance, $t(161) = -0.95$, $p = .35$, $d = -0.19$. Paired samples t-tests revealed that women made more fixations in the pelvic ROI of images of men compared to images of women, $t(130) = 5.09$, $p < .001$, $d = -0.45$ with no statistically significant difference for men, $t(31) = -0.14$, $p = .89$, $d = -0.02$.

Dwell Time (Figure 5.3)

Face. There was no effect of participant sex, $F(1,232) = 0.05$, $p = .83$, $\eta^2 = .001$, or arousal $F(1,232) = 0.06$, $p = .81$, $\eta^2 = .0001$, in the dwell time on the face ROI. When the results were subdivided by image sex, there was no effect on the dwell time on the face ROI based on image sex, $F(1,454) = 3.47$, $p = .06$, $\eta^2 = 0.01$. Paired samples t-tests revealed that women dwelled longer on the face of images of men, $t(130) = 2.24$, $p < .001$, d = 0.19. There were no statistically significant differences for men, $t(31) = 1.32$, $p = .20$, $d = 0.23$.

Chest. In the chest ROI there was an effect of participant sex, $F(1, 232) = 10.41$, $p = .001$, $\eta^2 = 0.04$. In particular, men spent more time in the chest ROI compared to women, $t(234) = -2.98$, $p = .003$, $d = -0.49$. There was also an effect of arousal, $F(1, 232) = 22.21$, $p < .001$, $\eta^2 = 0.09$, where participants dwelled longer on the chest ROI of high arousal images compared to low, $t(234) = -6.31$, $p < .001$, $d = 1.18$. Paired samples *t*-tests revealed that women dwelled longer in the chest ROI of high arousal images, $t(94) = -6.71$, $p < .001$, $d = -0.69$; for men, there were no statistically significant differences based on arousal, $t(22) = -1.67$, $p = .11$, $d = -0.35$.

When analyzed based on image sex, at the chest ROI, there was a main effect of participant sex, $F(1,454) = 5.80$, $p = .02$, $\eta^2 = 0.01$, where men spent more time in the chest ROI, $t(68) = -2.14$, $p = .03$, $d = .26$. Men showed a trend to more fixations in the women's chest ROI compared to women participants, $t(161) = -1.62$, $p = .05$, $d = -0.38$, as well as men showing longer dwell time in the chest ROI of men, $t(189) = -3.12$, $p = .002$, $d = -0.48$. Paired samples *t*-tests revealed that women dwelled longer on the chest ROI of women compared to images of men, $t(130) = 2.44$, $p = .02$, $p = 0.21$, with no statistically significant difference for men, $t(31) = 1.84$, $p = .07$, $d = 0.33$.

Pelvic. There was an interaction effect of participant and arousal at the pelvic ROI, $F(1,232) = 13.04$, $p < .001$, $\eta^2 = 0.05$. Specifically, women dwelled longer in the low arousal pelvic ROI than men, $t(116) = 2.50$, $p = .01$, $d = 0.58$, and men dwelled longer in the pelvic ROI of high arousal images than women, $t(116) = -2.67$, $p = .009$, $d = -0.62$. Planned paired samples *t*-tests revealed that women dwelled longer in the pelvic ROI of low arousal images $t(94) = 6.21$, $p < .001$, $d = 0.64$; however, for men, there we no statistically significant differences based on arousal, $t(22) = -1.00$, $p = .33$, $d = -0.21$.

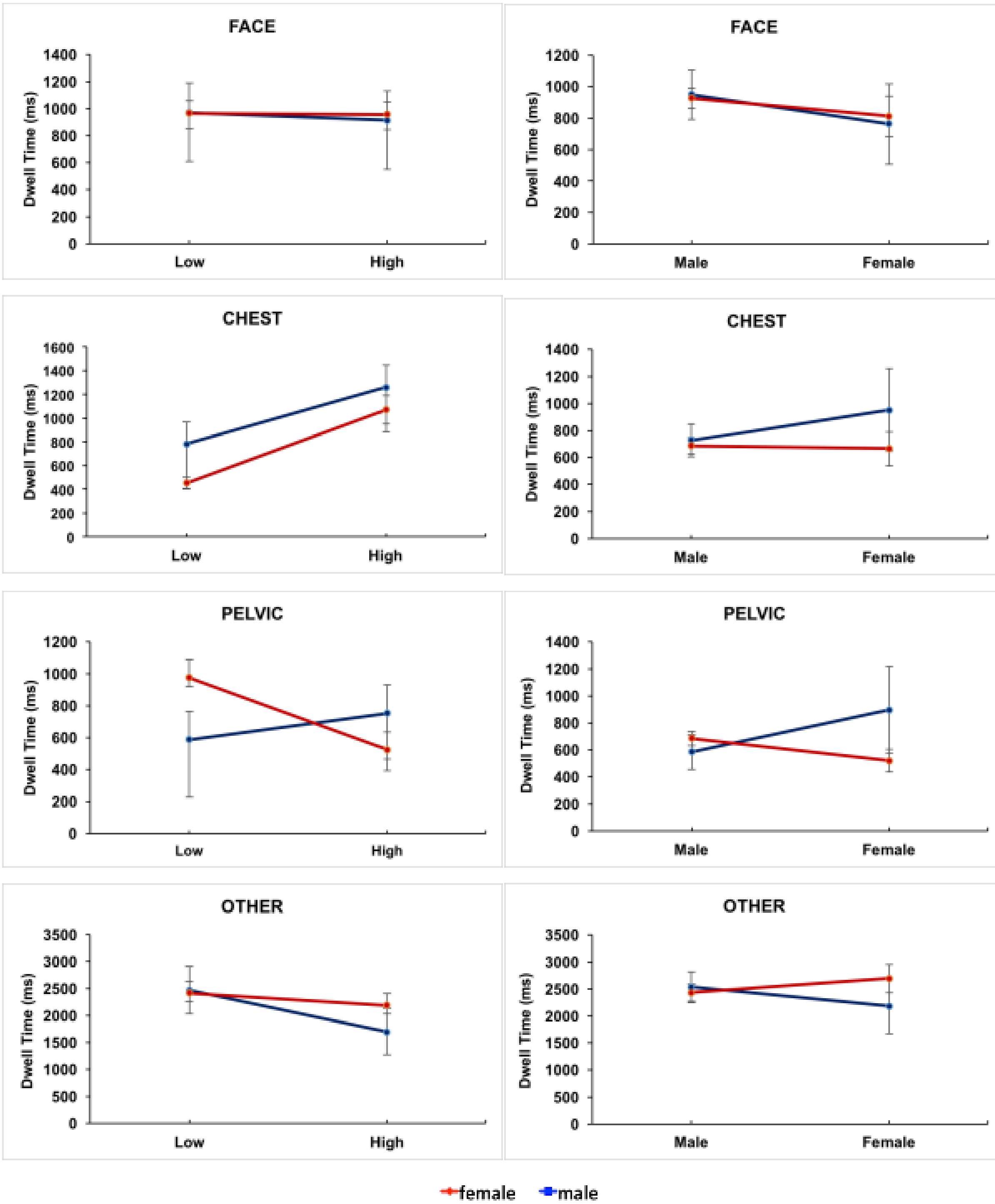
When analyzed based on image sex, there was an interaction effect at the pelvic ROI, $F(1,454) = 7.24$, $p = .007$, $\eta^2 = 0.01$, where women dwelled longer on the pelvic region of men $t(189) = 4.18$, $p < .001$, $d = 0.65$ and men dwelled longer on the pelvic ROI of women, $t(161) = -1.62$, $p = .11$, $d = -0.32$, though not achieving statistical significance. Paired samples *t*-tests revealed that women dwelled longer in the pelvic ROI of men, $t(130) = -4.94$, $p < .001$, $d = -0.43$, however, there was no statistically significant difference for male participants, $t(31) = 0.12$, $p = .90$, $d = 0.02$.

Other. There was a marginally significant effect of participant on dwell time of 'other' ROI, $F(1,232) = 3.88$, $p = .05$, $\eta^2 = 0.02$, with women dwelling longer in the pelvic ROI, $t(234)$

= 1.96, p = 0.05, d = 0.32 compared to men, as well as a statistically significant effect of arousal, $F(1,232) = 4.54$, $p = .03$, $\eta^2 = 0.02$. Women dwelled longer on the 'other' ROI of high rated images than men, $t(116) = 2.26$, $p = .03$, $d = 0.52$; however, there was no significant difference for low rated images, $t(116) = 0.49$, $p = .63$, $d = 0.11$. Interestingly, paired samples t-tests revealed that men showed a longer fixation time on the 'other' ROI of low rated images compared to high rated images, $t(22) = 1.998$, $p = .05$, $d = 0.42$, approaching significance with a moderate effect size; women showed no significant difference when comparing high and low images, $t(94) = 0.92$, $p = .34$, $d = 0.10$. Regardless of how interesting the image may be, women were also equally interested in the surrounding context of the image.

When analyzed based on image sex, there was a marginally significant interaction effect, $F(1,454) = 3.74$, $p = .05$, where women dwelled longer on the 'other' ROI of images of women $t(161) = 2.03$, $p = .04$, $d = 0.40$ and men dwelled longer on the 'other' ROI of images of men $t(189) = -0.41$, $p = .68$, $d = -0.06$ though not achieving statistical significance. Taken together, dwell time on the 'other' ROI suggests that women incorporate context as part of their interest; whereas, for men, attention to this ROI appears to be indicative of less interest in the model.

Figure 5.3.
Dwell time



Note. Dwell time as a measure of sustained attention Comparisons based on arousal levels and sex of image. ROI 'Other' refers to any eye movements onto non-body image regions. Error bars are 95% CI.

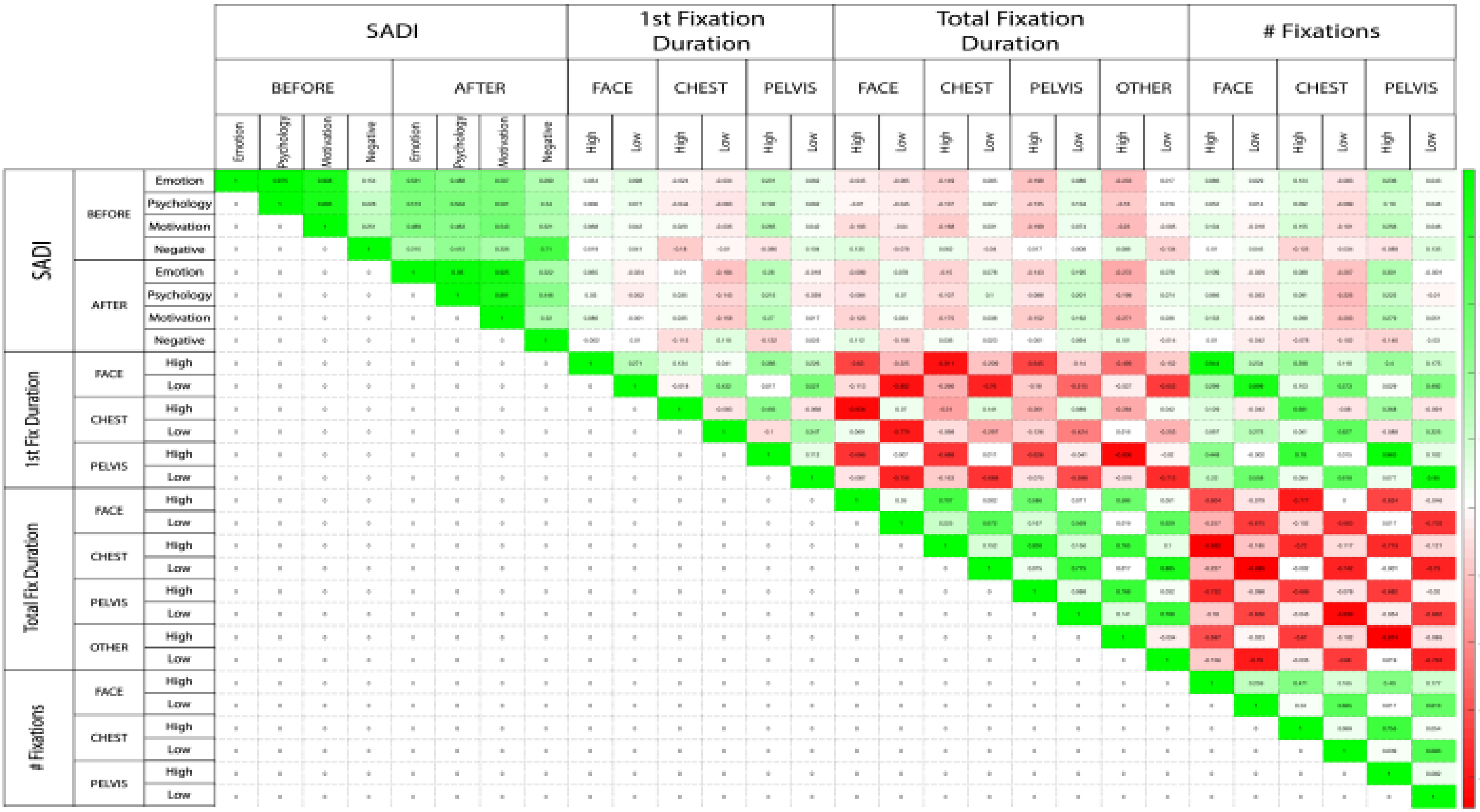
Correlations

Correlations were run in order to assess the influence of hormonal contraceptives, sex play and thoughts, desire levels, relationship duration, as well as difficulty during sex and SADI measures pre-and post-test and porn use. For full correlations see Table 5.1(women) and 5.2 (men). For women, hormonal contraceptives were not correlated with any eye movement patterns (first fixations, number of fixations, dwell time). Amount of sex play was correlated with number of fixations in the pelvic ROI of high rated images, $r(56) = 0.217$, $p < .05$. Desire levels were correlated with dwell time in the pelvic ROI of high rated images, $r(56) = 0.26$, $p < .05$ as well as negatively correlated with dwell time in 'Other' ROI, $r(56) = -0.29$, $p < .01$ suggesting more time spent on the body ROIs. Desire was also correlated with shorter time to first fixation in the face ROI of high rated images $r(56) = -0.263$, $p < .05$, and a shorter time to first fixation in the chest ROI of high rated images, $r(56) = -0.325$, $p < .01$ and finally a shorter first fixation to the pelvic ROI of high rated images, $r(56) = -0.301$, $p < .01$. Interestingly, while it has been suggested that the time to first fixation may be a reflexive action, these correlations suggest that there is some interplay with desire levels and some early processing may be occurring. Amount of porn used was not correlated with any eye movement patterns suggesting no desensitizing effect of pornography use. Results from the SADI (post-test) were correlated with first fixations to the pelvic ROI of high rated images. Specifically those who scored higher in the emotional factor showed a shorter latency to first fixation to the pelvic ROI, $r(56) = -0.233$, $p < .05$ as well as more fixations in the pelvic ROI of high rated images, $r(56) = 0.236$, $p < .05$. Similarly those that scored high in the post test emotional factor were negatively correlated with latency to first fixation in the pelvic ROI of high rated images, $r(56) = -0.272$, $p < .01$ as well as more fixations in the pelvic ROI of high rated images, $r(56) = 0.301$, $p < .01$. Number of fixations in the pelvic ROI was also correlated with post test SADI scores from the psychological factor, $r(56) = 0.222$, $p < .05$, and the motivational factor, $r(56) = 0.279$, $p < .001$ suggesting that, for women, the pelvic ROI of high rating images seems to be correlated with arousal and desire levels.

