ARTICLE

"I can see you": The impact of implied social presence on visual attention to erotic and neutral stimuli in men and women

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The watchful eye of others often leads people to alter their behaviour. Eye tracking methodology has been used to create implied social presence, as well as to examine gaze patterns to erotic stimuli, but the effects of implied social presence on visual attention to erotic and neutral stimuli remains largely unknown. In the present study, we examined precisely this issue. We compared looking behaviour of men and women who were either aware that their gaze patterns were being monitored (implied social presence) and those who lacked this knowledge (no implied presence). Women in the aware condition made significantly fewer fixations than men, whereas no such gender differences were found in the unaware condition. Across both conditions, men made significantly more fixations to the erotic stimuli compared to the neutral stimuli and the background. For women, no significant differences were found in the number of fixations to the erotic stimuli and the background, although women look at these areas more than the neutral stimuli. These results demonstrate that eye tracking creates an implied social presence, and this differentially affects the looking behaviour of women versus men. Moreover, gendered sexual norms coupled with the need to manage self-presentation may influence women's sexual urges and expressions. The inhibition of sexuality displayed by women indicates that sexual double standards still exist in society and need to be addressed. As well, theoretical, methodological, and clinical implications of eye tracking methodology should be taken into consideration in future research.

KEY WORDS: Erotic stimuli, eye tracking, implied social presence, impression management, sexual preferences, visual attention

Humans have considerable interest in how others perceive and evaluate them. Thus, a real, implied, or imagined presence of others can cause a variety of changes in an individual. According to the social impact theory, changes may occur in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, and/or values and behaviours (Latané, 1981). Situational and dispositional factors interact to determine how the surveillance of others will impact one's behaviour (Leary & Kowalski, 1990). Considerable research has indicated that social presence may trigger normative or socially desirable behaviour in different settings (Baumeister, 1982; Frey, 1978; Leary & Kowalski, 1990; Riordan, Dunaway, & James, 2001; Risko & Kingstone, 2011; Satow, 1975; van Rompay, Vonk, & Fransen, 2009). For instance, it has long been known that when others are watching, people tend to conform more readily to the opinions and expectations of others (e.g., Argyle, 1957; Baumeister, 1982; Deutsch & Gerard, 1955). According to Baumeister (1982), people comply with social norms most of the time because it is undesirable not to do so. The tendency to behave in a socially desirable manner can be conceptualized as an individual's temporary social strategy to cope with different situational factors (DeMaio, 1984; Krumpal, 2013). Factors such as the presence of an interviewer, the nature of the questions being asked, and the type of stimuli, just to name a few, can cause an individual to conform to socially desirable traits and behaviours and to deny socially undesirable ones (Krumpal, 2013).

In general, the topic of sexuality is considered a private and sensitive matter, with its disclosure causing concerns about possible negative consequences and disapproval by others. Sexual socialization begins at a young age when individuals are exposed to messages about modesty, nudity and privacy, and receive gender-specific messages about proper conduct (Shtarkshall, Santelli, & Hirsch, 2007). Traditional sex roles suggest male dominance and female submissiveness, and often lead women to inhibit expressions of sexual desire, exploration, and pleasure while leading men to view themselves as taking on the more powerful role (Dewitte, 2016; Huberman, Suschinsky,

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Lalumière, & Chivers, 2013; Sanchez, Fetterolf, & Rudman, 2012). A greater prevalence of sexually compliant behaviour is often seen among women because they are expected to submit to their partner's desires, whereas men are more likely to self-report being the initiators of sexual activity because they are expected to be the directors of sexual activity (Sanchez et al., 2012). Taken together, socialization, societal expectations, and the presence of others may lead to altered sexual attitudes and concomitant behaviours in men and women. In the present study, we extend this line of research to examine the effects of implied social presence on visual attention patterns to erotic and neutral stimuli. We will begin by reviewing previous research investigating the effects of impression management as well as general sexual attitudes at a societal level. We will also examine extant research on visual attention patterns to erotic and neutral stimuli before discussing the present investigation.

IMPRESSION MANAGEMENT

In past decades, impression management has attracted increased attention as a fundamental interpersonal process as it stems from the desire to maximize expected rewards and minimize punishments (Leary & Kowalski, 1990; Schlenker, 1980). Impression management can be defined as the process by which an individual consciously presents a false front to create favourable impressions (Zerbe & Paulhus, 1987). Research has demonstrated that a lack of comfort to reveal true attitudes and a need for approval are common sources that lead to this phenomenon (Groves et al., 2011; Holtgraves, 2004; Kaminska & Foulsham, 2016; Tourangeau, Rips, & Rasinski, 2000; Tourangeau & Yan, 2007). A plethora of strategies, such as deliberately falsifying test responses or inhibiting overt behaviour, have been shown to be used by individuals to create positive impressions (Dalton & Ortegren, 2011; Zerbe & Paulhus, 1987). Thus, conforming to social norms, independent of actual attitudes and true behaviours, invariably distorts the accuracy and validity of self-reported measures containing sensitive content (e.g., sexual activities, illegal behaviour, or unsocial attitudes) because of individuals' attempts to present themselves in a positive light (Krumpal, 2013; Meston, Heiman, Trapnell, & Paulhus, 1998; Preisendörfer & Wolter, 2014). Interestingly, studies have confirmed that women are more prone to the influence of societal norms and thus respond in a more socially desirable fashion than men (Bernardi & Guptill, 2008; Chung & Monroe, 2003; Dalton & Ortegren, 2011). To date, studies of impression management have largely focused on socially desirable responding, prosocial behaviour, and levels of privacy.

Several studies have demonstrated that as the level of privacy decreases, prosocial behaviour (e.g., monetary contributions made by participants, providing help to others, etc.) increases (Baumeister, 1982; Kidder, Bellettirie, & Cohn, 1977; Reis & Gruzen, 1976; Satow, 1975; Shapiro, 1975). Preisendörfer and Wolter (2014) found that compared to face-to-face surveys, mail surveys elicited significantly more truthful responses when the content in question was criminal behaviour (58 percent and 67 percent, respectively). Hence, the negative content as well as the lack of privacy appears to lower peoples willingness to self-report norm-violating behaviours. The question remains: what transpires when sensitive content, such as sexual stimuli, is coupled with low levels of privacy? Brown, Amoroso, Ware, Pruesse, and Pilkey (1973) tested the hypothesis that as erotic stimuli became more explicit and pornographic, the amount of time participants would spend looking at them would be shorter when the slides were viewed in the presence of observers versus when they were viewed alone. Indeed, they found that viewing times were significantly shorter in the audience condition; whereas, in the alone condition, viewing times increased as the slides' pornographic ratings increased (Brown et al., 1973).

