Gender differences in implicit processing of sexual stimuli

Dewitte, Marieke [1,2]

[1]Department of Experimental, Clinical, and Health Psychology, Ghent University

[2]Department of Clinical Psychological Science, Maastricht University

Correspondence should be addressed at Department of Clinical Psychological Science, Maastricht University, Universiteitssingel, 40, 6229 ER Maastricht; e-mail: marieke.dewitte@maastrichtuniversity.nl

ABSTRACT

The present studies investigated whether men and women differ in cognitive-motivational processing of sexual stimuli in order to better understand the commonly observed gender differences in sexual outcome variables. Because these processes often operate without conscious control, we focused specifically on automatic stimulus processing. Using a series of implicit tasks, we measured inhibition, attentional orientation, appraisal, and approach-avoidance motivation regarding sexually explicit stimuli in male and female students. Results showed that men were more strongly motivated to approach sexual stimuli than women, and were better able to inhibit sexual information as to prevent activation of the sexual response. With regard to attentional orientation, men were more easily drawn by sexual cues than women, yet only when the cues were presented long enough to allow more elaborative processing. No gender differences were found in the implicit evaluation of sexual information, although men and women did differ at the level of self-reported sexual evaluations. Our results indicate the importance of incorporating information-processing mechanisms and emotion regulation strategies into the conceptualization of the sexual response and promote further research on the specificity, robustness, predictive validity, and malleability of the cognitive-motivational processes underlying sexual arousal.

KEY WORDS: Sexual Arousal, Information Processing, Implicit, Gender Differences

INTRODUCTION

One of the most prominent ideas of recent sex research is that sexual arousal does not arise spontaneously but reflects a dynamic multi-component process that is triggered by internal and external stimuli and involves a cascade of cognitive-motivational processes (Janssen, 2011; Janssen, Everaerd, Spiering, & Janssen, 2000). Because this sequence of phases has a well-defined emotional signature, various researchers shifted towards studying sex as an emotion (Everaerd, 1988; Everaerd et al., 2009; Frijda, 1986). According to this emotion perspective, sexual arousal would be triggered by a stimulus that pre-attentively captures attention and is automatically appraised as sexually meaningful and rewarding. Such automatic appraisal will evoke genital arousal responses, which motivates people to maintain their attention to the sexual stimulus and cognitively elaborate (i.e., consciously appraise) on it. When this results in a positive evaluation, a subjective sense of sexual desire and arousal is experienced, which further increases physical and subjective arousal. These ongoing sexual responses may then trigger the motivation to actually engage in sexual activities (see Janssen et al., 2000; Öhman, 1993; Toates, 2009). Figure 1 presents an overview of the cognitive-motivational processes involved in sexual response generation. Men and women are generally found to show different patterns of sexual arousal, which are reflected in different preferences for sexual stimuli (i.e., (non)specificity of sexual arousal; Chivers, 2005), visual processing of different (aspects of) sexual stimuli (Rupp & Wallen, 2008 for a review), different neural activation patterns in response to sexual stimuli (Hamann, Herman, Nolan, and Wallen 2004; Karama et al, 2002; Wehrum et al., 2013), different levels of sexual motivation (Baumeister, Catanese & Vohs, 2010) and different levels of sexual concordance between subjective and physiological arousal (Chivers, Seto, Lalumiere, Laan, & Grimbos, 2001 for a review). The present investigation was set out to provide a direct test of how men and women process sexual information in order to better understand these gender differences in sexual responding. Although several processes have been the topic of previous investigation, they have rarely been examined in men and women at the same time.