For men, desire was not correlated with any eye movement patterns, neither was porn use. Frequency of difficulty during sexual intercourse was correlated with longer latency to first fixation in the low rated face ROI, $r(18) = 0.563$, $p < .001$, as was time to chest ROI of low rated images, $r(18) = 0.730$, $p < .001$. Results from the SADI suggest a shorter time to first fixation in the pelvic ROI of high rated images when the negative factor was high in the pre-test questionnaire, $r(18) = -0.454$, $p < .05$ suggesting that time to the first fixation in the pelvic ROI may be more of a reflexive eye movement based on an aversion. Interestingly, while porn use did not affect the eye movement patterns for men, it was correlated with many of the post test SADI factors, specifically it was correlated with higher levels of emotional factor, $r(18) = 0.595$, $p < .01$, psychological factors, $r(18) = 0.690$, $p < .001$, and motivational factors, $r(18) = 0.671$, $p < .001$ with no correlation to negative factors, $r(18) = 0.305$, $p > .05$, suggesting a positive influence of pornography exposure.

Table 5.1

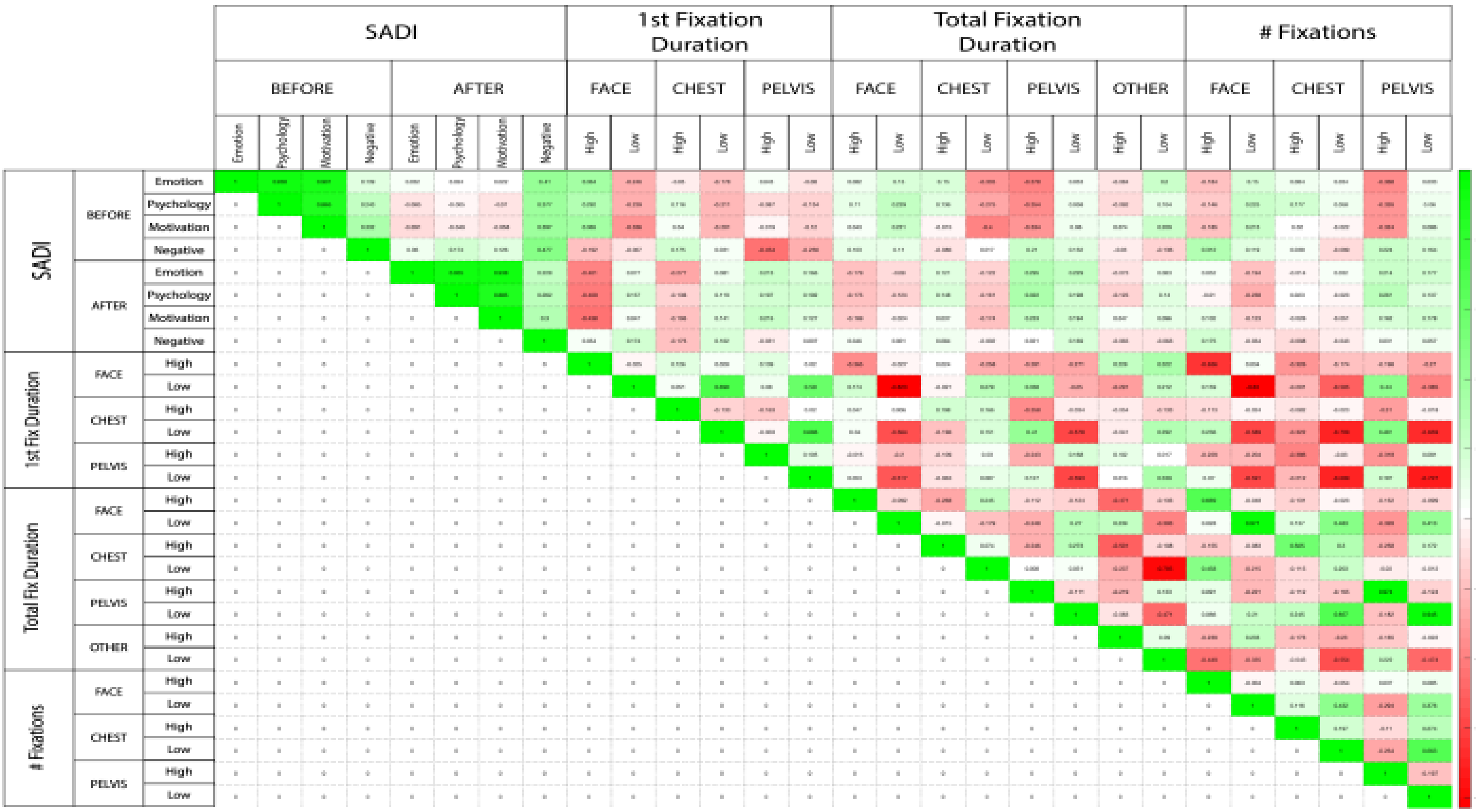
Female correlations



Note. Female correlations to pre and post test SADI. p < .01 (red), p < .05 (green)

Table 5.2

Male Correlations



Note. Male correlations to pre and post test SADI. p < .01 (red), p < .05 (green)

Discussion

The aim of this study was to track eye movement patterns (including scan path, dwell time, number of fixations, and time to first fixation) for images based on ratings of arousal and valence. Furthermore, the data were analyzed based on the sex of the models in the images. This variation in sexual saliency was expected to result in different patterns of image region processing. We hypothesized that both women and men would show a greater degree of attention allocation for images that had been previously rated as highly arousing, and less specificity for images previously rated as low-arousing. Images were divided into face, chest, pelvic, and 'other' regions of interest (ROI). Given that women have shown less specificity in sexual attention (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers et al., 2010) by attending to their preferred and non-preferred stimuli equally, it was hypothesized that they would show similar eye movement patterns for images of men and women. Our data support the notion that eye movement patterns are significantly different between men and women when viewing low and high arousing images as well as if the target image is of a man or woman. In particular, participants showed differences in their scan path, where women consistently looked at face, pelvic, then chest, of images irrespective of arousal rating or sex of the image. Men, however, were more specific in where they looked in high and low arousing images. When viewing images that have been rated as high in arousal, their initial fixation was to the pelvic ROI, followed by face, then chest. When looking at low rated images, the scan path was face, chest, pelvic. This is consistent with the findings of Farisello and colleagues (2014) that found the same scan paths when participants viewed images rated as moderate in arousal. When subdivided by the sex of models within the viewed image, men showed a pattern of face, chest, pelvic when looking at men (similar to low arousal category); and face, pelvic, chest when viewing women.

Although a pattern of objective specificity of sexual preference was seen with both the women and men, preference for regions within the image appeared to occur regardless of the type of image presented (e.g., high versus low). In comparison to other ROIs, there was increased attention allocated to the facial ROI, irrespective of level of arousal and sex of image. A potential reason as to why so much attention is given to the face ROI is that facial cues are important to human sexual behavior. Greater sexual interest with the high arousal images may have led women to go to the face first as a reflex (Langton, Law, Burton, & Schweinberger,

2008) to gain information about the individual's health and fitness, before moving their eyes onto the bodily regions for further reproductive evaluation (Nummemnaa et al., 2012). According to the sexual strategies theory (Buss & Schmitt, 1993), heterosexual women attend to cues that reflect a man's status (e.g., facial hair, maturity; Dixson & Vasey, 2012). Other body regions that involve muscularity are also important when heterosexual women evaluate a man's attractiveness, as seen with the progressive viewing of the chest and pelvic regions of the high arousal images (Frederick & Haselton, 2007). Participants spent longer and made more fixations to the face ROI of images of men. We can speculate that this may be because women were looking at the face out of interest and men as a means to avoid other ROIs on the nude man. After this initial fixation location, overall women then continued with an eye movement to the pelvic region, displaying a similar pattern of preference for the high arousal images. Although not as apparent, men also showed a trend of objective specificity of sexual preference; however, the pattern of eye movements differed from what was seen with the women participants. Specifically, man participants spent longer in the chest ROI of images, including in those images rated low in arousal. This behavior in men is different from women participants, who dwelled longer in the chest ROI of high rated images, irrespective of the sex of the model in the image.

An unexpected finding occurred in the pelvic ROI. Our women spent increased amount of time, and made frequent and faster first fixations to the pelvic ROI of low rated images. These findings may be due to the fact that the sight of a penis may be particularly engaging, regardless of whether the rest of the image content is pleasurable (Spape et al., 2014). Based on previous literature, an erect penis has been shown to capture a heterosexual woman's attention (Farisello et al., 2014; Nummenmaa et al., 2012; Spape et al., 2014); with women initially fixating on the pelvic region when viewing images of nude men. In addition to orienting toward and fixating on the genitals, heterosexual women have been found to display greater brain activity when viewing penises (Ponseti et al., 2006), as well as having their own genital response when the penis is erect (Spape et al., 2014). Such findings are not surprising, as an erect penis has both reproductive and erotic value to women. Why then did the women in the current study spend a similar amount of time orienting towards and fixating on the pelvic region of both the high and low arousal images? A potential reason is that the low arousal images also included erect penises, indicating that women had the potential to fixate on an erect penis in both the high and low arousal images. Additionally, the low arousal images displaying non-preferred sexual stimuli (e.g., exposed vulva) may have captured the women participants' attention due to identification with the women in the image. The women may not have been viewing the pelvic region of such images as an object of their sexual desire; instead they may have identified with their gender's genitalia being displayed in the image (Bossio, Spape, Lykins, and Chivers, 2013). Furthermore, when comparing the amount of time both sexes spent looking at the "other" region of the image, men spent more time in the body ROIs of the high rated images compared to low, however, this was not evident with women participants. There was almost an equal split of time between the bodily ROIs and the "other" region. This may indicate that women may be searching for context within these images and the sight of a nude body may not be sufficiently satisfying for women (regardless of how arousing they find these images).

Regarding the limitations of this study, while there is a clear distinction between the high and low arousal images based on the heterosexual men's ratings, heterosexual women tended to rate the images more moderately (Shilhan et al., *submitted*). This lack of a clear separation between the high and low arousal images as rated by heterosexual women were more representative of high and low ends of a moderate spectrum as opposed to capturing truly high and low arousal images. Further, few of the low rated images by heterosexual men included women. As a result, a direct comparison of high and low arousal images was limited, as comparisons often involved images of homosexual men to nude women. It is also possible that these images did not reflect the preferences of our participants, suggesting that attentional differences were not indicative of a difference in arousal. A common limitation to consider when conducting sex research is volunteer bias; for example, volunteers in sex research masturbate more, are more sociosexually open (Marcinkowska, Helle, & Lyons, 2015), and have a higher number of sexual partners (Morokoff, 1985, 1986; Strassberg & Lowe, 1995**).** Although the use of eye tracking lends to greater privacy compared to sexual physiological measures (e.g., plethysmography), this form of bias must still be considered.

Ultimately, through the use of previously rated images, both heterosexual women and men showed objective specificity in what they found sexually arousing. Furthermore, the different patterns of increased allocation of attention indicate that heterosexual women and men do not process sexual stimuli in the same way. Using images solely because they contain sexual content is not enough when using eye tracking as a measure of sexual arousal. Due to the differences between the sexes in their allocation of attention, having one gender randomly pick the images to be used as sexual stimuli may not capture this difference in preference. Likewise, perhaps the specificity of sexual preference cannot be dichotomized as basically as man or women given the apparent fluidity of women sexuality. A follow up study which presents two images simultaneously (similar methodology to Dawson & Chivers, 2016), would allow further comparisons of eye movement patterns given the option for participants to attend to one image rather than the other.

Chapter 6: Effects of Menstrual Cycle on Scan Path Patterns While Viewing Erotic Videos

Effects of Menstrual Cycle on Scan Path Patterns While Viewing Erotic Videos

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Abstract

The purpose of this study was to quantify eye movement patterns of men and women when viewing erotic video clips as well as to track a difference in these patterns based on the women's menstrual cycle. Three groups of participants (men, women on contraceptives, naturally cycling women) viewed a pornographic film (~12 min) which had been divided into four clips (Clip 1: clothed interaction, Clip 2: nude interaction & oral sex, Clip 3: penetrative intercourse, Clip 4: climax, cuddling). Naturally cycling women used an ovulation predictor in order to be tested during ovulation, then again when luteal. Women on contraceptives, and men, were tested at a two-week interval in order to maintain testing consistency. Within isolines areas were quantified in order to assess correlations between the groups as well as to verify in which scenes participants fixated on similar content or where the attention was divided. The clips with the highest correlated eye movement patterns included clothed interaction between actors then proceeding to nude interaction. Similarities in these clips were fixations on the actress' face as well as the saccades around the contextual cues. Men showed correlations with both the NOV as well as the OV women. Women (PILL) were mostly focused on the actors whereas the naturally cycling women (OV and NOV) showed similar interest to men in the contextual cues. When the video became more sexually salient, the interest for all groups was the actress' chest. In the clips, which included nude interaction, men's fixations were on the actress' face whereas women of all groups looked at contextual cues. During the penetrative intercourse clip, ovulating women maintained a gaze on two specific ROIs, in particular the actress' face and actor's penis. The results of this study suggest that hormones may modulate eye movement patters in order to acquire the most valid information.

***Keywords*: Cognition, eye tracking, ovulation, arousal**

Introduction

Sexual arousal as a construct has been defined as a combination of objective sexual responses (i.e., physiological responses such as engorged genitalia, activation of neural correlates, increased heart rate, etc.) and subjective or perceived levels of arousal (i.e., person specific, self-reported qualification of an arousal state). One possible mediator of sexual arousal for women, which affects both physical and psychological responding, is the fluctuation of hormones throughout the menstrual cycle. The ovulatory shift hypothesis (Buss, Pillsworth, & Hasleton, 2004) suggests that women experience a change in sexual behavior, specifically increased arousal and motivation towards sexually salient cues when approaching ovulation. This is evident in studies which found that during ovulation, women rate men's facial hair (Dixson & Brooks, 2013; Penton-Voak et al., 1999), masculine features (Penton-Voak & Perrett, 2000; Thornhill & Gangestad, 1996), and even the scent of facially symmetrical men (Gangestad, Thornhill, & Garver-Apgar, 2005) as more arousing. Women also self-reported a significant increase in subjective levels of sexual arousal (i.e., feelings, fantasies, and dreams) during ovulation (Dawson, Suschinsky, & Lalumiere, 2012; Regan & Berschied, 1999; Slob et al., 1996). Unexpectedly, Slob and collegues found that women who were ovulating and non-ovulating showed the same physiological response (as measured using labial temperature); however, they reported heightened subjective arousal indicating that this increase in arousal is predominantly psychological.