Considering the above, it is evident that in the public eye, behaviours and attitudes tend to converge toward the norm prevailing in the respective context. However, research suggests that the presence of others does not need to be real: simply thinking, anticipating, or imagining the presence of others can influence behaviour and lead to similar effects (Latané, 1981; Risko & Kingstone, 2011; van Rompay et al., 2009). In a study examining helping behaviour, van Rompay et al. (2009) found that participants were more likely to help a confederate in the presence of a security camera that implied the presence of an audience, i.e., the mere thought of being recorded was enough to motivate participants to display prosocial behaviour. These effects even extend to the situation when a camera is directed to an individual's eye. Risko and Kingstone (2011) used an eye tracker, providing a moment-to-moment record of an individual's visual attention, to compare looking behaviour when individuals believed that the eye tracker was turned on (implied presence) and when they believed it was turned off (no presence). In the latter condition, 92 percent of participants looked at the provocative stimulus that was strategically placed in the room compared to only 36 percent of participants in the former condition (Risko & Kingstone, 2011). Intriguingly, when the provocative stimulus was replaced with a nonprovocative stimulus, wearing an eye tracker did not influence looking behaviour to this neutral image (Risko & Kingstone, 2011). These findings were not only replicated by Nasiopoulos, Risko, Foulsham, and Kingstone (2015), but they also found that impression management disappears over time (i.e., participants begin to look readily at the provocative stimulus) presumably because the presence of the eye tracker is forgotten; but implied presence can be reactivated (i.e., they avoided looking at the provocative stimulus) if participants are subtly reminded of the eye tracker. The results from the latter two studies not only confirm that implied social presence can have a profound influence on visual attention based on the nature of the stimuli, but also suggest that it might be necessary to maintain an active representation of the social context in order to capture social-norm-based influences on gaze.

SEXUAL ATTITUDES

Despite the fact that men and women typically receive similar socialization regarding sexuality, gender differences in

sexual attitudes tend to be largest with respect to sociosexual restrictiveness (Buss, 1989). According to Meston, Trapnell, and Gorzalka (1996, 1998), males not only behave in a more sexually unrestrained manner than females, but also hold more liberal attitudes in this regard. Although there is some evidence that sexual roles are becoming more egalitarian (e.g., O'Sullivan & Byers, 1992; Segal, 1995, 1997; Vannier & O'Sullivan, 2011), a sexual double standard continues to exist at a societal level. More specifically, men's sexual dominance and expressions of sexual desire are often applauded, whereas women who express sexual interest or desire fear backlash involving negative labels (Sanchez et al., 2012). For instance, examining whether women would report fewer sexual encounters than men when their responses might be revealed to others confirmed the hypothesis that people misreport more gendered sexual behaviour to avoid negative labels, with men reporting a greater number of past sexual partners than women (Alexander & Fisher, 2003). Moreover, women in the public exposure condition were less likely to report masturbation and exposure to pornography than women in the anonymous condition (Alexander & Fisher, 2003). Gender bias in reporting is also observed in non-sexual contexts. For instance, a study investigating gender differences in dietary self-reports found that men overestimated and women underestimated their dietary intakes on a 7-day dietary recall (Hebert et al., 1997). Thus, gender effects in reporting is not necessarily specific to sexual contexts although it may be exacerbated by such contexts.

These findings suggest that responding in a socially desirable manner may generate either inflated or deflated responses when the content in question is sexual in nature, and that women are more likely to be impacted by societal expectations and conform accordingly. Convergent with this, results from Fisher, Moore, and Pittenger (2012) showed significant negative associations between measures of social desirability and women's frequencies of sexual thoughts. Furthermore, after controlling for the combined effects of personality and conservatism, Meston and colleagues (1998) discovered many associations between impression management and sexuality measures. Even under stringent anonymous conditions in which situational demands were expected to be absent, impression managers (particularly females) presented themselves in a favourable light (Meston et al., 1998). In summary, beliefs regarding sexual behaviour and related gendered sexual norms coupled with a need to manage and optimize self-presentation seem to heavily influence men and women's sexual attitudes and expressions, and that this may be especially true for women.

VISUAL ATTENTION TO EROTIC STIMULI

Visual attention is arguably the most basic step in the cognitive processing of information and is also a primary component of most sexual experiences. Because motivationally salient stimuli are thought to automatically attract the allocation of cognitive resources (Yiend, 2010), gaze patterns can be used as sensitive indexes of our attention, motivation, and preferences, as they provide a real-time behaviour index of ongoing perceptual and cognitive processing (Hall, Hogue, & Guo, 2011). Thus, eye tracking provides meaningful data by capturing preferences that are associated with distinct and identifiable gaze patterns (Jiang, Potters, & Funaki, 2016). Studies have shown that preferred regions within an image are typically inspected earlier and attract more fixations and longer viewing time (Hall et al., 2011; Henderson, 2003).

Data from the visual attention literature confirms that men and women attend differently to erotic and non-erotic images (Lykins, Meana, & Kambe, 2006; Lykins, Meana, & Strauss, 2008; Rupp & Wallen, 2007; Wenzlaff, Briken, & Dekker, 2016). When viewing erotic images, both men and women dedicate more attention by more thoroughly inspecting the images with fixations biasing away from the face and towards the chest and pelvic regions (Lykins et al., 2006). On the contrary, when the erotic stimulus contains an image of a heterosexual couple engaged in intercourse (versus opposite-sex nude models standing alone as utilized in the aforementioned study), the female face and genital regions were highly salient for all participants as indicated by extensive viewing (Rupp & Wallen, 2007). In the absence of erotic stimuli, however, both men and women were specifically attracted to the face of opposite sex models wearing casual clothing (Hewig, Trippe, Hecht, Straube, & Miltner, 2008).

Men and women differ in processing sexual information by not only selectively focusing on different aspects of erotic stimuli, but also implicitly and explicitly demonstrating different preferences and attitudes with regards to sexuality (Lykins et al., 2008). When viewing an image of a heterosexual couple (e.g., male-female dyad either engaged in sexual activity or interacting in casual clothing), heterosexual men exhibit a strong and clear attentional preference for opposite sex figures, regardless of whether the stimulus is erotic or neutral (Lykins et al., 2008). Heterosexual women, on the other hand, divide their visual attention more evenly across male and female figures across both types of stimuli (Lykins et al., 2008). These results were recently replicated and expanded on by Dawson and Chivers (2016) using a forced attention paradigm in which two single images were simultaneously presented and competed for attention. Men exhibited initial and controlled attentional preference towards female stimuli, whereas, women's initial attention was not directed towards their preferred gender. Women did, however, exhibit gender-specific patterns of controlled attentional bias towards the male stimuli, but this effect was stronger among men. A more recent study examining how stimulus modality (static images versus dynamic videos) influences attentional processing of sexual stimuli found that the degree of gender-specificity of men's visual attention was similar for static and dynamic stimuli, whereas women displayed gender-specific patterns for static stimuli and gender-nonspecific patterns for dynamic stimuli (Dawson & Chivers, 2018).

From the extant data we can conclude that men and women appraise sexual stimuli differently and consequently employ different gaze patterns when viewing preferred and non-preferred figures. To what extent however, are these

differences real versus an 'artifact' of people knowing that their behaviour (e.g., eyes) is being recorded? Past research has clearly established that individuals are motivated to and able to modulate their looking behaviour in response to having their eyes monitored because presenting oneself in a positive manner appears to be highly ingrained in humans. Moreover, this effect may be especially true for women, as many women alter their sexual experiences in accordance with prevailing norms by holding conservative sexual attitudes and acting in a sexually restrained manner compared to men.

THE CURRENT STUDY

To our knowledge, no previous studies have specifically manipulated an implied social presence and examined its influence on the distribution of visual attention to explicit erotic stimuli. In the present study, our purpose was two-fold: (1) to manipulate an implied social presence context using an eye tracker, and (2) to evaluate cognitive processing of explicit erotic and non-erotic stimuli in men and women. Using sets of picture stimuli, we compared looking behaviour of men and women who were either aware that their eyes are being monitored and those who lacked this knowledge.