Researchers have used video stimuli to track levels of objective and subjective arousal at both the follicular and luteal stages of ovulation (Bossio, Suschinsky, Puts, & Chivers, 2013; Suschinsky, Bossio, & Chivers, 2014). Bossio and collegues (2013) presented naturally cycling women with 12 films (same films as Chivers, Seto, & Blanchard, 2007) which varied in sexual content from neutral (landscapes), exercising, masturbation, and same sex intercourse (heterosexual intercourse clips were not analyzed); at the follicular stage, then again when luteal (ovulatory state and video progression counterbalanced). What they found was that objective sexual arousal was not more sex specific during the follicular phase, but rather, it was a greater predictor of physiological arousal. Suschinsky and colleagues (2014) further analyzed this with the inclusion of heterosexual intercourse clips. They found that women in the follicular stage showed more objective arousal in both sessions when viewing penetration, with subjective arousal rating staying consistent throughout the ovulatory cycle. These studies are important because they highlight that the lack of sex specificity in women's arousal is not because of the fluctuation in hormone or fertility. It appears as though arousal (specifically subjective arousal) superseded the potential of fertilization given that arousal was not sex specific. This also gives an explanation for the physiological arousal that occurs in absence of subjective arousal. Suschinsky (2014) suggested that these findings give credence to the preparation hypothesis (Bancroft & Graham, 2011; Chivers, 2005; Suschinsky & Lalumiere, 2011) which suggests that a woman's vagina will lubricate automatically whenever there is the possibility of sexual contact in an effort to minimize any potential injury which may arise (Levin, 2003). This evolutionary adaptation in which the body primes itself, may explain why there is non-specificity in physiological arousal (Benson, 2003; Chivers et. al, 2004, Chivers et al., 2010).

Although these studies have used video in order to measure arousal, they have not explored what exactly on the screen is captivating the participants' attention. To date, only one group of researchers have investigated eye movements using erotic video stimuli. Tsujimura and colleagues (2009) used two segments of video as the sexual stimuli; a non- intercourse clip (nude heterosexuals kissing), followed by a video segment of heterosexual intercourse. The researchers found that there was more variability in eye movements in participants when viewing the non-intercourse scene. Specifically, men looked more frequently at the actress' face and body, while women looked more frequently at the actor's body, face, and contextual aspects. However, when viewing the segment that contained sexual intercourse, there was no statistically significant difference between men and women's viewing patterns. These findings suggest that gender differences are less evident when sexual stimuli are more explicit (i.e., during the intercourse scene), compared to one of less sexual saliency (i.e., non-intercourse scene). The greater variability in the non-intercourse scene is indicative of individuals searching the screen for information that is of interest. When a highly salient, sexual stimulus is on screen, the focus is more narrow (for both men and women).

While the study developed by Tsujimura and colleagues (2009) provided a crucial foundation in terms of using erotic videos as stimuli, there were some limitations to the study. First, they did not collect self-reported measure of arousal therefore it is difficult to infer whether or not these differences in eye movement patterns were the result of differences in subjective or objective arousal levels. Secondly, women were grouped together without regard to their ovulation cycles. As previous researchers have shown, women's sexual behavior changes throughout the ovulation cycle (Buss et al., 2004). The present study sought to build upon the research conducted by Tsujimura and colleagues (2009) by addressing these main limitations. Participants viewed an erotic movie while self-reporting their current level of sexual arousal. Three different groups of participants were recruited: men, women on hormonal contraceptives, and naturally cycling women. The distinction was made between women taking hormonal contraceptives and those that were not, as contraceptives artificially alter the physiological fluctuations of LH and estrogen, and thereby suppress ovulation (Behre, Kuhlage, & Gassner, 2000). Eye movements while viewing the erotic video were measured at two time points. Naturally cycling women were tested at the start of ovulation (confirmed with an ovulation predictor), when LH and estrogen are at maximal levels, and again 14 days later when these hormones were at lower levels and sufficient time had passed for familiarity with the movie to be less of an influence. The first exposure to the movie and hormonal state were counterbalanced in order to further analyze the order effect which has been found in previous research (Slob et al., 1991; Suschinsky et al., 2014;Wallen & Rupp 2010) which suggests that when women are in the follicular phase and shown highly sexually salient stimuli, the following time, stimuli will also be interpreted as highly arousing as though the heightened saliency results in a priming effect not seen in women whose first exposure is during the luteal phase.

Given the previous findings by Tsujimura and colleagues (2009), as well as what has been suggested by the ovulatory shift hypothesis (Buss et al., 2004) it is hypothesized that all groups will look at sexually salient areas of the video. It is also hypothesized that women on contraceptives, will experience less subjective arousal while watching the video and as such will fixate and saccade towards contextual aspects of the video. This group should display the greatest within group variability given that their attention will be less focused upon the sexual content of the video (compared to the other groups). Men and ovulating women should show the highest levels of subjective arousal and as such should show similar eye movement patterns, mainly focused on the most sexually salient regions of interest in the video. Given what has been shown extensively about gender specificity for arousal (or lack thereof for women; Benson, 2003; Bossio et al., 2013; Chivers et. al, 2004, Chivers et al., 2010; Suschinsky et al., 2014) it is hypothesized that women will show less specificity for their preferred gender, however, will show more attention to the sexual acts being portrayed.

Method

Participants

A total of 56 participants; 20 men, and 36 women (26 taking oral contraceptives and 10 normally cycling, M_{age} =24.56, SD = 3.24). Students were recruited from Concordia University, Montreal, QC., Canada. All of the participants gave informed consent, and received either cash compensation (10$), or a participation credit for the Psychology Participant Pool. Only participants that were self-identified as exclusively heterosexual (i.e., by answering 0 or 1 on the Kinsey Scale; Kinsey, Pomeroy, & Martin, 1948) were included in the study. The research protocol was approved by the human research ethics board at Concordia University, in accordance with the Canadian Tri-Council policy statement of ethical conduct for research involving humans.

Materials

All stimuli were presented on a 21" Viewsonic G225fb Cathode Ray Tube screen (Screen resolution of 1024 x 768 pixels, 100Hz refresh rate) on a Dell 3.2GHz Dual-Core computer running Microsoft Windows 7. Eye movements were recorded using an S2 Eye tracker (Mirametrix, Montreal) running on the same computer. The Mirametrix S2 (Mirametrix, Montreal), was used to assess participant's eye movements when viewing the sexual stimuli. The eye tracker samples the eye position at 60 hertz. All aspects of the experiment (i.e., image presentation, eye tracking recording, and data analysis) were conducted in parallel using the Open Gaze and Mouse Analyzer (OGAMA) open-source software (ver. 4.5: Voßkühler, Nordmeier, Kuchinke, & Jacobs, 2008). Briefly, OGAMA allows for the recording and analyzing of eye tracking data from slideshow eye tracking experiments, and it can control the S2 eye tracker directly from the recording interface.

The pornographic video used was originally available on a commercial DVD, entitled "The Perfect Fit" (http://Babes.com). This video was chosen based on a number of inclusion criteria. Specifically, researchers were looking for approximately equal exposure of the on-screen couple, as both sexes were required to be equally visible throughout the duration of the video. In addition, the setting in which the on-screen couple was filmed needed to be minimally distracting (setting minimally decorated, mild lighting). The video was digitized using Handbrake (ver. 0.9.9; https://handbrake.fr), and edited into four segments using iMovie (ver. 10.0.6; Apple, California). The segments (segment 1: 145 s, segment 2: 145 s, segment 3: 122 s, segment 4: 134 s) each contained a different stage of sexual activity: clothed and interacting, nude interaction and oral sex, heterosexual intercourse, climax and post-intercourse cuddling.

Measures

Ovulatory Predictor Test (OPT). The Clear Blue ovulation test was administered to the women participants who are not taking contraceptive. The test accurately (97%: manufacturers specification) determines the time of ovulation by assessing of luteinizing hormone (LH) and estrogen 24-36 hours prior to ovulation. According to Behre, Kuhlage, and Gassner (2000), the Clear Blue provides high probability (.97) of indicating that ovulation occurred within two days of the peak levels of LH.

Demographics Questionnaire. A demographics questionnaire was administered to all participants prior to beginning the study. This was used to determine basic information such as age, ethnicity, religion, and relationship status.

Sexual Arousal and Desire Inventory (SADI). The SADI questions were administered to evaluate the subjective experience of sexual arousal and desire (Toledano & Pfaus, 2006) at the start of the experiment for a baseline measure, as well as after watching the movie. It consists of 54 item descriptors, and has four dimensions: cognitive-emotional, motivational, physiological, and negative control (Cronbach's alpha is .90). Individuals were presented with a list of descriptive words and as to rate each word on a Likert type scale based on how it reflects their current state of arousal (1 = "does not describe it at all" and 5 = "describes it perfectly").

Beck's Depression Inventory (BDI). The BDI is designed to measure the levels of depression within individuals who are at least 13 years of age. It consists of 21 multiple-choice questions designed to measure levels of depression. Each item describes a symptom the participant has been experiencing in the past week. Participants have the choice of four statements (0,1,2,3). For example, some statements that participants will choose from are "I am not particularly discouraged about the future", "I feel discouraged about the future", "I feel I have nothing to look forward to", or "I feel the future is hopeless and that things cannot improve" (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The items are scored from 0 to 3, 0 indicating the least severe statement and 3 indicates the most severe. The BDI has high internal consistency (.86: Beck et al., 1961). This was used strictly as an exclusion criterion. Any participant that scored as having depressive tendencies were excluded from the study and referred to the Counselling Department of Concordia University. This was done because depression may negatively influence arousal states (example see Lykins, Janssen, & Graham, 2006).

Procedure

Participants were scheduled for a preliminary meeting to discuss brief details of the study, explained informed consent and were scheduled for future testing dates. Women on contraceptives, as well as men, were tested twice in a two-week interval. Women not on contraceptives were given the Clear Blue ovulatory predictor test with detailed instructions on how to properly utilize the test. Naturally cycling women tested their hormonal levels through the use of disposable test sticks for two months. The first month was used as a means for the women to familiarize themselves with the ovulation predictors as well as to establish their "normal" cycling. Naturally cycling women were tested once at the start of ovulation (as indicated by a "smiley" face on the ovulation predictor) and once when they were not (approximately 2 weeks, assessed by no indication of a "smiley" face).

The first scheduled testing session began with the participants' completion of the demographics questionnaire and also the pre-trial SADI to assess baseline arousal levels. The researcher then started the OGAMA program, to calibrate the participant's pupil and corneal reflection for accurate recording of the eye-movement data, based on a 9-point calibration system. The calibration was accepted if the average error was equal or less than .5°, and that the maximum error was less than 1°. After the calibration, the participant was then advised to read the instructions on the opening screen, before pressing the "space-bar" to begin the experiment. The first self-report arousal question was placed on the screen, with the participant using the keypad to answer their current arousal level. Once the answers were entered, the video presentation began. Each video began with a fixation circle (1° in diameter black outer circle, .7° diameter white inner circle), which the participant was instructed to fixate to initiate the trial. Headphones were used to listen to the audio of the video, and to eliminate any other distracting noise from the surrounding environment. The erotic video was presented in 4 segments with a brief pause between segments, where an on-screen arousal scale. The on-screen arousal scale was presented before the study began, to assess baseline levels of sexual arousal, and then the questions were repeated between each movie clip to assess changes in arousal levels. During this state arousal segment, participants were asked to rate three statements: "I am sexually aroused" (subjective arousal), "My body feels aroused" (attune to physiological state), "I will likely engage in sexual activity" (motivation to engage in any type of sexual activity, not limited to intercourse). Participants were asked to respond with a Likert type scale from 0-3(0 = not at all; 3 = high). Two weeks later, the participant returned to complete the study again using the same process as described.

Data Analysis

To examine eye movement variability in men, women on contraceptive and women (not on contraceptive), the within-isolines area technique is a non-normal distribution with a confidence interval of 68% (Castet & Crossland, 2012; Johnson, 2015). According to Castet and Crossland (2011), the within-isolines area method is the preferred method when used to assess eye stability in the presence of multiple area/items of interest, as it does not make any assumption on the nature of the random variables underlying the distribution of data points. For each frame of the video, the eye position is plotted in terms of current gaze coordinates for each participant in each group. Once this is determined, it is possible to calculate the within-isolines area using a custom script written in MATLAB (ver. 2014b, The Mathworks, MA). These analyses convert the distribution of the eye movements into a numeric description of the variability in eye movements for a specific frame. This number will change in between frames depending on the variability of eye movements of each group of participants. A smaller numeric value indicates less variability in eye movements, meaning the group of participants is looking at the same area. A bigger numeric value indicates more variability and that the group of participants is looking at different areas in that specific frame. This allows for a simplified method of analysis for the entire video, while precisely knowing the frame with the greatest, or least variance for each of the three groups. Given that eye tracking latency results often violate rules for using standard t-tests (i.e. skewness, kurtosis, non-normal distribution, importance of including outliers) it was decided to use a Bayesian analysis in addition to regular t-tests for post hoc latency analysis. Wetzels and colleagues (2011) have used a meta-analysis in order to exemplify the extra information offered by Bayesian analysis. Specifically, the Bayesian factor (BF_{10}) gives information on which hypothesis (H_o= null hypothesis, H_A= alternate hypothesis) is better supported while still maintaining "prudence" without overestimating the magnitude of the effect (BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011).

Results

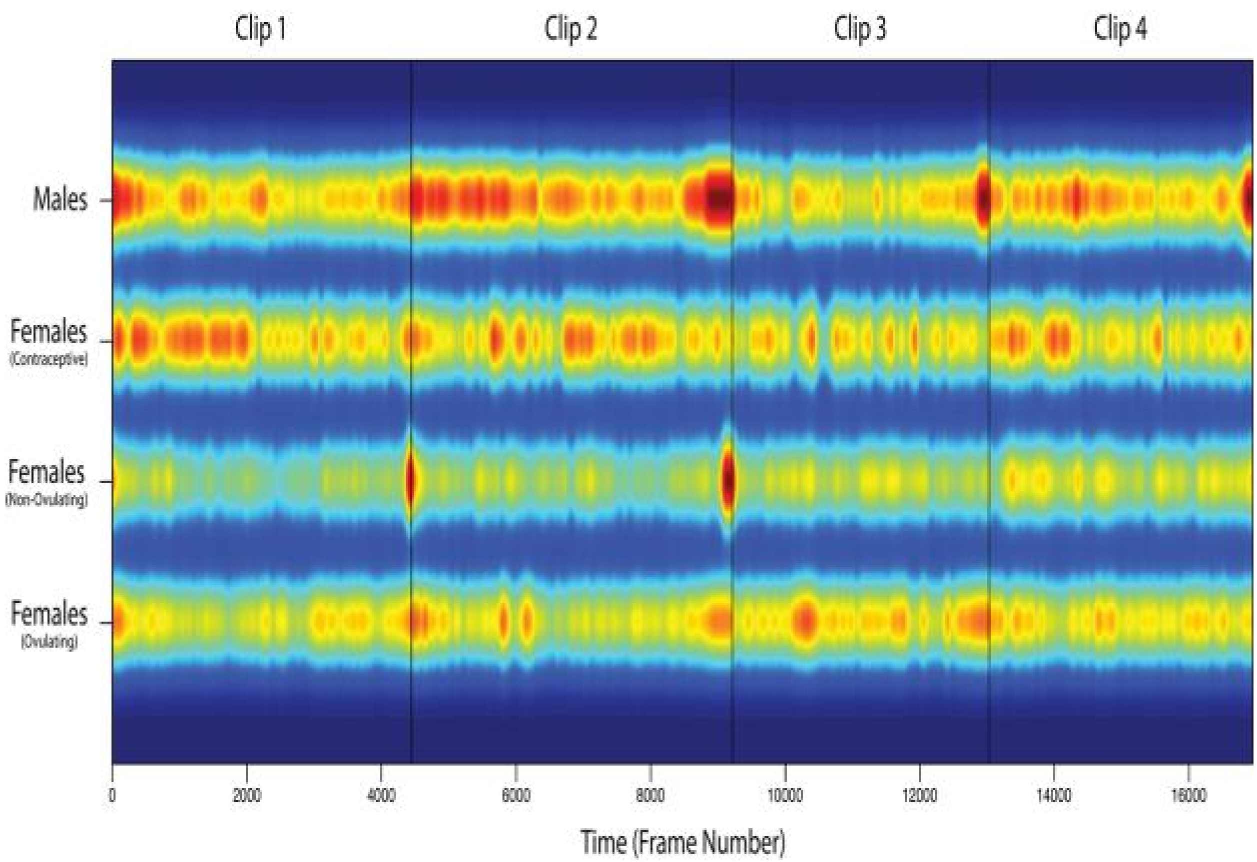
Data Integrity and Cleaning

Given that the video was shown at 30 frames per second (i.e. 30 hertz), and the eye tracker samples eye position at 60Hz, the analysis required down sampling from 60 hertz to 30 hertz. This was achieved by averaging two eye-tracking samples per video frame. The within-isolines area data was also transformed to remove noise artifacts from these data. This involved transforming the data into Fourier space, and then isolating the 100 components with the highest amplitude irrespective of frequency which were then used to reconstruct the signal. This was a standard data cleaning procedure in eye tracking research (e.g., Laeng, Sirois, & Gredeback, 2012). This has the effect of removing high temporal frequency noise from the data, while keeping the overall shape of the data intact.

Questionnaires. The BDI was used as a means to assess possible depression levels as a means to exclude participants based on levels which may affect sexual interest. There were no participants whose scores were of concern and as such, none were excluded. ANOVAs were run for pre-and post-test scores on the SADI divided into positive and negative ratings. Results from the SADI indicated that there were no statistically significant differences in pre-test positive SADI scores, $F(3, 62) = 0.05$, $p = .99$, $\eta^2 = 0.002$, nor in pre-test negative scores, $F(3,62) = 0.14$, $p = .93$, $\eta^2 = 0.01$, suggesting that groups did not differ in baseline levels of arousal and desire, and more importantly that no participant entered into the study holding negative views of sexuality. In post-test SADI, again groups did not differ in positive scores, $F(3,62) = 0.697$, $p = .56$, $\eta^2 = 0.033$, nor negative scores, $F(3,62) = 0.420$, $p = .74$, $\eta^2 = 0.020$, suggesting that participants had reacted similarly to the video. Paired samples *t*-tests were run in order to compare within group pre-test to post-test SADI scores (see Table 2). There was a statistically significant increase in positive arousal scores for the women (PILL) group, $t(25) = -2.759$, $p = .01$, $d = -0.541$ posttest, with no differences in negative post test scores, $t(25) = 0.130$, $p = .90$, $d = 0.026$. This was the same for women (OV), with an increase in positive scores, $t(9) = -10.413$, $p < .001$, $d = -3.293$ and no difference in negative scores, $t(9) = -0.614$, $p = .55$. $d = -0.194$. Women (NOV) also increased in positive scores, $t(9) = -3.995$, $p = .003$, $d = -1.263$ with no changes in the negative scores, $t(9) = -0.632$, $p = .54$, $d = -0.200$. These results were consistent with men, with positive scores increasing, $t(19) = -4.716$, $p < .001$, $d = -1.054$ and no statistically significant differences in negative scores, $t(19) = -0.292$, $p = .77$, $d = -0.065$. These data are important because they suggest that participants were aroused by the video and there were no participants who had reported an aversive reaction to the film.

Overall Between Group Isolines Comparisons. The within isolines areas were averaged across 60 sample windows (thus 1 second of movie) x length of movie. The clips were part of the same movie, however, divided by segments based on content. A heat map was generated for the entire film divided by clip segments (Image 6.1). The heat map is a way to quantify fixations and variability. Smaller isolines areas (red) indicate a focused attention on a specific region, whereas blue is indicative of dispersed visual attention (larger isolines). Furthermore, correlations were run to compare eye movement patterns. Given that eye movement patterns are variable and non-normally distributed, rather than relying solely on Pearson correlations, a Bayesian correlation was run (JASP Team (2016). JASP (Version 0.8.0.0). Bayesian factors (BF_{10}) < 1/10 to 1/3 indicate substantial evidence for the H_o, 1/3-1 suggests anecdotal evidence for the H_o, 1 suggests no difference, 1-3 suggests anecdotal evidence for the H_o, >3 suggests substantial evidence for the H_A. For correlation scatterplots see supplemental materials (Appendix 2)

Image 6.1
Within isoline areas of movie



Note. Within isoline heat map generated of entire video by clip (*Clip 1* = clothed interaction, *Clip 2* = nude interaction & oral sex, Clip 3 = penetrative intercourse, *Clip 4* = climax (not shown) and nude refractory). Red heat map signifies smaller isoline area (focused eye movement patterns), green signifies larger isoline area (broader eye movement patterns).

Clip 1 – Clothed interaction (Table 6.1, Table 6.2). This clip involved a heterosexual couple engaged in clothed foreplay. Although, men and women (PILL) showed the most focused attention, there was no statistically significant correlation in scan path, $r(44) = 0.012$, $p = .11$ (further Bayesian analysis revealed a $BF_{10} = 0.034$, suggesting substantial evidence for the H_o). This indicates that in this video segment, the area of their focus was significantly different. Men focused on the contextual cues, in particular a statue in the scene, women (PILL) were more focused on the on the actors. Women (OV & NOV) showed the most variability in their scan path looking at contextual cues as well as the actors' bodies. There was a statistically significant correlation between men and women (NOV), $r(28) = 0.152$, $p < .001$(further Bayesian analysis revealed $BF_{10} = 1.714e^{85}$, suggesting decisive evidence for the H_A). There was a statistically significant correlation between men and women (OV), $r(28) = 0.118$, $p < .001$ (further Bayesian analysis revealed a $BF_{10} = 2661$, suggesting decisive evidence for the H_A), women (PILL) and women (NOV), $r(34) = -0.029$, $p < .001$ ($BF_{10} = 12.01$, suggesting decisive evidence for the H_A), women (PILL) and women (OV), $r(34) = -0.038$, $p < .001$($BF_{10} = 2661$, suggesting decisive evidence for the H_A) and women (NOV) and women (OV), $r(18) = -0.053$, $p < .001$($BF_{10} = 9.312e^{62}$, suggesting decisive evidence for the H_A). Women that were ovulating were focused on the faces of the actors. Non-ovulating women divided their time between the scenery and the actresses face.

Table 6.1

Pearson Correlations (traditional) Correlation Matrix – CLIP 1

		MEN	**WOMEN (PILL)**	**WOMEN (NOT OVULATING)**	**WOMEN (OVULATING)**
MEN	Pearson's r	—	0.012	0.152 ***	0.118 ***
	p-value	—	0.111	< .001	< .001
	Upper 95% CI	—	0.027	0.167	0.133
	Lower 95% CI	—	-0.003	0.137	0.104
WOMEN (PILL)	Pearson's r		—	-0.029 ***	-0.038 ***
	p-value		—	< .001	< .001
	Upper 95% CI		—	-0.014	-0.023
	Lower 95% CI		—	-0.044	-0.053
WOMEN (NOT OVULATING)	Pearson's r			—	0.132 ***
	p-value			—	< .001
	Upper 95% CI			—	0.146
	Lower 95% CI			—	0.117
WOMEN (OVULATING)	Pearson's r				—
	p-value				—
	Upper 95% CI				—
	Lower 95% CI				—

* p < .05, ** p < .01, *** p < .001

Table 6.2

Bayesian Pearson Correlations Clip 1

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	0.012	0.152 ***	0.118 ***
	BF_{10}	—	0.034	1.714e^{+85}	2.732e +50
WOMEN (PILL)	Pearson's r		—	-0.029 *	-0.038 ***
	BF_{10}		—	12.01	2661
WOMEN (NOT OVULATING)	Pearson's r			—	0.132 ***
	BF_{10}			—	9.312e^{+62}
WOMEN (OVULATING)	Pearson's r				—
	BF_{10}				—

* BF_{10} > 10, ** , BF_{10} > 30, *** BF_{10} > 100

Note: BF10 is a Bayes Factor. >3 is Evidence for the Alternative, <3 and >.3 is inconclusive (no evidence for null or alternative, <.3 is evidence for the Null hypothesis.

Clip 2 – Nude interaction & oral sex (Table 6.3, Table 6.4). This clip began the nude interaction between the on-screen couple (included oral sex) and there appear to be more similar scan paths amongst the groups. Men and women (PILL) showed a significant correlation, $r(44) = -0.030$, $p = .04$ (however, a $BF_{10} = 26.57$ suggests no evidence of an effect). Men and women (NOV) showed a statistically significant correlation, $r(28) = 0.350$, $p < .001$, ($BF_{10} = 2.068e^{145}$ suggesting substantial evidence for the H_A), as did men and women (OV), $r(28) = 0.300$, $p < .001$, ($BF_{10} = 5.440e^{101}$ suggesting substantial evidence for the H_A). The women groups also showed similar eye movement patterns with women (PILL) showing a statistically significant correlation with women (NOV), $r(34) = -0.063$, $p < .001$, ($BF_{10} = 220.2$ suggesting substantial evidence for the H_A) and women (NOV) showing a statistically significant correlation with women (OV), $r(18) = 0.176$, $p < .001$, ($BF_{10} = 4.091e^{31}$ suggesting substantial evidence for the H_A). The main similarities amongst all groups occurred early in the clip where the main area of focus held by these groups was fixation on the women's chest. There was no statistically significant correlation between women (PILL) and women (OV), $r(34) = 0.024$, $p = .09$, ($BF_{10} = 0.075$ suggesting no evidence of an effect). In this clip, the women (NOV) showed the largest isolines with eye movement patterns looking at the contextual as well as physical cues.

Table 6.3.

Pearson Correlations (traditional) Correlation Matrix – CLIP 2

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	-0.030 *	0.350 ***	0.300 ***
	p-value	—	0.037	< .001	< .001
	Upper 95% CI	—	-0.002	0.374	0.325
	Lower 95% CI	—	-0.059	0.325	0.274
WOMEN (PILL)	Pearson's r		—	-0.063 ***	0.024
	p-value		—	< .001	0.092
	Upper 95% CI		—	-0.034	0.053
	Lower 95% CI		—	-0.091	-0.004
WOMEN (NOT OVULATING)	Pearson's r			—	0.176 ***
	p-value			—	< .001
	Upper 95% CI			—	0.204
	Lower 95% CI			—	0.149
WOMEN (OVULATING)	Pearson's r				—
	p-value				—
	Upper 95% CI				—
	Lower 95% CI				—

* p < .05, ** p < .01, *** p < .001

Table 6.4

Bayesian Pearson Correlations Clip 2

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	-0.030	0.350 ***	0.300 ***
	BF_{10}	—	0.160	2.068e +145	5.440e +101
WOMEN (PILL)	Pearson's r		—	-0.063 ***	0.024
	BF_{10}		—	220.2	0.075
WOMEN (NOT OVULATING)	Pearson's r			—	0.176 ***
	BF_{10}			—	4.091e +31
WOMEN (OVULATING)	Pearson's r				—
	BF_{10}				—

* $BF_{10} > 10$, ** , $BF_{10} > 30$, *** $BF_{10} > 100$

Clip 3 – penetrative sex (Table 6.5, Table 6.6). This was the most sexually salient clip, which included penetrative intercourse. In this clip, man and women (PILL) showed a statistically significant correlation, $r(44) = -0.061$, $p < .001$ ($BF_{10} = 26.57$ suggesting substantial evidence for the H_A), as did man and women (OV), $r(28) = 0.138$, $p < .001$ ($BF_{10} = 1.864e^{14}$ suggesting substantial evidence for the H_A). This similarity, again is based on focus on the woman's chest. Further into the clip, the groups begin to show variances in scan paths, specifically, men and women (NOV) did not show a significant correlation, $r(28) = -0.009$, $p = .59$ ($BF_{10} = 0.023$ suggesting substantial evidence for the H_o) likely due to the fact that at the start of the fellatio scene (man still clothed), men focused on the women's face ROI while women groups had a larger isolines area and greater variance within the groups. Women (PILL) and women (NOV) did not show a statistically significant correlation, $r(34) = 0.026$, $p = .11$, ($BF_{10} = 0.075$ suggesting substantial evidence for the H_o), nor did women (PILL) and women (OV), $r(34) = -0.017$, $p = .30$, ($BF_{10} = 0.034$ suggesting substantial evidence for the H_o) with ovulating women maintaining a gaze on the women face, and penis, whereas non-ovulating women groups showing a larger isolines and taking in more contextual cues. Women (NOV) and women (OV) showed no statistically significant correlation, $r(18) = 0.016$, $p = .32$, ($BF_{10} = 0.033$ suggesting substantial evidence for the H_o), with ovulating women showing a greater interest in the man's face and non-ovulating women showing more interest in the women face. On first exposure of the erect penis, men fixated on the women's face, whereas the women groups attended to the penis. In this clip men showed a larger isolines throughout the women model's body. Women who were ovulating spent longer on the face ROI of both models, compared to women on contraceptives. Women on contraceptives were least interest in the facial ROI and were the only group to show most interest in the contextual cues (i.e. extended focus on wine bottle and glasses).