We hypothesized that compared to participants who were unaware that their eye movements were being monitored, participants who were aware that they were being eye tracked (implied social presence) would have fewer fixations to erotic stimuli. For non-erotic stimuli, we expected participants to look more at the faces of the models in comparison to erotic stimuli. We further predicted that men, regardless of condition, would look more often and for longer periods at their preferred target stimulus, whereas women would divide their visual attention equally to both preferred and non-preferred target stimuli. Given gender differences in social norms, we hypothesized that women who were aware they were being eye tracked would look more often and for longer periods of time at the contextual features of the erotic stimuli, compared to women who were unaware.

METHOD

Participants

Participants were recruited through the University of British Columbia Human Subject Pool in the Department of Psychology. A total of 126 men and women took part in the study, all of whom indicated exclusive or predominant sexual attractions to the opposite gender. We excluded data from 17 participants for one of two reasons: (1) data from participants who made fewer than 300 overall fixations were excluded, as some participants may have unwittingly spoiled the acquisition of their eye movements by changing their head position substantially throughout the experiment, and (2) data from participants who indicated that they had previously participated in a mobile eye tracking study and were in the unaware condition were excluded because they were familiar with the eye tracker and may well have been aware that their eye movements were being monitored. Of the remaining 109 participants, 26 female participants (M_{Age} = 21.50, SD = 4.34) and 26 male participants (M_{Age} = 20.73, SD = 2.20) were in the *aware* condition. Twenty-seven female participants (M_{Age} = 20.41, SD = 1.91) and 30 male participants (M_{Age} = 20.43, SD = 2.76) were in the *unaware* condition. There was no significant difference in age across the groups. Participants remained naïve with respect to the true purpose of the study until they were debriefed upon completion of the experiment. Although participants had the option to withdraw their eye tracking data if they chose to do so after being debriefed, none did so. All participants received course credit for participating in the study.

Materials and Design

Eye movements were recorded using the SensoMotoric Instruments (SMI) RED desktop eye tracking system with a sampling rate of 120 Hz. The SMI is a contact-free, remote sensor eye tracker that measures gaze patterns using an infrared camera and is compatible with both eyeglasses and contact lenses. The system is discreetly attached to the bottom of a 22-inch monitor, presenting stimuli at a resolution of 1680 x 1050 pixels, with accuracy of 0.4° and spatial resolution of 0.03°.

Visual stimuli were 30 sets of coloured pictures displayed on a desktop computer screen and were obtained via web searches. Using a forced attention paradigm, each set contained two images presented simultaneously side-by-side. Image location (e.g., male left side/female right side, female left side/male right side) was balanced across trials. Half of the sets contained erotic pictures depicting a naked male model and a naked female model with visibly aroused genitals (e.g., erect penis or engorged vulva) and the other half contained non-erotic pictures depicting male and female models in casual clothing (e.g., runway models). To prevent background features from possibly distracting attention, background features of each image were removed so that each model was isolated. Images were also matched for size (640 x 1050 pixels), brightness, luminance, and contrast using Adobe® Photoshop software. Each set was presented for 10 seconds and the order of erotic and non-erotic sets were randomized.

Post-stimulus attraction ratings. Following the presentation of each set of images, participants were asked to rate the models ("How attractive do you find the male?" and "How attractive do you find the female?"), using a 7-point scale ranging from 0 (not at all attractive) to 6 (very attractive).

Questionnaires. Participants completed a questionnaire asking demographic information. In addition, we administered the Impression Management (IM) subscale of the Balanced Inventory of Desirable Responding (BIDR-6; Paulhus, 1991) as it is sensitive to participants' tendency to give consciously inflated self-descriptions (i.e., "I sometimes tell lies if I have to."; "When I was young I sometimes stole things"). Due to the social context and the explicit nature of our stimuli, we administered the IM as it measures the tendency to give a falsely good impression. The IM consists of 20 statements on which

respondents rate their agreement with items on a 7-point Likert scale ranging from 1 (not true) to 7 (very true), with a coefficient alpha range from .75 to .86 (Paulhus, 1991).

The Ten-Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003) was also used as a short measure of personality with each item consisting of two descriptors to which respondents rate their agreement on a 7-point Likert scale ranging from 1 (disagree strongly) to 7 (agree strongly), with Cronbach alphas of .68, .40, .50, .73, and .45 for the Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience scales, respectively (Gosling et al., 2003). Although the inter-item correlations are low (consistent with having only two items per scale), this scale emphasizes content validity and was administered to examine potential correlations among personality traits and visual attention patterns.

Procedure

Upon arriving at the laboratory, a female experimenter explained to participants that the visual stimuli in this study contained nude images. After obtaining signed consent, participants were seated facing a computer monitor equipped with the SMI eye tracker at a viewing distance of approximately 60 cm. Prior to viewing the images, participants calibrated the unit and were asked to complete a basic colour test in which they reported the number embedded in an image made of different coloured circles. Following this test, participants in the *unaware* condition were asked to complete a second colour test. In actuality, the SMI 9-point calibration was being executed at this point. More specifically, participants were instructed to follow the calibration fixation dot with their eyes and notify the experimenter if and when the colour of the dot changed. While the colour never actually changed, it was essential to perform the calibration in this manner to ensure that participants in this condition remained naïve to the eye tracking component of this study. In the *aware* condition, participants were informed that a calibration was being conducted because they were cognizant that their eye movements were being recorded.

Upon completing the SMI 9-point calibration, participants were given the following detailed instructions. Prior to each trial, a small fixation point in the shape of a red circle appeared at the centre of the screen for 2–4 seconds (Figure 1). The duration was randomized to avoid an automatic predicted response. Participants were instructed to focus on the red circle and hit the space bar as soon as the circle turned green in order to begin the trial. This procedure ensured that all participants were looking at the centre of the screen at the beginning of each trial. During each trial, participants viewed a pair of images. Participants were instructed that each set of models would either be completely naked or fully clothed. With each