Table 6.5.

Pearson Correlations (traditional) Correlation Matrix – CLIP 3

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	-0.061 ***	-0.009	0.138 ***
	p-value	—	< .001	0.589	< .001
	Upper 95% CI	—	-0.030	0.023	0.169
	Lower 95% CI	—	-0.093	-0.041	0.106
WOMEN (PILL)	Pearson's r		—	0.026	-0.017
	p-value		—	0.106	0.304
	Upper 95% CI		—	0.058	0.015
	Lower 95% CI		—	-0.006	-0.048
WOMEN (NOT OVULATING)	Pearson's r			—	0.016
	p-value			—	0.324
	Upper 95% CI			—	0.048
	Lower 95% CI			—	-0.016
WOMEN (OVULATING)	Pearson's r				—
	p-value				—
	Upper 95% CI				—
	Lower 95% CI				—

* p < .05, ** p < .01, *** p < .001

Table 6.6.

Bayesian Pearson Correlations: Clip 3

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	-0.061 *	-0.009	0.138 ***
	BF_{10}	—	26.57	0.023	1.864e +14
WOMEN (PILL)	Pearson's r		—	0.026	-0.017
	BF_{10}		—	0.075	0.034
WOMEN (NOT OVULATING)	Pearson's r			—	0.016
	BF_{10}			—	0.033
WOMEN (OVULATING)	Pearson's r				—
	BF_{10}				—

* $BF_{10} > 10$, ** , $BF_{10} > 30$, *** $BF_{10} > 100$

Clip 4 – orgasm & cuddling (Table 6.7, Table 6.8). The final clip was the orgasm scene and nude interaction. Here the groups behaved significantly different from each other. Again, in this clip, there were fewer similarities amongst the groups. Man and women (PILL) did not show a statistically significant correlation, $r(44) = 0.008$, $p = .62$ ($BF_{10} = 0.023$ suggesting substantial evidence for the H_o) nor did women (PILL) and women (NOV), $r(34) = 0.030$, $p = .06$, ($BF_{10} = 0.112$ suggesting substantial evidence for the H_o), nor man and women (OV), $r(28) = 0.000$, $p = .98$ ($BF_{10} = 0.020$ suggesting substantial evidence for the H_o). Women (PILL) and women (OV), $r(34) = -0.024$, $p = .13$, ($BF_{10} = 0.064$ suggesting substantial evidence for the H_o). Men again moved their focus throughout the bodies rather than the contextual cues, their isolines was larger possibly because their gaze moved throughout both models' bodies whereas women appeared to fixate on specific regions (face, chest). Man and women (NOV) showed a statistically significant correlation, $r(28) = 0.085$, $p < .001$ ($BF_{10} = 33651.284$ suggesting substantial evidence for the H_A), as did women (NOV) and women (OV), $r(34) = -0.045$, $p = .005$, however, with further Bayesian analysis, the $BF_{10} = 1.022$ suggests no evidence. The similarities occurred when the couples were engaged in closer contact. In the post-climactic scenes, isolines were larger with all participants looking at contextual cues.

Table 6.7.

Pearson Correlations (traditional) Correlation Matrix – CLIP 4

		MEN	WOMEN (PILL)	WOMEN (NOT OVULATING)	WOMEN (OVULATING)
MEN	Pearson's r	—	0.008	0.085 ***	0.000
	p-value	—	0.619	< .001	0.981
	Upper 95% CI	—	0.039	0.117	0.032
	Lower 95% CI	—	-0.023	0.054	-0.031
WOMEN (PILL)	Pearson's r		—	0.030	-0.024
	p-value		—	0.063	0.128
	Upper 95% CI		—	0.061	0.007
	Lower 95% CI		—	-0.002	-0.056
WOMEN (NOT OVULATING)	Pearson's r			—	-0.045 **
	p-value			—	0.005
	Upper 95% CI			—	-0.014
	Lower 95% CI			—	-0.076
WOMEN (OVULATING)	Pearson's r				—
	p-value				—
	Upper 95% CI				—
	Lower 95% CI				—

* p < .05, ** p < .01, *** p < .001

Table 6.8.

Bayesian Pearson Correlations: Clip 4

		MEN	**WOMEN (PILL)**	**WOMEN (NOT OVULATING)**	**WOMEN (OVULATING)**
MEN	Pearson's r	—	0.008	0.085 ***	0.000
	BF_{10}	—	0.023	33651.284	0.020
WOMEN (PILL)	Pearson's r		—	0.030	-0.024
	BF_{10}		—	0.112	0.064
WOMEN (NOT OVULATING)	Pearson's r			—	-0.045
	BF_{10}			—	1.022
WOMEN (OVULATING)	Pearson's r				—
	BF_{10}				—

* $BF_{10} > 10$, ** , $BF_{10} > 30$, *** $BF_{10} > 100$

Discussion

The purpose of this study was to quantify eye movement patterns between men, and women while watching video clips of varying sexual salience (clip 1: clothed interaction, clip 2: nude interaction and oral sex. Clip 3: penetrative intercourse, and clip4: nude cuddling). The effects of women's hormonal fluctuations were analyzed based on ovulation and luteal phases. The first hypothesis proposed for the current study was that men and women (OV) would look at sexually salient areas of the video. The second hypothesis was that women (PILL) would look at contextual aspects of the video more than ovulating women. The data suggests sex differences in eye movement variability as seen in previous research (Tsujimura et al., 2009; Rupp & Wallen, 2007). Although all groups reported feeling increased subjective arousal after watching the video, similar to previous studies, the magnitude of the effect was most pronounced in ovulating women (i.e. Cohen's $d > 3.00$; Buss et al., 2004; Slob et al., 1996; Suschinsky et al. 2014). The clip with the most correlated eye movement patterns (between all groups) was the clothed interaction between the actors as well as the nude interaction and oral sex clip. Similarities in these clips were fixations on the actress' face as well as the saccades around the contextual cues. Men showed correlations with both the OV and NOV groups. Interestingly, it was the men and the naturally cycling women (both groups) who appeared to be most interested in the contextual cues throughout the clip. Women (PILL) were mostly focused on the actor's face whereas the naturally cycling women (OV and NOV) showed similar interest to men in the contextual cues. When the clips became more sexually salient (Clip 2), the interest for all groups was the actress' chest. This is similar to previous research which highlighted the interest of the chest ROI (Rupp & Wallen, 2007). In this clip, which included nude interaction, men's fixations were also on the actress' face whereas women of all groups also looked at contextual cues. This may be indicative of women seeking context even when nude interaction is on the screen. When the video became more explicit (Clip 3 which included penetrative intercourse & cunnilingus) ovulating women maintained a gaze on two specific ROIs, in particular the woman's face and man's penis. This is interesting because it may suggest an immersion into the film; conversely, the non-ovulating women were taking in more contextual cues (as demonstrated by larger isolines). On first exposure of the erect penis, men fixated on the women's face, whereas all groups of women attended to the penis. This is similar to previous chapters in this thesis as well as Spape, Timmers, Yoon, Ponseti, and Chivers, (2014) who showed that an erect penis is highly likely to engage the attention of women. Women on contraceptives were the least interested in the face ROI and showed the most interest in the contextual cues (i.e. extended focus on the wine bottle and glasses); however, faces appear to be a main source of information for men. In the final scene, which involved a climax (ejaculation not visible) and then nude interaction, men maintained their gaze on the nude bodies whereas the women groups looked at contextual cues.

The results of the current study revealed similarities to the findings of Tsujimura and colleagues (2009). Both studies suggest that eye movement variability is decreased when there are explicitly sexual scenes. Although there were differences between the current study and the study conducted by Tsujimura and colleagues (2009), such as the number of clips in the video, and the hormonal cycles that were accounted for in the current study, these similarities were still evident. One possible explanation for correlations could be the camera angles of certain scenes where the interaction was filmed from a close-up perspective showing just the genitals of the man and buttocks of the women, therefore it lacked contextual aspects (i.e. background, couch, statue). Parts of video was shot from the director's perspective with close-ups mainly during the sexual salient areas of the video. According to Smith (2013), shot size or camera-subject distance is a common measure used in film theory and cinematography. When there is one main point of interest (i.e. close up scenes) individuals eye movements cluster around that point of interest. According to this theory, it may be difficult to separate whether these eye movements were caused by sex differences or the camera angles used in the video.

One advantage of the current study is the within-isolines area analysis, unlike the Tsujimura study where the researchers used a frame-by-frame analysis of the video, the current study's isolines metric allows us to isolate the frames with high and low degrees of eye movement variability making the analysis much more time efficient. Traditional analysis of eye movements while watching video has been limited to qualitative analysis of the eye movement patterns. The fluctuations of eye movements are more apparent in the within-isolines. The within-isolines area can analyze multiple locations of eye movements, irrespective of if they are on a single (or multiple) points in an image. Therefore, the within-isolines is directly used to assess eye stability.

One limitation that may have resulted in different results was the video selected. In order to be able to assess the eye movement patterns when the actors were clothed, as well as nude interacting for several minutes, a movie was selected that was soft-core and did not show ejaculation. A film with more explicit content may result in differing eye movement patterns. Although there were steps taken to improve on the perceived limitations of the Tsujimura (2012) study, this study would benefit from incorporating a neuro-imaging component. One of the limitations of neuro-imaging studies (as suggested by Parada et al., 2016) is the short duration of the stimuli presented. While presenting a stimulus for seconds might activate some primary brain regions, the fact that eye movement patterns are differentiable throughout a 12-minute clip may suggest different neural underpinning when presented with a more ecologically valid stimulus as a video. Together, a neuro-imaging study which incorporates eye tracking may offer a more cohesive approach to understanding subjective sexual arousal.

Chapter 7. General Discussion

The aim of this thesis was to use cognitive measures (low level and high level processing tasks) to examine whether eye-tracking methodology could reveal patterns that constitute a more objective assessment of sexual arousal and desire. Arousal is defined as the ability to engage in and maintain physiological response during the excitement phase (APA, 2013); whereas desire is defined as the motivational state driving seeking behavior (Pfaus, 1999). Eye movement analysis allows for assessment of early cognitive processes (first fixation as indicative of autonomic processes) as well as later processing (sustained attention as measured with fixations and dwell time). This thesis was divided into five studies with the first two (saccadic Stroop and mixed saccade task) assessing early processing and interference as measured by the SCID, as well as three other studies (nude versus clothed images, high versus low arousal images, video) focusing on the later, or controlled attentional processes where participants were allowed to engage with the image or video for a longer duration (5000ms).

The early processing portion of the IPM (Everaerd, 1995; Laan & Everaerd, 1995; Janssen et al., 2000, Massaro & Cowan, 2005) suggests that the initial processing of sexual stimuli is unconscious and automatic. This biased attention towards sexual stimuli results in a SCID in which limitations of attentional processes makes performing a task more difficult resulting in longer latency times to make decisions. In the first two chapters of this thesis, we sought to elucidate the SCID in terms of whether it is happening at a subconscious level or if there requires further processing. While lexical tasks (Geer & Bellard, 1996; Geer & Melton, 1997) have shown SCID to be more evident in women compared to men, it remained to be seen if this was the case for image stimuli, specifically because images are processed at a much faster rate (~120ms; Kirchner & Thorpe, 2006) compared to semantic word content (~200ms; Chanceaux et al., 2012). Given the results of chapters 2 and 3, sexual imagery indeed does capture attention and produces a distraction. The SCID is evident in men and women, however unlike the lexical tasks, the effect is less pronounced in women (smaller effect sizes; Geer & Bellard, 1996; Geer & Melton, 1997). Both men and women showed category specificity, though somewhat differently; women showed lower accuracy when presented with images of men, but no difference from neutral when presented with images of their non-preferred stimuli (women), whereas men were most accurate in their non-preferred stimulus, and least accurate when presented with couples. In terms of latency, women and men showed longer latencies when presented with their preferred sexual stimulus and couples. Interestingly, men showed a shorter latency when presented with their non-preferred image, this was not evident in women.

The self-reported questionnaires allowed us to further understand the emotional implications on SCID. While Conaglen (2004) found that latency times were longer when desire was low, this does not seem to be the case for sexual imagery. Low desire was correlated with longer latency for men only when presented with images of other men. Men who reported sexual difficulties were less accurate when viewing images of men and showed longer latency times when presented with images of women and couples. This may be similar to the anxiety studies which showed that latency times were longer when presented with images specific to their type of anxiety (Algom, Chajut, & Lev, 2004; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heimberg, & Hope, 1993; McNally, Kaspi, Riemann, & Zeitlin, 1990; Williams et al., 1996; Wyble, Sharma, & Bowman, 2008). For women, low desire was negatively correlated with latency times only for neutral and baseline images. Women who reported being in a relationship were more accurate when presented with images of couples. Likewise, length of relationship was correlated with greater accuracy when presented with images of couple.

In the Stroop task, men and women reported a similar arousal state, therefore, it may be the images that were causing the SCID because it was contributing to arousal. In order to further understand if the SCID effect happens in early processing or as a factor of arousal, a mixed saccade task was set up, in which images again were presented quite quickly in order to engage early processing, however, this time baseline arousal states were manipulated. Participants were primed with either a pornographic video of their choice or a neutral video. Results for women who were primed with the pornographic video but were not aroused were not excluded, but analyzed as a separate group. The SCID was manifest in men and women in very different ways. Men responded based on the image content whereas women's responses were based on arousal level. Women in the aroused group showed the lowest accuracy overall as well as the longest overall latency times compared to the neutral as well as to the porn-unaroused group. This was irrespective of image type, as though the delay was based on arousal state rather than stimulus. For men, accuracy was stimulus dependent whereas latency was arousal dependent. Men were most accurate in the pro-saccade (move gaze towards target) when preferred images were presented (women, couples) and least accurate in the pro-saccade when presented with images of men as well as low valence images. The anti-saccade results were somewhat different such that men showed the greatest error rate when presented with images of women. Latency, for men, was dependent on arousal state rather than image type with men in the porn prime group showing faster latency times overall compared to the neutral group. Overall, the results from the first two chapters of the thesis suggest that there is some specificity of response based on preference of stimulus that occurs early on, however, this seems to be more pronounced in men than in women. Men showed a distraction specific to their preferred stimuli in both studies, whereas for females, the distraction was based on their subjective arousal state.

Following these chapters, three higher processing studies were conducted with participants having longer to interact with the images (5000ms) and video (~9 minutes). In chapter 4, participants were shown the nude and clothed version of the same model in a non-provocative position (standing upright, white background). Participants rated these images mildly arousing, and relatively high in valence. The aim of this study was to track the scan path within three regions of interest (ROI; face, chest, pelvic) again with first fixation being an indication of a reflexive response, then the transitions from one ROI to another. Also, dwell time in each ROI was assessed as an indication of controlled attention. Men and women showed different scan path analyses based on the sex of the model as well as the clothing. Men consistently showed the same scan path (face, chest, then pelvic ROI) viewing a clothed or nude image (regardless of sex). Women showed a similar scan path but only when the images were of clothed models. When presented with images of nude women, the first fixation was to the chest, followed by face, then pelvic ROI; whereas, when presented with a nude male image, the first fixation was on the pelvic, then face, then chest ROI. The face ROI was a first fixation whenever the image was clothed likely because that is where the majority of information is located when a body is clothed. Humans are evolutionarily primed to look at faces from as early as 4 weeks old, an infant will show a preference for human faces (Hainline, 1978) and this has been seen in other studies in which the face ROI has engaged initial attention (Hewig et al., 2008). When the image was that of a nude individual, women's gaze was quickly drawn to the sexually salient ROIs rather than the face. This may be because of the increased information that can be gathered from a nude body, indicating fertility as well as a potential sexual partner (Buss, 1989). In terms of sustained attention, males spent more time on the facial ROIs of both sexes, again suggesting the importance of facial cues when a person is not exhibiting any other signs of sexual receptivity.

Men and women spent more time on the chest ROI of women compared to the pelvic ROI, likely because of the pose of the model, there was no visible inner labia to signal sexual arousal or receptivity, therefore cues were mainly available via the face or chest. Previous research has shown that female breasts are indeed more captivating than the pelvic ROI (e.g., Dixson et al., 2011). Similar to previous research, the male pelvic ROI received sustained attention from both males and females given the salience of the visible penis (Spape et al., 2014).

Although the results of Chapter 4 gave a clear path of eye movement patterns when viewing nude and clothed images, it did not offer information based on variability in eye movements when arousing stimuli are presented. In Chapter 5, high and low arousal images were again divided into ROI's (face, chest, pelvic, other) and eye movement patterns were assessed based on time to first fixation in each ROI, as well as number of fixations, and dwell time. Results were analyzed based on ratings of arousal and valence and then again based on image content (sex of model). Results suggested that arousal and sex (image content) may contribute to different eye movements. Women, showed consistency in their eye movement patterns, face, pelvic, then chest regardless of the image rating, whereas males showed a scan path based on arousal rating as well as content (sex of model). High arousing images resulted in a scan path of pelvic, face, then chest, whereas when the image was low in ratings of, the men performed a scan path of face, chest, then pelvic. This is interesting because it seems as though there is an earlier judgement performed by men, given that initial fixations are indicative of either a reflex or initial attention. The fact that this is not different for women suggests a more reflexive action, however, men differentiate their eye movement based on what they are looking at. Attention to the face ROI followed by the body may be reflexive in an attempt to gain information (Buss & Schmitt, 1993; Langton, Law, Burton, & Schweinberger, 2008; Nummemnaa et al., 2012) about mating potential. The pelvic ROI again is shown to be highly salient (similar to findings by Spape et al., 2014) with specificity based on preferred sexual stimulus (women dwelling longer on the men's pelvic ROI and men dwelling longer on the women's pelvic ROI). Again, this suggests that beyond the initial fixation which may indicate a reflexive, non-differentiated attention (specifically for women), later processing shows specificity based on preference. Furthermore, in Chapter 6 we saw that hormones modulate eye movement patterns. Before even exploring eye movement patterns, females who were ovulating reported the largest magnitude of change in perceived sexual arousal compared to baseline. This chapter was similar to a study by Tsujimura and colleagues (2012) with modifications such as having women who were naturally cycling and testing them at ovulation and luteal stages as well as women on hormonal contraceptives, and men. Interestingly in the first clip which did not involve nudity, men, and naturally cycling women looked at contextual cues as well as the faces of both actors. Women on contraceptives fixated mainly on faces. This may be due to an attempt to fully immerse themselves in the video. When the clip became more sexually salient, again, it was evident that women sought out context even when there was a nude couple on the screen. The sexually salient clip resulted in the most correlated clip (amongst the groups) with participants focusing on the actress' chest and face. Interestingly, when there was penetrative intercourse on the screen, ovulating women maintained their gaze on the actor's penis and the actress' face. This was interpreted as the time when this group had fully immersed themselves into the video and watching it from a perspective in which they can feel as though they are part of it. Conversely, non-ovulating women still attended to contextual cues and possibly not as immersed into the video. In the final scene, which was post-climactic and involved a nude refractory phase, participants' eye movement patterns were least correlated. Men maintained the focus on the bodies of the actors whereas the groups of women showed a broader range of eye movement patterns and looking at contextual cues. This chapter allowed us to understand that there are differences based on hormonal states. Eye movement patterns are associated with information retrieval and hormonal state was place a woman in a context where different ROIs offer the specific type of information necessary at that time. We noted that ovulating women focused on faces as well as the erect penis more so than when non-ovulating likely because during ovulation, both the penis, as well as the facial expression give important information.

The results of this thesis suggest that a cognitive measure of arousal and desire shows distinct sex differences. While the early processing tasks showed little delay for women's task performance, men appeared to be affect by the content. This may suggest that women are less affected by visual sexual stimuli, it may in fact be an indication that subjective arousal in women is not an immediate response but rather one that takes longer to process. As was seen in the mixed saccade task, when women had achieved a heightened level of subjective arousal they showed interference when attempting the task. As Basson (2003) suggested, women's sexual response may be a culmination of several factors which integrate with the stimuli presented. Akin to the IPM (Everaerd, 1995; Janssen, Everaerd, Spiering, & Janssen, 2000; Laan &

Everaerd, 1995; Massaro & Cowan, 1999), beyond the reflexivity of the physiological arousal (Chivers, 2016), higher cognitive processing allows for influence from sexual schemas. These schemas contribute to how these stimuli are interpreted and as such perhaps women may have more pre-existing schemas. Furthermore, the influence of the existing schema was also evident in men who reported having experienced problems during intercourse. Previous research has shown that schemas (specifically negative schemas and conservatism) affect the interpretation of sexual cues (Carvalho, Verissimo, & Nobre, 2013). When given longer to interact with images, we see similarities to previous research which suggest longer dwell on their preferred sexual stimulus for men, and undifferentiated preference for women (Lykins, Meana, & Struss, 2008; Tsujimura et al., 2009; Nummenmma et al., 2012). While this was evident in the last three chapters, women did respond differently to images based on how arousing they were rated. This may suggest that although there does not appear to be a differentiation based on the sex of the stimulus, there is concordance between what the person rates as arousing and the eye movement patterns that ensue.

While there has been much research on the concordance versus discordance of subjective and objective arousal (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010; Janssen & Everaerd, 1993), eye tracking may offer another perspective. Perhaps the initial responses (first fixation, vaginal lubrication) are reflexive and are useful in processing information quickly (as suggested in the Preparation Hypothesis; Bancroft & Graham, 2011; Chivers, 2005; Lann, 1994; Levin, 2003; Suschinsky & Lalumiere, 2011) but then when one has the chance to fully process the information, more concordant results are found. This may be where desire and arousal intersect. Given the information from this thesis, it may appear that the two may be inextricable in men but not in women. If women require additional time (or an increase in state arousal) this suggests that early indicators of physiological arousal (labial engorgement, lubrication) may be an artifact rather than evidence of true arousal. The potentiation of subjective arousal may require sustained desire in order for VSS to be a distractor. One important methodological bonus to eye tracking is that, unlike measuring blood flow which achieves a maximum state and therefore more informative early on, eye movement patterns are sustained for longer as long as interest in the stimulus is sustained. One important factor to consider is the importance of subjective arousal responses. While it is often suggested that there are discrepancies between reported levels of arousal when participants are in a lab setting, it nonetheless allows a window of opportunity to have a glimpse into the life of the participant. Rather than assume that the participant is either being less truthful or simply unaware of their arousal, it remains the responsibility of the researcher to provide a surrounding where the participant feels secure enough to be honest. Eye tracking allows for a non-invasive tool to be used and possibly a more comfortable setting for participants.

To further assess the validity of eye tracking as an objective measure of sexual arousal and desire, methodologies should be combined to explore the link between eye movement and genital arousal (pairing of eye tracking and plethysmography or thermography) which would give an indication of whether first fixations are responsible for the physiological response. As mentioned previously, Parada et al. (2016) have shown that longer presentation of stimuli lessens the sex differences between participants, as well as having participants rate their subjective arousal throughout will give an indication of eye movement pattern correlations with brain activation. Eye tracking can easily be incorporated into fMRI research. Also, in order to fully elucidate the reflexive nature of the first fixation, a forced selection task will be a clearer indicator. If participants are presented simultaneously with two images (preferred and non-preferred, high/low), a clearer indicator of first fixation will be assessed. Furthermore, it is suggested that researchers who use VSS allow participants to rate the imagery used. As was shown in Chapter 5, not all sexual imagery will be processed in the same way and as such, may affect results.

Most importantly, by addressing the implications of underlying cognitive factors that come into play when being presented with sexual stimuli, further diagnostic or treatment options for arousal and desire disorders may be implemented. Specifically, given that males who reported occasional sexual dysfunction showed more of a distraction effect when presented with images of females and couples, a cognitive assessment based on low level processing tasks may assist with diagnosing an underlying disorder. Furthermore, in terms of treatment, addressing cognitive factors has been shown to have excellent results. Mindfulness (for a review see Arora & Brotto, 2017) has been incorporated in treatment centers to assist with low levels of arousal and desire. Mindfulness means attending to the situation without distraction (Teasedale, & Segal, 2007). If a woman experiences distraction, then given what we have found in the chapters including higher level processing, arousal and desire may be impacted. Mindfulness training has recently been used as a means to increase relationship satisfaction (Khaddouma, Gordon &

Bolden, 2015, body image and sexual insecurity (Dunkley, Goldsmith, & Gorzalka, 2015) and increase sexual desire (Paterson, Handy, & Brotto, 2016). Mindfulness has further been shown to reduce pain perception in women with provoked vestibulodynia, with results suggesting a maintained improvement (> 6 months) in pain vigilance, allodynia, and general mood (Brotto et al., 2015; Brotto, Basson, Carlson, & Zhu, 2013). While it may be useful to inquire about satisfying sexual events when testing pharmaceuticals, we should not dismiss what is occurring cognitively. Finally, this methodology could be extended to ageing populations and to those clinical populations with sexual dysfunctions. Ageing populations have garnered interest within the research community given that sexual satisfaction has been strongly linked with higher self-reported ratings of quality of life as well as day-to-day happiness (Laumann et al., 2006). Although a decline in desire and arousal is common with age, many people continue a healthy sex life. Having a baseline of cognitive performance in the tasks used in this thesis, may help us understand if part of the decline in sexual satisfaction is cognitive in nature. It is hoped that the methodology used in this thesis will be extended to other groups and sexual subcultures.

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SUPPLEMENTAL MATERIALS

APPENDIX 1
Supplemental Material Chapter 4

Bayesian Independent Samples T-Test

	BF_{10}	error %
Time Until 1 Fixation		
FC: AOI:FACE (ms)	0.434	4.178e -5
FN: AOI:FACE (ms)	0.260	1.595e -5
MC: AOI:FACE (ms)	0.866	9.506e -5
MN: AOI:FACE (ms)	4.208	2.373e -5
FC: AOI:CHEST (ms)	0.353	6.655e -6
FN: AOI:CHEST (ms)	0.274	1.550e -5
MC:AOI:CHEST (ms)	0.273	2.758e -5
MN:AOI:CHEST (ms)	0.340	8.705e -6
FC: AOI:PELVIC (ms)	4.371	1.980e -5
FN: AOI:PELVIC (ms)	2.462	3.973e -5
MC:AOI:PELVIC (ms)	0.984	7.825e -5
MN:AOI:PELVIC (ms)	38.344	1.665e -8
Number of Fixations		
FC: AOI:FACE	1.205	8.687e -5
FN: AOI:FACE	3.958	2.198e -5
MC:AOI:FACE	0.587	7.356e -5
MN:AOI:FACE	7.979	1.422e -5
FC: AOI:CHEST	330.526	5.091e -9
FN: AOI:CHEST	7.699	1.081e -5
MC:AOI:CHEST	27.216	7.193e -9
MN:AOI:CHEST	25.121	1.626e -7
FC: AOI:PELVIC	3.206	2.896e -5
FN: AOI:PELVIC	0.790	6.952e -5
MC:AOI:PELVIC	1.590	6.330e -5
MN:AOI:PELVIC	0.265	3.274e -5
Complete Fixation Time		
FC: AOI:FACE (ms)	77.343	2.931e -9
FN: AOI:FACE (ms)	149.492	9.586e -9
MC:AOI:FACE (ms)	15.818	8.676e -8
MN:AOI:FACE (ms)	381.492	2.644e -10

Bayesian Independent Samples T-Test

	BF_{10}	error %
FC: AOI:CHEST (ms)	197.731	8.722e -9
FN: AOI:CHEST (ms)	26.558	1.431e -7
MC:AOI:CHEST (ms)	43.431	5.702e -9
MN: AOI:CHEST (ms)	7.486	1.108e -5
FC: AOI:PELVIC (ms)	9.104	9.865e -6
FN: AOI:PELVIC (ms)	26.115	1.487e -7
MC:AOI:PELVIC (ms)	1.604	6.283e -5
MN:AOI:PELVIC (ms)	0.904	1.003e -4

Note. $BF_{10} < 1$ evidence for H_o, $BF_{10} = 1$ no evidence, $BF_{10} = 1\text{-}3$ anecdotal evidence for H_A, $BF_{10} > 3$ evidence for H_A; Wetzels et al., 2011