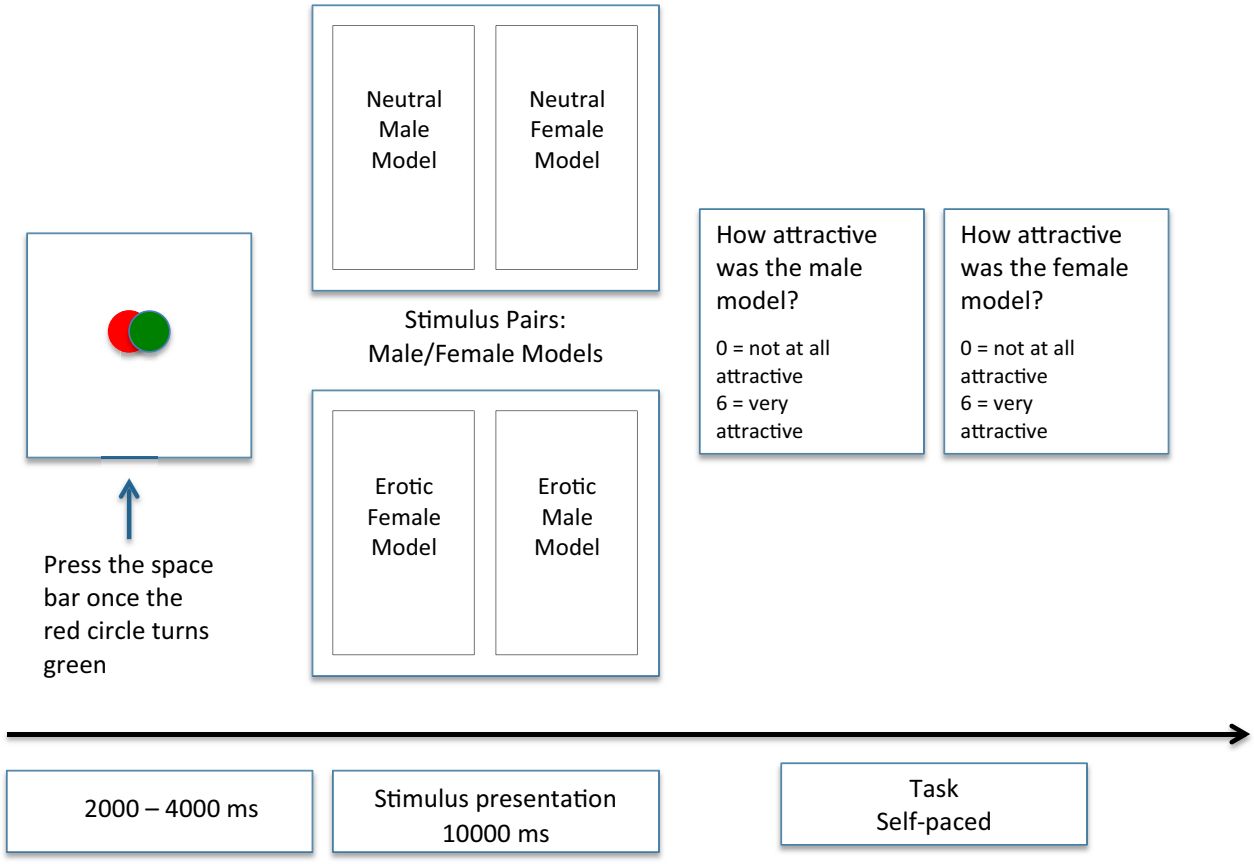

Figure 1. Depiction of the time sequence and orientation of a single trial

set appearing on the screen for 10 seconds, participants were asked to look at the pair of images as they naturally would on the Internet or in magazines. Following each set, participants were asked to rate the models on a 7-point Likert scale.

After viewing all 30 sets of pictures, the demographic, IM and TIPI questionnaires were administered in the private experiment room. Once complete, participants were asked whether or not they had participated in an eye tracking study in the past, whether or not they knew the purpose of the study, and whether they felt like their behaviour was being recorded. They were then debriefed and informed of the true nature of the study. The University of British Columbia Behavioural Research Ethics Board approved all procedures.

Data Analysis

In order to analyze visual attention towards the male and female models in the image pairs, we first divided each set of stimuli into two general areas of interest (AOIs): one containing the image of the male model and the other containing the image of the female model. We further broke down each image within each set into different AOIs for the face, chest, and pelvic regions. Using the SMI BeGaze™ software, we extracted the total number of fixations and the total fixation duration for the above-mentioned AOIs. Number of fixations can be defined as the number of times the participant's gaze (lasting a minimum of 100ms) landed in the AOI. Total fixation duration can be defined as the total amount of time (in milliseconds) a participant fixated on an AOI. A mixed model Analysis of Variance (ANOVA) was conducted with two between subject conditions: Participant Gender (men, women) and Condition (aware, unaware), and three within subject conditions: Stimulus Sex (male, female)[1], Stimulus Type (neutral, erotic), and AOI (face, chest, pelvic region). In order to avoid redundancy, we report our results only for total number of fixations as these results were consistent when examined using total fixation duration.

RESULTS

Visual Attention

Condition. Tables 1 (aware condition) and 2 (unaware condition) show the means across participants (men vs. women) for total number of fixations and total fixation duration to the face, chest, and pelvic regions of the male and female models broken down by each type of stimulus (erotic vs. neutral). For total number of fixations, the mixed model ANOVA revealed a significant interaction between Condition and Participant Gender, $F(1, 101) = 4.53$, $p = .036$, $\eta^2 = .04$. As shown in Figure 2, follow-up comparisons indicated that in the aware condition, women made significantly fewer fixations than men (marginal means for fixation count are 20.94 for women and 42.34 for men with $p < .001$, $d = 1.29$), whereas no significant gender differences were found in the unaware condition (marginal means for fixation count are 28.53 for women and 36.41 for men with $p = .076$, $d = .47$). When comparing women's fixations across conditions, we found that women in the unaware condition made more fixations than women in the aware condition, but this result does not reach statistical significance ($p = .10$, $d = .46$). Condition was not significantly related to any other variable ($ps > .10$, $d = .02–.27$).

Areas of interest and stimulus type. Our analyses yielded the following significant three-way interactions for total number of fixations. While both men and women made significantly more fixations to the AOIs of the erotic images compared to the AIOs of the neutral images, an AOI x Participant Gender x Stimulus Type interaction, $F(2, 202) = 4.93$, $p = .008$, $\eta^2 = .05$, showed that men looked significantly more at the face of the models (regardless of Stimulus Sex) than women for both erotic ($p < .001$, $d = 1.03$) and neutral stimuli ($p < .001$, $d = 1.27$).

Table 1. Marginal Means of the Total Number of Fixations and Total Fixation Duration Men and Women Made to the Face, Chest, and Pelvic Regions, of the Male and Female Models for Each Type of Stimulus in the Aware Condition

	Neutral Stimulus		Erotic Stimulus	
	Men	*Women*	*Men*	*Women*
	Face Number of Fixations (Duration in milliseconds)			
Female Model	77.61 (20916.40)	15.35 (5889.00)	85.31 (19822.38)	24.45 (9264.31)
Male Model	66.80 (19093.29)	13.76 (6429.06)	74.76 (17293.99)	26.02 (11127.54)
	Chest Number of Fixations (Duration in milliseconds)			
Female Model	27.36 (5173.38)	15.91 (5984.51)	44.95 (8450.28)	27.13 (5793.24)
Male Model	25.54 (4302.94)	15.91 (6067.93)	27.57 (4964.13)	26.30 (5535.89)
	Pelvic Number of Fixations (Duration in milliseconds)			
Female Model	8.19 (1719.42)	14.57 (2207.67)	25.00 (5824.96)	25.55 (4950.98)
Male Model	10.34 (2053.48)	17.09 (2328.17)	34.58 (7663.02)	29.22 (6568.89)

1 Although previous research has described visual stimuli as "Stimulus Gender" we elected to use the phrase "Stimulus Sex" since the character's gender cannot be deduced on the basis of their physical characteristics.

Table 2. Marginal Means of the Total Number of Fixations and Total Fixation Duration Men and Women Made to the Face, Chest, and Pelvic Regions, of the Male and Female Models for each Type of Stimulus in the Unaware Condition

	Neutral Stimulus		Erotic Stimulus	
	Men	*Women*	*Men*	*Women*
	Face Number of Fixations (Duration in milliseconds)			
Female Model	55.87 (16815.07)	23.03 (8284.72)	67.17 (16098.22)	30.58 (9461.57)
Male Model	57.00 (15930.69)	23.10 (8423.71)	55.60 (12778.46)	37.64 (10988.51)
	Chest Number of Fixations (Duration in milliseconds)			
Female Model	28.03 (5791.73)	22.20 (7610.54)	42.47 (8902.71)	35.53 (9227.17)
Male Model	25.47 (5189.97)	30.18 (9567.44)	20.53 (4267.98)	33.53 (8624.57)
	Pelvic Number of Fixations (Duration in milliseconds)			
Female Model	7.57 (1952.73)	21.13 (4509.41)	31.43 (6801.97)	26.05 (6908.32)
Male Model	9.37 (2185.99)	20.45 (4418.78)	36.37 (7933.75)	39.00 (9667.96)

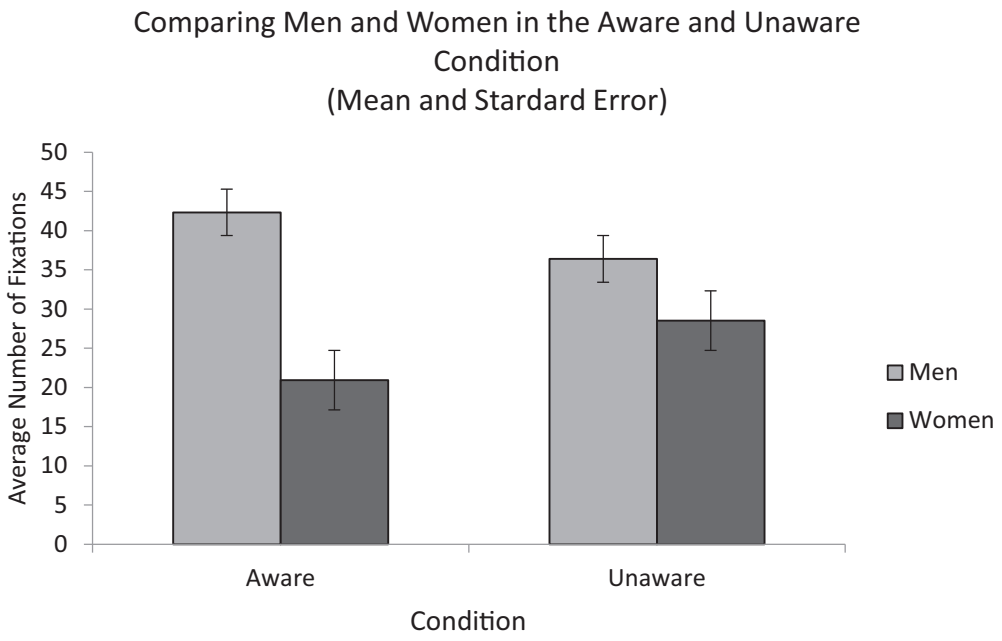

Figure 2. In the aware condition, men made significantly more fixations than women. In the unaware condition, no significant gender differences were found

Additionally, an AOI x Participant Gender x Stimulus Sex interaction, $F(2, 202) = 9.52$, $p < .001$, $\eta^2 = .09$, indicated that with respect to the face and chest AOIs, men looked more (*ps* < .001, *d* = .21 and .61, respectively) at the female models compared to the male models. For the pelvic region, however, the male models captured more attention than the female models. Both men and women looked significantly more (*ps* < .001, *d* = .29 and .34, respectively) at this region of the male models than the female models. No significant differences were found in the number of fixations women had to the chest and face regions of the male and female models (*ps* > .39, *d* = .05–.07) (see Figure 3).

Lastly, an AOI x Stimulus Type x Stimulus Sex interaction, $F(2, 202) = 19.08$, $p < .001$, $\eta^2 = .16$, revealed that regardless of Participant Gender, participants made significantly more fixations at the chest of the female models compared to the male models ($p < .001$, $d = .48$), but only for the erotic stimuli. This result was reversed for the pelvic region, whereby significantly more fixations were made to the pelvic region of the male models compared to the female models for both neutral ($p = .04$, $d = .11$) and erotic ($p < .001$, $d = .43$) stimuli. For the face AOI, regardless of Participant Gender, no significant differences were found with respect to Stimulus Type and Stimulus Sex (*ps* > 0.11, *d* = .08).

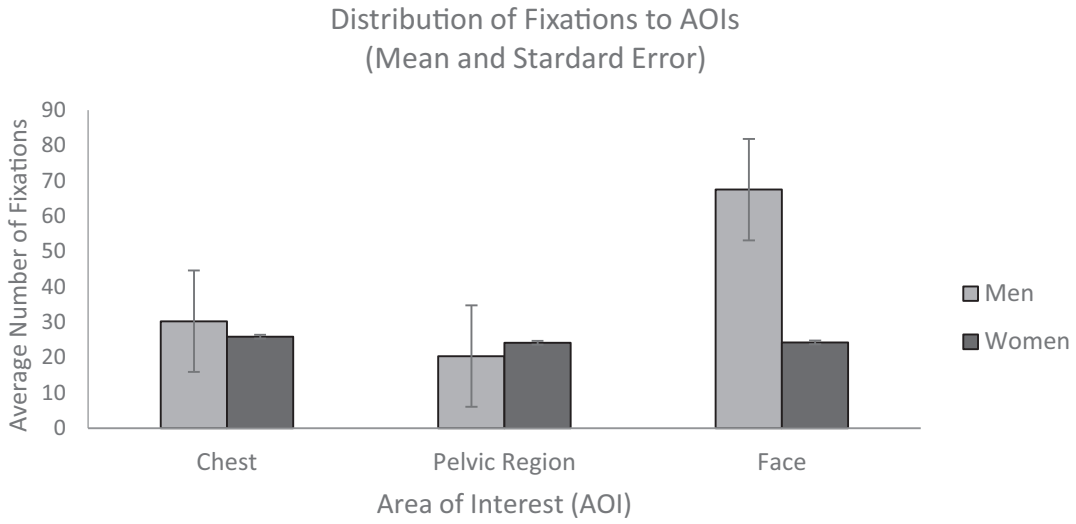

Figure 3. Men made significantly more fixations to the face AOI compared to the chest and pelvic regions. Women evenly distributed their attention to the three AOIs

Stimulus sex. Exploring viewing patterns of men and women to preferred and non-preferred stimuli (Stimulus Sex) revealed a significant three-way interaction for total number of fixations among Participant Gender x Stimulus Sex x Stimulus Type, $F(1, 101) = 8.83$, $p = .004$, $\eta^2 = .08$. As shown in Figure 4, men and women looked significantly more at their preferred figures (i.e., opposite sex models), but this was dependent on the type of stimulus. For the erotic images, men looked significantly more at the female models than the male models (marginal means for fixation count = 49.39 and 41.57, respectively, $p < .001$, $d = .39$), and women looked more at the male models than the female models (marginal means for fixation count = 31.95 and 28.22, respectively, $p = .039$, $d = .19$). For the neutral stimulus, however, both men and women divided their visual attention more evenly between the male and female models as no significant differences were observed ($ps > .14$, $d = .09$–$.11$).

Stimulus type and background. We extracted the total number of fixations to the background (i.e., whitespace on the screen not containing the images) and compared them to the values we calculated for neutral images (i.e., sum of the area containing the neutral male model and the neutral female model) and erotic images (sum of the area containing the erotic male model and the erotic female model). The data are illustrated in Figure 5. When these values were subject to a 2 (Condition) x 2 (Participant Gender) x 3 (Area on Screen: Erotic, Neutral, Background) mixed model ANOVA, there was a significant Area on Screen x Participant Gender interaction, $F(2, 210) = 4.19$, $p = .016$, $\eta^2 = .04$. For women, total fixations to the erotic images were significantly higher than neutral images ($p < .001$, $d = .71$), and although they made more fixations to the erotic images than the background, this difference was not significant ($p = .31$, $d = .22$). For men, total fixations to the erotic images were significantly higher than both neutral images ($p < .001$, $d = .62$) and the background ($p < .001$, $d = .63$).