Women paired samples t-test

			BF_{10}	error %
Time to 1st Fixation				
Face				
	FC	FN	10.249	7.977e -10
	MC	MN	3655.985	1.217e -11
	FC	MC	1.016	3.923e -8
	FN	MN	0.154	3.624e -7
Chest				
	FC	FN	62.586	8.216e -11
	MC	MN	0.291	1.531e -7
	FC	MC	1.743	2.195e -5
	FN	MN	84.986	9.610e -11
Pelvic				
	FC	FN	4923.475	9.731e -12
	MC	MN	2.893e +6	1.517e -15
	FC	MC	0.310	1.420e -7
	FN	MN	10433.641	4.279e -12
Number of fixations				
Face				
	FC	FN	5.758e +8	9.072e -18
	MC	MN	3.273e +6	4.986e -15
	FC	MC	55.119	7.261e -11
	FN	MN	3.741	1.315e -5
Chest				
	FC	FN	17070.592	2.776e -12
	MC	MN	0.369	1.145e -7
	FC	MC	103.627	9.945e -11
	FN	MN	60877.187	7.210e -13
Pelvic				
	FC	FN	6.317e +6	8.919e -16
	MC	MN	378406.984	4.680e -14
	FC	MC	2.005	1.833e -5
	FN	MN	0.161	2.582e -7
Dwell time				
Face				
	FC	FN	1.140e +9	7.917e -14
	MC	MN	5.721e +6	2.170e -15
	FC	MC	7005.061	6.678e -12
	FN	MN	10.790	7.039e -10
Chest				
	FC	FN	0.472	1.029e -7
	MC	MN	0.248	1.858e -7

FC	MC	2.489	1.536e -7
FN	MN	6.433	2.173e -9
Pelvic			
FC	FN	1016.269	4.144e -11
MC	MN	19.513	3.542e -10
FC	MC	0.146	3.394e -7
FN	MN	0.713	2.694e -5

Note. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Men: Bayesian Paired Samples t-test

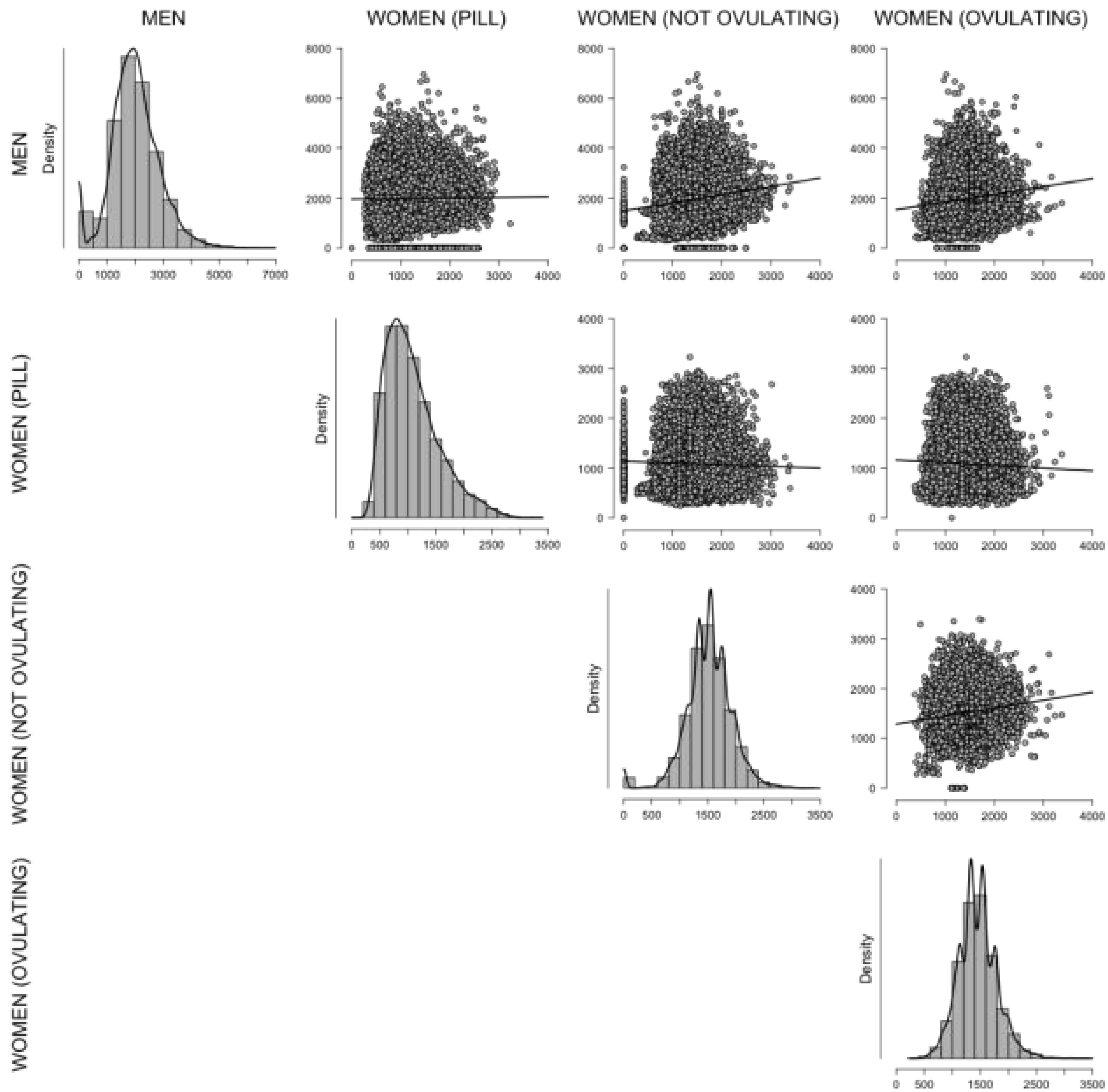
		BF_{10}	error %
Time to 1st Fixation			
Face			
FC	FN	5.183	1.626e -5
MC	MN	0.686	4.467e -5
FC	MC	2.818	3.024e -5
FN	MN	1.207	1.550e -5
Chest			
FC	FN	3.581	2.197e -5
MC	MN	0.322	1.945e -4
FC	MC	0.239	2.155e -4
FN	MN	1.624	8.470e -6
Pelvic			
FC	FN	1.991	1.478e -5
MC	MN	1.069	1.038e -5
FC	MC	0.274	2.677e -4
FN	MN	0.232	2.150e -4
Number of fixations			
Face			
FC	FN	39.317	3.074e -6
MC	MN	1.289	1.865e -5
FC	MC	0.414	1.478e -4
FN	MN	1.612	2.823e -5
Chest			
FC	FN	1.713	1.016e -5
MC	MN	0.233	2.151e -4
FC	MC	1.544	2.663e -5
FN	MN	24.994	1.797e -6
Pelvic			
FC	FN	200.703	3.696e -9
MC	MN	1.689	2.977e -5
FC	MC	0.626	1.069e -4
FN	MN	17.784	3.280e -6
Dwell time			
Face			
FC	FN	51.451	4.104e -8
MC	MN	0.251	2.152e -4
FC	MC	2.684	3.098e -5
FN	MN	2.500	3.184e -5
Chest			
FC	FN	0.346	2.418e -4
MC	MN	0.740	3.383e -5

FC	MC	0.288	2.075e -4
FN	MN	0.240	2.692e -4
Pelvic			
FC	FN	0.286	2.651e -4
MC	MN	0.418	1.457e -4
FC	MC	0.228	2.669e -4
FN	MN	0.235	2.153e -4

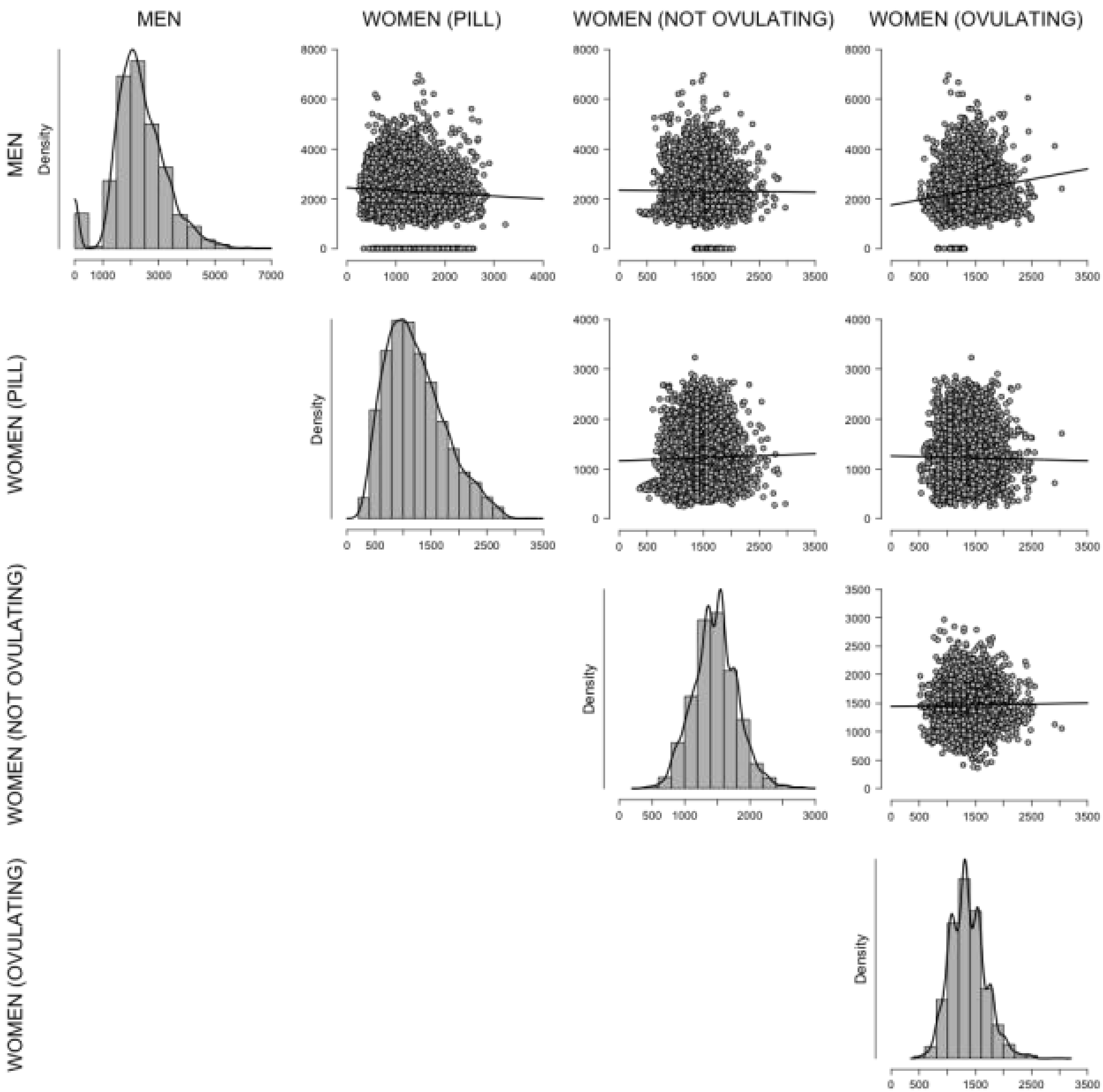
Note. BF_{10} <1 evidence for H_o, BF_{10} = 1 no evidence, BF_{10} = 1-3 anecdotal evidence for H_A, BF_{10} > 3 evidence for H_A; Wetzels et al., 2011