Associations between fixations to erotic and neutral images. We conducted bivariate Spearman correlations and found that for all participants, the total number of fixations to erotic images was significantly correlated with the total number fixations to neutral images and the background, $r_s = .87$ and .47, respectively, n = 109, $p < .001$. Similarly, the total number of fixations to the neutral images were also significantly correlated with the total number of fixations to the background, $r_s = .34$, n = 109, $p < .001$.

Self-reported Sexual Attraction Ratings

A paired sample t-test was conducted to examine self-reported attraction ratings for the experimental stimuli. Women's average attraction rating was significantly higher for the female models ($M = 3.46$, $SD = .83$) compared to their ratings of the male models ($M = 3.27$, $SD = 0.76$), $t(52) = 2.90$, $p = .005$, $d = .40$. Men reported significantly higher attraction ratings to the female models ($M = 4.21$, $SD = 2.98$) compared to the male models ($M = 2.82$, $SD = 1.15$), $t(55) = 3.33$, $p = .002$, $d = .45$. Mean attraction scores to preferred stimuli fell within the "moderately sexually attracted" range, meaning that neither men nor women reported a high degree of attraction towards the images presented.

Impression Management and Personality Measures

Responses to the IM subscale were dichotomized using the procedure described by Paulhus (1991). Due to well-established gender differences in IM, the scores were dichotomized ('high' versus 'low') using gender specific median values. The addition of a dichotomized IM factor to the above-mentioned mixed-model ANOVA, did not significantly change any of the findings (all $ps > .05$).

For each participant, five-personality dimension scores were calculated using the TIPI. Table 3 displays the means

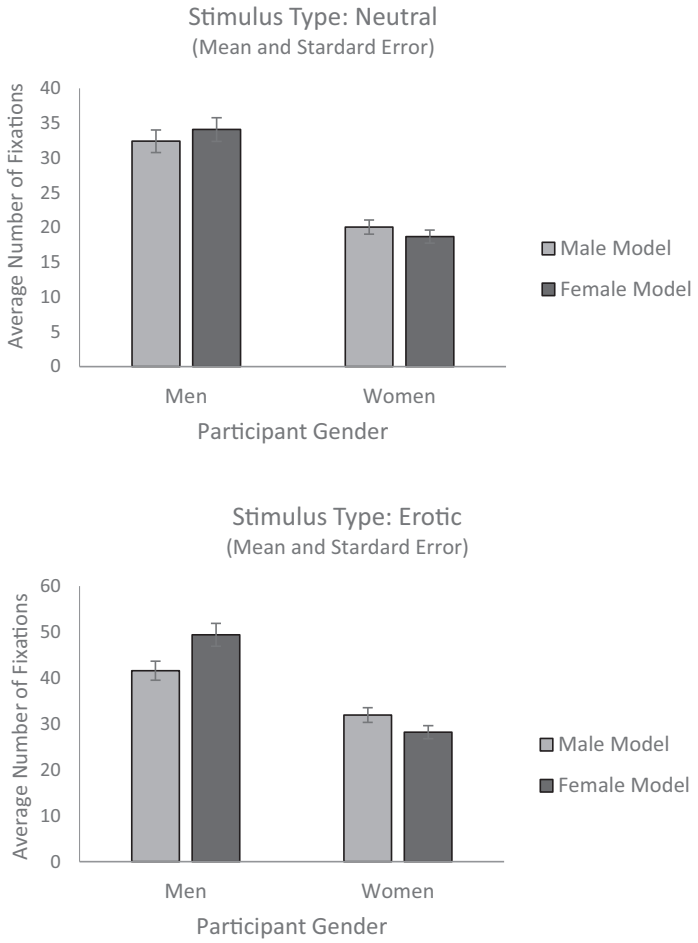

Figure 4. Three-way interaction illustrating a significant difference in how men and women distribute their visual attention to male and female models based on the type of stimulus. Men and women display gender-specific patterns of visual attention when viewing erotic stimuli and gender-nonspecific patterns when viewing neutral stimuli

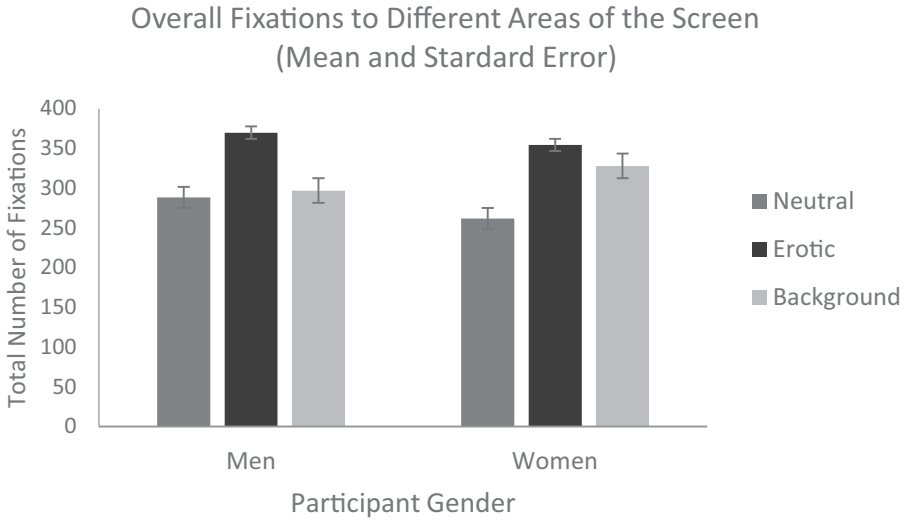

Figure 5. Men made significantly more fixations to the erotic stimuli compared to the neutral stimuli and background. Women looked significantly more at the erotic stimuli and background compared to the neutral stimuli, but no significant differences were found between overall fixations to the erotic stimuli and background

Table 3. Means and Standard Deviations for TIPI and IM Measures for Men and Women

	Men	Women
	M (SD) Range	*M (SD) Range*
Impression Management	83.21 (19.82) 95	91.83 (16.93) 76
Extraversion	4.19 (1.84) 6.00	4.46 (1.38) 5.50
Agreeableness	4.34 (1.14) 5.00	5.12 (1.24) 4.50
Conscientiousness	5.06 (1.29) 6.00	5.06 (1.33) 5.00
Emotional Stability	4.96 (1.40) 5.50	4.34 (1.18) 5.00
Openness to Experience	5.23 (1.07) 4.50	5.14 (1.02) 5.00

across genders for the five-personality dimensions as well as impression management scores. We used the scores and tested correlations with the number of fixations within the type of stimulus (neutral, erotic). Across all participants, no significant correlations were detected.

DISCUSSION

Overall Findings

The goal of the present study was to examine the influence of a broader social context on men and women's distribution of visual attention to sexual images. We found a significant effect of perceived social presence for women such that in the aware condition, women made fewer overall fixations than men; but no such differences were observed in the unaware condition. We also found significant effects for our within subject variables. Across all participants, the erotic stimuli garnered more fixations than the neutral stimuli and the background. Furthermore, men looked significantly more at the face of the models compared to women, regardless of condition. Number of fixations to the chest and pelvic regions were comparable among men and women, with the chest of the erotic female model and pelvic region of the erotic male model being the most popular. Both men and women demonstrated gender-specific patterns of visual attention but only for the erotic stimuli. For neutral stimuli, gender non-specific patterns were observed.

Implied Social Presence

The present study corroborates the findings demonstrated by Risko and Kingstone (2011) that individuals are sensitive to having their eyes tracked and are willing and able to modulate their visual attention in response to this knowledge. That women in the aware condition—but not the unaware condition—made significantly fewer fixations than men suggests that women who knew that their eyes were being monitored may have been inhibiting their natural gaze patterns. We view this as the most relevant finding because our main objective was to examine the impact of implied social presence on visual attention. More specifically, the perceived social context in the aware condition coupled with the explicit nature of our stimuli may have deterred women from looking at the monitor. Further validation for this finding comes from an examination of fixations to areas on the screen that did not contain the images, as participants may have been inclined to look at the background in an effort to avoid the stimuli. There was no effect of whether participants knew they were being watched on looking at other areas of the screen. Thus, the fewer overall fixations women made in the aware condition was likely caused by looking away from the monitor altogether. Taken together, we interpret these findings as support for the view that the presence of others, whether real, implied, or imagined, makes an individual a potential object of evaluation (van Rompay et al., 2009). This risk of being evaluated along with maintaining a socially favourable self-image may motivate individuals—women in the aware condition in this case—to modify their behaviour by inhibiting their natural gaze patterns (Krumpal, 2013; Satow, 1975; van Rompay et al., 2009).

While the significant finding above is a prominent one for this experiment, it is also important to note that the effect sizes were small and our manipulation of condition did not have any significant impact on the distribution of attention for the within subject variables (i.e., Stimulus Sex, Stimulus Type, and AOI). A potential explanation for this lack of effect may be that participants were provided with a specific task—a task that required them to look at both models in order to provide an attractiveness rating at the end of each trial. As such, participants in both conditions were likely to examine each model. Evidence for this explanation is provided by the seminal work of Yarbus (1965/1967) which suggests that the task assigned to participants may indeed influence the distribution of visual attention. Birmingham, Bischof, and Kingstone (2008) found further support for this as participants directed their gaze to specific areas depending on the nature of the task.

Looking at these results from a different lens, could there be alternative factors that lead to our observed gender differences? For instance, the approach-inhibition theory of power posits that having power increases the tendency to approach and decreases the tendency to inhibit (Keltner, Gruenfeld, & Anderson, 2003). Thus, if participants with elevated power are less likely to pay attention to social norms, to take the perspective of others, and/or are disinhibited (including sexual inhibitions), then could the apparent gender differences observed be more indicative of power differences? Examining the role of power dynamics (including the determinants of power, social power, and social consequences) and its effect on visual attention to explicit stimuli in a social context seems a fruitful line of investigation for future research.

Allocation of Visual Attention to Erotic Stimuli Versus Other Images

In line with previous findings that men and women dedicate more attention to erotic images compared to non-erotic images (Lykins et al., 2008; Nummenmaa, Hietanen, Santtila, & Hyönä, 2012; reviewed in Wenzlaff et al., 2016), we found that total fixations were indeed highest for erotic stimuli, compared to neutral stimuli and the background. The novelty of erotic stimuli could be a factor that influences this pattern of visual attention. Despite the widespread accessibility to pornography, for most individuals, sexual content stands out and captures our attention when it appears because it is more compelling (Lykins et al., 2006). The higher number of fixations to the erotic stimuli suggests that participants' attention was being captured repeatedly by the erotic stimuli (i.e., even if participants were trying to fixate on the background, they would make quick glances at the erotic stimuli). Additional studies that manipulate implied social presence and examine novelty by having sets of stimuli simultaneously presenting both erotic and non-erotic images are needed to test this possibility.

Unlike previous research indicating that there are no gender differences in viewing patterns to contextual features of images (Lykins et al., 2008), our results had medium effect sizes and found that men made more fixations to erotic stimuli than both neutral stimuli and background features. Women, on the other hand, made a comparable number of fixations to the erotic stimuli and the background. That women looked equally at erotic stimuli and the background further supports the previously stated idea that women may have been inhibiting themselves from freely viewing the erotic images whereas men were not impacted by inhibition and thus looked at erotic images more than background.

Gender Specific Versus Non-Specific Patterns of Visual Attention

Previous research has shown that women divide their visual attention evenly across male and female images, whereas men focus their attention more on their preferred sex (i.e., female model), regardless of the type of stimulus (Dawson & Chivers, 2016; Lykins et al., 2008). Contrary to these findings, our results indicate that whether the stimulus is erotic or neutral does impact how men and women distribute their attention to male and female models. Although our effect sizes were small, we found gender-specific patterns of visual attention in both men and women when viewing erotic images, and gender non-specific patterns in both men and women when viewing neutral images. The most basic explanation for why sexually attractive stimuli (compared to non-attractive or neutral stimuli) garners preferential attention is that viewing those stimuli is rewarding. Among our sample of heterosexual participants, focusing attention on opposite sex erotic images would be most rewarding since viewing sexually attractive stimuli elicits neuronal activities in brain areas associated with the human reward system (Imhoff et al., 2010). Further evidence for this explanation is provided by a study investigating visual attention patterns among women with varying sexual attractions. This investigation found that controlled attention patterns mirrored the patterns of self-reported sexual attraction (Dawson, Fretz, & Chivers, 2017). More specifically, androphilic women (sexually attracted to men) looked significantly longer at male targets and gynephilic women (sexually attracted to women) looked significantly longer at female targets (Dawson et al., 2017). Future studies may benefit by examining the impact of implied social presence on patterns of visual attention among women with varying sexual attractions.

Alternative explanations exist in the literature to account for gender differences in gaze patterns when viewing preferred and non-preferred stimuli. An evolutionary perspective postulates that longer viewing time of preferred figures may be adaptive for mate seeking and because sexual attraction is closely related to reproduction, it seems plausible that the cognitive system directs attention to potential sexual mates (Imhoff et al., 2010; Redouté et al., 2000). A different explanation posits that gender differences in gaze patterns may reflect organizational differences in sexual arousal, with men's arousal dependent on stimulus-specific features and women's genital arousal dependent on an automatic response to stimuli categorized as "sexual" (Chivers & Bailey, 2005; Hall et al., 2011).

Areas of Interest Preferences

Past research which found that participants attended more to the body region of models than the face (particularly for erotic stimuli) (Lykins et al., 2006; Rupp & Wallen, 2007) may be explained by the fact that the body has greater surface area. In this study, however, we used three specific AOIs (face, chest, pelvic region), all of which were similar and comparable in size. With small effect sizes, we found that men, compared to women, had a markedly greater number of fixations to the face AOI of both models, in both types of images, and regardless of whether they were being observed or not. Men are generally socialized to put emphasis on physical appearance; as such, faces of the opposite sex are highly salient and positive stimuli for heterosexual men (Kranz & Ishai, 2006). Faces of the male models also garnered men's visual attention as participants were asked to rate the attractiveness of each model after each trial.