Appendix 2
Supplemental Material Chapter 6

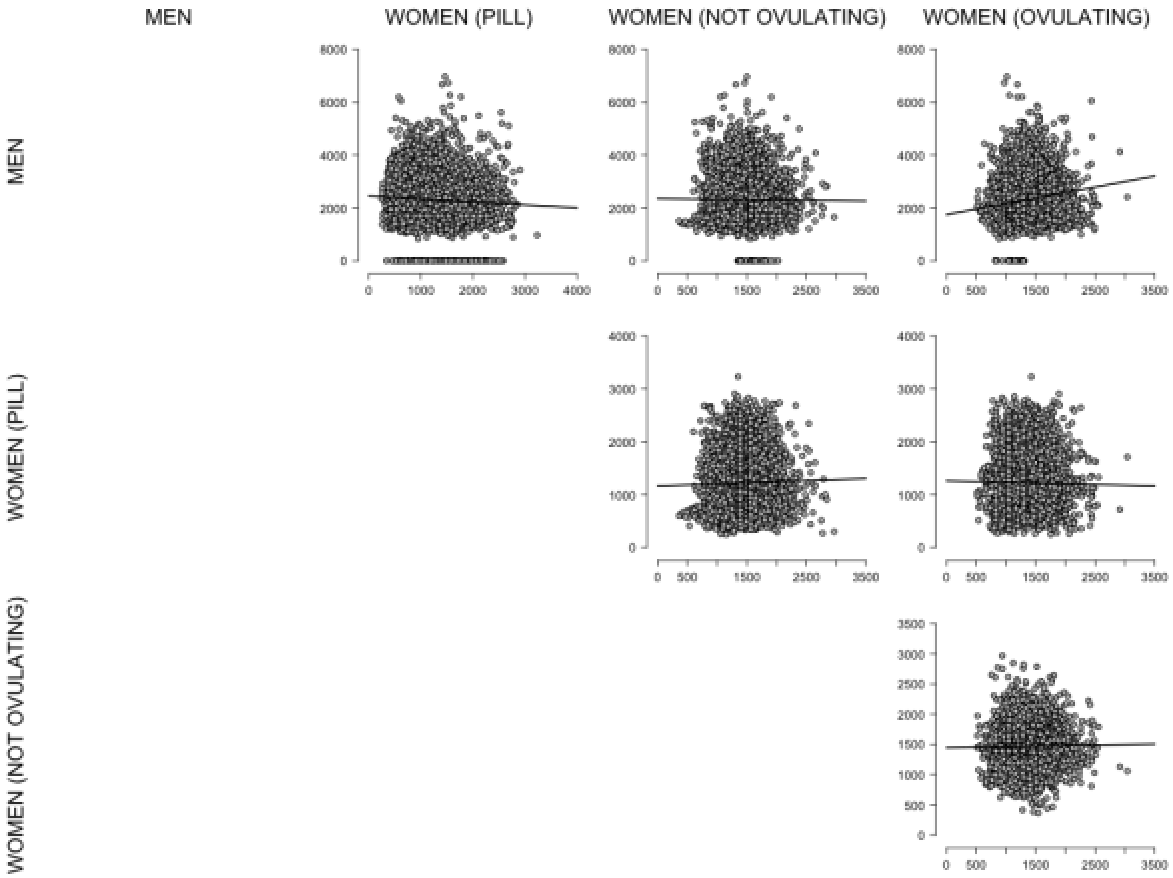
Correlation Plots: Clip 1



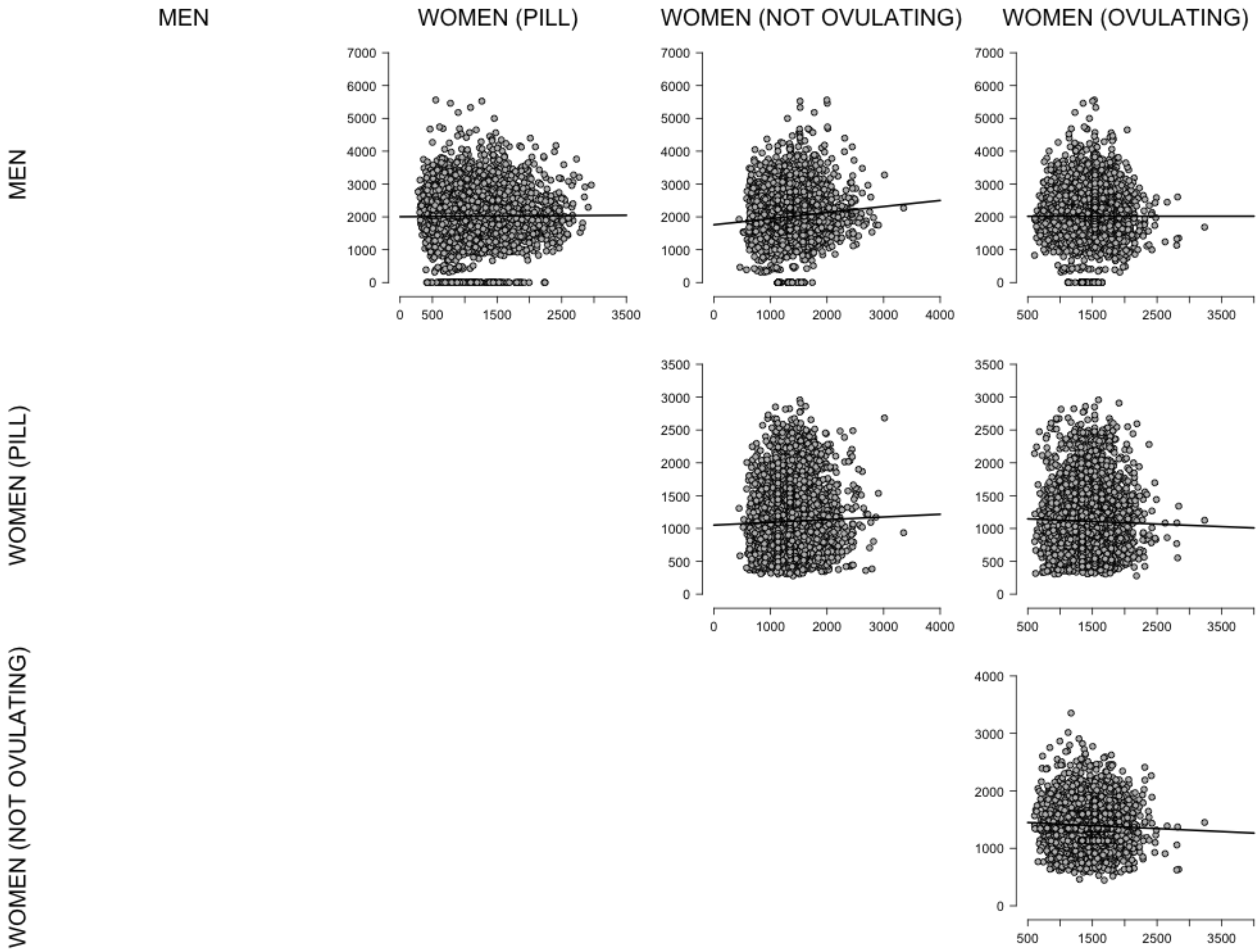
Correlation Plot: Clip 2



Correlation Plot: Clip 3



Correlation Plot: Clip 4



Appendix 3
Supplemental Material Questionnaires

CONCORDIA SEX LAB QUESTIONNAIRE

PARTICIPANT INFORMATION

Please fill in this part of the questionnaire as accurately as you can. All information you provide will remain strictly confidential. Please use the choice that best describes your answer to each question.

1. **What is your gender?**
   - ☐ Male
   - ☐ Female
   - ☐ Transgender
   - ☐ Other (please specify) _____

2. **What is your age? _____ years old**

3. **What is your race or ethnic group?**
   - ☐ African American
   - ☐ American Indian
   - ☐ Asian
   - ☐ Hispanic
   - ☐ Caucasian
   - ☐ Other (please specify) _____
   - ☐ Prefer not to say

4. **What is the religion you were brought up in? (Choose one)**
   - ☐ Catholicism
   - ☐ Protestantism
   - ☐ Judaism
   - ☐ Islam
   - ☐ Hinduism
   - ☐ Other (Please specify) _____
   - ☐ No religion
   - ☐ Prefer not to say

5. **How religious would you describe yourself? (Circle one)**

1	2	3	4	5
Very low (N/A)	Low	Moderate	High	Very high

6. This inventory is concerned with **<u>SEXUAL AROUSAL and DESIRE</u>.** We define **sexual arousal** as **the physiological responses that accompany or follow sexual desire**. For example, when you feel sexually aroused, your heart might beat faster or your palms may get sweaty. Men may experience penile erection and women may feel a moistness of the vagina. Sexual Arousal involves the more physiological aspects of wanting sex. We define **sexual desire** as **an energizing force that motivates a person to seek out or initiate sexual contact and behavior**. You can think of it as a hunger or a sexual "drive" that leads you to seek out sexual contact. Sexual Desire involves the more psychological aspects of wanting sex.

Following is a list of words that might describe how you feel when you experience **sexual arousal and desire** in a sexual circumstance. Different people experience sexual arousal and desire in distinct, individual ways, so there is no "right" or "wrong" answer. Think about how you feel at this moment (in terms of sexual arousal and desire) and place the number that describes the feeling most accurately.

Please use the following scale to rate each of the words below. **Please rate all of the words. Do not skip any.**

0	**1**	**2**	**3**	**4**	**5**
does not describe it at all			describes it moderately well		describes it perfectly

Anticipatory _____
Tingly all over _____
Restrained _____
Anxious _____
Driven _____
Frigid _____
Sensitive to touch _____
Sluggish _____
Urge to satisfy and/or be satisfied _____
Enthusiastic _____
Unhappy _____
Wet (women only) _____
Hard (men only) _____
Resistant _____
Warm all over _____
Excited _____
Tingling in genital area _____
Uninterested _____
Pleasure _____
Heart beats faster _____
Happy _____

Frustrated _____
Lustful _____
Entranced _____
Aversion _____
Hot _____
Tempted _____
Passionate _____
Fantasize about sex _____
Repressed _____
Disturbed _____
Flushed _____
Impatient _____
Sensual _____
Breathe faster/ Pant _____
Displeasure _____
Stimulated _____
Tingling sensation in gut _____
I forget about everything else _____
Repulsion _____
Sexy _____
Quivering sensations _____

SADI (cont'd)

0	**1**	**2**	**3**	**4**	**5**
does not describe it at all			describes it moderately well		describes it perfectly

Angry _____
Attractive _____
Powerful _____
Naughty _____
Alluring _____
Lethargic _____
Horny _____

Insensible _____
Seductive _____
Genitals Reddish _____
Unattractive _____
Good _____
Throbs in genital area _____

7. How many times each week do watch erotic videos or view pornographic images?

☐ 0 ☐ 1 - 5 ☐ 6 - 10 ☐ 10 – 15 ☐ 15 or more

8. What type of erotica/pornography do you usually watch (select all that apply):

____soft core **____mature (i.e., milf, senior)** **____male homosexual**

____hard core **____heterosexual** **____female homosexual**

____bondage/bdsm **____anal** **____gang bang**

____threesome **____amateur** **____hentai**

____female friendly **____point of view** **____bisexual**

____toys **____webcam** **____celebrity**

fetish (Specify):______________________________

race specific: ______________________________

Other (Specify): ______________________________

If you are Male, please skip to Question 13.

9. Are you taking some form of hormonal contraceptive (i.e., a birth control pill, Nuva Ring, patch, injection)?

- ☐ Yes
- ☐ No

- If 'Yes', please identify the contraceptive brand name.

____

10. Are you currently using a non-hormonal form of contraceptive (i.e., diaphragm, intrauterine device, etc.)

- ☐ Yes
- ☐ No

- If 'Yes', please identify which one.

____

11. Are you currently menstruating?

- ☐ Yes.
- ☐ No. When was first day of your last menstrual cycle? (approximate if not known))

____

12. a) What is your level of sexual arousal during the first two days of your period?

1	2	3	4	5
Very low (N/A)	Low	Moderate	High	Very high

b) What is your level of sexual arousal midway through your monthly cycle (around ovulation)?

1	2	3	4	5
Very low (N/A)	Low	Moderate	High	Very high

13. What is your relationship status? (Tick all that apply)

- ☐ Single (skip to Question 15)
- ☐ Casual dating
- ☐ In a relationship / Exclusive dating
- ☐ Engaged
- ☐ Married / Common-law
- ☐ Widowed

☐ Divorced

14. Select the item that corresponds with the duration of the relationship

☐ Less than or equal to 1 month.
☐ Between 1 and 3 months.
☐ Between 3 and 6 months.
☐ Between 6 months and 1 year.
☐ Between 1 and 2 years.
☐ Between 2 and 4 years.
☐ Between 4 and 6 years.
☐ Between 6 and 10 years.
☐ Over 10 years

15. What is your sexual orientation? (Circle one)

0. Exclusively heterosexual
1. Predominantly heterosexual, only incidentally homosexual
2. Predominantly heterosexual, but more than incidentally homosexual
3. Equally heterosexual and homosexual
4. Predominantly homosexual, but more than incidentally heterosexual
5. Predominantly homosexual, only incidentally heterosexual
6. Exclusively homosexual

X- Asexual (i.e. no socio-sexual contacts or reactions)

16. On average how many times a week do you have sexual intercourse? (Tick one per type of sexual intercourse)

Anal:	☐ 0	☐ 1 - 4	☐ 5 - 8	☐ 9 or more
Genital (Penile-Vaginal):	☐ 0	☐ 1 - 4	☐ 5 - 8	☐ 9 or more
Oral:	☐ 0	☐ 1 - 4	☐ 5 - 8	☐ 9 or more

17. On average how many times a week do you engage in other forms of sex play (e.g., dildo, fingering, hand job) (Tick one)

☐ 0 ☐ 1 - 4 ☐ 5 - 8 ☐ 9 or more

18. On average how many times a week do you think about sex? (Tick one)

☐ 0 ☐ 1 - 5 ☐ 6 - 10 ☐ 10 – 15 ☐ 15 or more

19. Over the past 4 weeks, how would you rate your level (i.e., degree) of sexual desire or interest? (Circle one)

1	2	3	4	5
Very low (N/A)	Low	Moderate	High	Very high

20. When was the last time you engaged in sexual intercourse? _____

21. Over the past 4 weeks, how often did you feel sexually aroused ("turned on") during sexual activity or intercourse? (Circle one)

0	1	2	3	4	5
No Sexual	Almost never	A few times	Sometimes	Most times	Almost always
Activity	or never	(less than ½ the time)	(about ½ the time)	(more than half the time)	or always

22. Over the past 4 weeks, when you had sexual stimulation or intercourse, how often did you reach orgasm (i.e., climax / cum)? (Circle one)

0	1	2	3	4	5
No Sexual	Almost never	A few times	Sometimes	Most times	Almost always
Activity	or never	(less than ½ the time)	(about ½ the time)	(more than half the time)	or always

23. Recall to the best of your ability the most recent orgasm you experienced during sex <u>with a partner</u>. This includes any sexual activity which resulted in your orgasm while your partner was present.

To the best of your memory, which activity led to your orgasm? (circle letter)

a. intercourse (vaginal/anal/other) **b.** oral stimulation from partner

c. manual stimulation from partner **d.** manual stimulation from myself

e. other (describe briefly on line, e.g., clitoral stimulation/vaginal intercourse at same time)

____

24. How many times a week do you masturbate?

☐ 0 ☐ 1 - 5 ☐ 6 - 10 ☐ 10 – 15 ☐ 15 or more

25. When was the last time you engaged in solitary masturbation? _____

26. Please rate the intensity of your orgasms through masturbation.

0	1	2	3	4	5
Not intense			**Moderate**		**Intense**

27. Do you experience any difficulty engaging in sexual activity? (Circle one)

0	1	2	3	4	5
Never		**Sometimes**		**Often**	**Always**

28. What was the cause of the difficulty engaging in sexual activity? (Tick all those that apply)

☐ Pain.
☐ Lack of erection or lubrication.
☐ Premature ejaculation.
☐ Lack of desire.
☐ Lack of orgasm.
☐ Lack of satisfaction.
☐ Other. Briefly describe: _____

29. Over the past 4 weeks, how often did you experience the difficulty? (Circle one)

0	1	2	3	4	5
Did not attempt intercourse	Almost never or never	A few times (less than ½ the time)	Sometimes (about ½ the time)	Most times (more than half the time)	Almost always or always

Thank You

<u>SEXUAL AROUSAL AND DESIRE INVENTORY (SADI)</u>

This inventory is concerned with **<u>SEXUAL AROUSAL and DESIRE</u>.** We define **sexual arousal** as **the physiological responses that accompany or follow sexual desire**. For example, when you feel sexually aroused, your heart might beat faster or your palms may get sweaty. Men may experience penile erection and women may feel a moistness of the vagina. Sexual Arousal involves the more physiological aspects of wanting sex. We define **sexual desire** as **an energizing force that motivates a person to seek out or initiate sexual contact and behavior**. You can think of it as a hunger or a sexual "drive" that leads you to seek out sexual contact. Sexual Desire involves the more psychological aspects of wanting sex.

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Please use the following scale to rate each of the words below. **Please rate all of the words. Do not skip any.**

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does not describe it at all			describes it moderately well		describes it perfectly

Anticipatory _____
Tingly all over _____
Restrained _____
Anxious _____
Driven _____
Frigid _____
Sensitive to touch _____
Sluggish _____
Urge to satisfy and/or be satisfied _____
Enthusiastic _____
Unhappy _____
Wet (women only) _____
Hard (men only) _____
Resistant _____
Warm all over _____
Excited _____
Tingling in genital area _____
Uninterested _____
Pleasure _____
Heart beats faster _____
Happy _____

Frustrated _____
Lustful _____
Entranced _____
Aversion _____
Hot _____
Tempted _____
Passionate _____
Fantasize about sex _____
Repressed _____
Disturbed _____
Flushed _____
Impatient _____
Sensual _____
Breathe faster/ Pant _____
Displeasure _____
Stimulated _____
Tingling sensation in gut _____
I forget about everything else _____
Repulsion _____
Sexy _____
Quivering sensations _____

SADI (cont'd)

0	**1**	**2**	**3**	**4**	**5**
does not describe it at all			describes it moderately well		describes it perfectly

Angry _____
Attractive _____
Powerful _____
Naughty _____
Alluring _____
Lethargic _____
Horny _____

Insensible _____
Seductive _____
Genitals Reddish _____
Unattractive _____
Good _____
Throbs in genital area _____