For the pelvic region of the erotic images, both men and women looked significantly more at the male model's genitalia. The most parsimonious and relevant explanation for this interesting finding is one which was noted earlier: novelty. It might be that naked female models are more readily available and visible in media and magazines, whereas completely naked male models with visibly aroused genitalia are not as universally accessible to the public. As a result, the novelty of the aroused male images may have shifted attention of both men and women to the male pelvic region of the erotic stimuli. A secondary explanation might suggest that men were making fixations to the male model's pelvic region because they were

concerned with socially comparing themselves to the male model's, particularly with respect to the genital region, because for many men the size of their penis is an important issue (particularly in its erect state) as it is a symbol of masculinity (Wylie & Eardley, 2007).

Subjective Attraction Ratings

Our results support existing data that shows heterosexual men generally rate stimuli with same-sex models lower than women rate images of same-sex models (Rupp & Wallen, 2008). Indeed, men in this study rated the female models as more attractive than the male models. Women, however, gave the female models a higher attractiveness rating than the male models. Although we had small effect sizes, this result parallels findings that showed heterosexual women provided higher ratings for attractive faces than men, in a study where faces of female models were rated as more attractive overall than male models (Leder, Tinio, Fuchs, & Bohrn, 2010). While we observed these gender differences in attractiveness ratings, it is important to note that although significant, the mean difference in women's assessments of the models was only 0.19 on a 7-point scale. By contrast, men had a much greater mean difference of 1.39. These differences strongly suggest that while both men and women's attractiveness ratings fell roughly in the middle of the scale ("moderately sexually attractive"), there were significant evaluation differences given that men vary substantially in their assessments while women do so to a much lesser extent. Nevertheless, our finding may be explained by the fact that we asked about general attractiveness, not sexual attractiveness, and if we had asked about sexual attractiveness, our heterosexual female participants would have rated the male models higher than the female models, as target specificity would predict (Dawson & Chivers, 2016).

Moderating Effects of Personality and Impression Management on Visual Patterns

We found no effect of personality, as measured by the TIPI, on fixations. This may be explained by the fact that personality factors were measured in too global and abstract a manner to account for much of the relationship between implied social presence and visual attention. Meston et al. (1998) have suggested that specific traits within the Big Five factors may explain a much larger portion of the associations than do brief global markers of personality, such as the TIPI. In future studies, it will be important to establish whether personality is associated with particular self-presentational motives using more comprehensive measures of personality.

Due to the close association between sexual restraint and traditional sex roles (Meston et al., 1998), we expected a correlation between IM and restrictiveness of sexuality. Specifically, we anticipated that individuals scoring high on the IM measure would restrict their sexuality by inhibiting fixations to the nude pelvic regions. However, we did not observe any association between impression management and number of fixations or total fixation duration. That impression managers, particularly women, tend to present themselves in a favourable light even under stringent anonymous conditions (Meston et al., 1998) may help explain the absence of any associations in our results.

Implications

Results from the current study represent an important methodological challenge for researchers because while extant eye tracking literature looking at visual attention patterns to erotic stimuli have been conducted with participants being aware that their gaze patterns are being monitored, this study postulates that the act of experimental observation, even when it is implied, may influence the behaviour observed. Thus, for researchers conducting eye tracking studies, consideration should be given to whether participants know they are being eye tracked because it may have a direct bearing on the findings, as illustrated here. The content of the stimuli should also be taken into account because the level of novelty may potentially play an important role in the distribution of visual attention and/or behaviour observed. For researchers working with clinical populations who are generally more likely to have negative thought patterns and negative expectancies, knowing that they are being eye tracked could magnify their need to impression manage and influence results accordingly. Additional research is required as there is a need to understand the mechanisms that explain these group differences; especially since eye tracking is considered a valid measure of neural processing.

Our study showed that women were impacted by the social context more so than men. Women are socialized to inhibit expressions of sexual desire and pleasure due to societal expectations (Sanchez et al., 2012). As well, that women tend to associate sexual words with more negative meaning than men suggests that women's negative attitudes towards sexual stimuli can be quite pervasive (Dewitte, 2016; Geer & Robertson, 2005). Considering the explicit nature of our stimuli, the fact that women in the aware condition made fewer overall fixations coupled with the finding that women look at erotic stimuli and background features relatively equally, suggests their need to conform to societal expectations by holding back sexual urges. Our ability to detect these effects paves the path for future studies to identify ways in which societal expectations cause women to restrain their sexuality. Inhibiting sexual responses and adhering to submissive roles is problematic for women in multiple ways with the most obvious being restriction to half the human experience (Sanchez et al., 2012). As such, utilizing findings from future research to develop successful strategies to help women overcome both cognitive and behavioural sexual inhibition is encouraged.

Limitations

One limitation of the present study is that each 10-second set of stimuli contained either neutral or erotic images—never

a mixture of the two. In each set, participants were only provided with one type of image pair in order to examine whether knowledge of being eye tracked would influence looking behaviour. The contrast of an erotic image and a neutral image simultaneously would likely enhance the effects we observed by offering participants a choice within each set of stimuli. More specifically, participants would have to decide whether they are going to fixate more on the clothed model or the naked model in each set. While we would predict that women aware of a social presence would look more at the clothed models, it is also possible that whether the images were novel or not would also impact gaze patterns. Our design which showed pairs of images within the same category, one type at a time, allowed us to unpack some of these different contributors.

While concealing the eye calibration process was necessary to keep participants unaware of the implied social presence we were manipulating, it also proved to be costly as it generated noise in our data. Because participants in the unaware condition remained naïve to the eye-tracking component of the study, the acquisition of eye movements for some participants was challenging due to changes in their head position and/or being outside the view of the eye tracker. Another potential source of noise is that eyes can fixate just outside an AOI while the information in that area is still processed (Jiang et al., 2016). Although we did not include participant data containing fewer than 300 total fixations in our analysis, the variability in the number of fixations amongst all participants was large enough to warrant future modifications. Future studies may need to utilize a more elaborate deception plot to keep participants from making unnecessary head movements while being tested. Related to the above, we did not remind participants in the aware condition that they were being eye tracked during the experiment. As demonstrated by Nasiopoulos et al. (2015), participants may have forgotten about the eye tracker over time, which may have impacted our results in two ways: (1) participants in the aware condition may have made unnecessary head movements causing variability in the number of fixations, and (2) participants in the aware condition may have forgotten about the social presence context.

We did not control for pornography use or previous exposure to explicit material. These factors may have impacted the visual attention patterns observed. Similarly, we did not test the possible effects of comfort level with sexual content on the findings. Ascertainment bias is a common concern regarding the external validity of most research in human sexuality (Huberman et al., 2013). According to Strassberg and Lowe (1995), compared to non-volunteers, volunteers in sexuality studies report more positive sexual attitudes, less sexual guilt, more sexual experience, and more exposure to erotic materials. The more recent work of Dawson et al. (2019) also found the latter individual difference variables on the willingness to volunteer for a variety of sexuality studies. Because of these factors, participants in sexuality research may be less prone to IM bias; which would help to explain why we did not find any correlations between IM scores and number of fixations.

CONCLUSIONS

The present study found that knowledge of being eye tracked affects looking behaviour, particularly in women. While erotic stimuli attract more attention overall, women—but not men—tend to fixate a comparable amount to the background. Men display a strong preference for the face of models, whereas women distribute their attention more evenly across face, chest, and pelvic regions. From our results, we can conclude that individuals may not feel comfortable displaying their real behaviour with decreased levels of privacy, especially when viewing explicit content. Novelty of stimuli as well as social comparison factors may also play an important role in governing visual attention patterns.

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