Defining sexual arousal as a process – instead of a static entity - that is determined by multiple indicators has clear heuristic value because it offers concrete guidelines and hypotheses to decompose sexual arousal into its component features, namely attention, appraisal, motivation, and subjective and genital arousal. Such a decomponent approach is mandatory when studying gender differences in sexual arousal responding because it has been argued that men and women would not differ in the pathways underlying sexual arousal, but only in the stimuli and strategies that activate and regulate the sexual response (Rupp & Wallen, 2007). Another important benefit of this model is the idea that sexual responding depends on both automatic and controlled processes, which are assumed to have different effects on sexual outcome variables (Bush, 2001; Everaerd, Janssen, & Spiering, 2003). Automatic and deliberate processes can operate in parallel, synchronously, or in conflicting ways, which may explain the commonly observed discordance between sexual (arousal) responses, especially in women (Chivers, et al., 2010).

Given the theoretical relevance of the aforementioned emotion perspective, more work is needed on the cognitive and motivational processes that generate and regulate sexual arousal. This level of specificity is useful to delineate the precise function of sexual arousal in relation to other sexual responses (e.g., desire, sexual preferences, sexual behavior, etc) and to better understand the source of (gender) differences in levels of sexual arousal. If we want to intervene at the level of arousal, it is important to know at which component(s) the process of arousal has stagnated and whether this is different for men and women. That is, problems with sexual arousal may be caused by the fact that the sexual stimulus lacks rewarding properties, the individual fails to notice and attend to the sexual stimulus, and/or one's motivation to engage in sexual behavior cannot be translated into an actual approach response. Many of the processes involved in sexual responding - such as perception, attention, interpretation, evaluation, and so on - have been shown to work well without conscious control (Bargh & Barndollar, 1996). However, because sex research typically relied on self-report measures, we know fairly well how people consciously and deliberately respond to sexual stimuli, but we know much less about automatic sexual stimulus processing. In the context of sexual arousal, this may be problematic because people are often not aware of their sexual responses – which implies that they are not available for reflection and report - or they may be motivated to distort their thoughts, feelings, and behavior in the service of self-regulation and self-presentation (for an overview on the accuracy of self-report in sex research, see Schroder, Carey, & Vanable, 2003). Another important limitation of self-report is that these measures can reveal only the end-products of stimulus-processing, but cannot tap into the automatic process itself. That is, people can report on the outcome of emotion and behavioral regulation processes (such as attention, goal-pursuit), while remaining unaware of the process itself. Although the role of deliberative factors should not be minimized, the study of conscious processes is overrepresented in sex research. Therefore, the present investigation primarily aimed at measuring the implicit features of sexual information processing.

Attention

Scholars have mainly been interested in exploring the role of attention in facilitating and impeding sexual arousal (see de Jong, 2009 for a review). This is not surprising because attention acts early on in the emotion regulation process and can thus be regarded as a key process in the activation and regulation of sexual responding (Barlow, 1986). Selective attention consists of two different interrelated mechanisms, namely allocating attention to goal-relevant information and active inhibition of goal-irrelevant information (Zacks & Hashler, 1994). Using different manipulations of attention [e.g., private and public self-focus, external and internal distraction such as performance demand, habituation effects, and directed attention (i.e., focusing on stimulus versus emotion, bodily versus genital cues)], it is clearly established that attentional processes are a necessary condition for sexual arousal to emerge, ultimately affecting how sexual experiences unfold (e.g., Elliot & O'Donohue, 1997; Heiman & Rowland, 1983; Meston, 2006; Salemink & Van Lankveld, 2006; Van Lankveld, van den Hout, & Schouten, 2004; van den Hout, & Barlow, 2000; Van Lankveld & Bergh, 2008). Unfortunately, most of these processes have been studied in separate samples of men and women, which precludes a direct analysis of gender differences in attentional processes.

Another intriguing observation is that, despite the large literature on attention, research so far has almost exclusively focused on the regulatory effect of attention on sexual arousal, thereby considering attention as an independent instead of a dependent variable. There are yet a few studies that did provide a direct test of attentional processes, focusing mainly on the orienting component of attention. Using a dot-probe task, attentional orientation towards sexual stimuli has been studied as a function of sexual desire status, yet only in a group of women (Brauer, van Leeuwen, Janssen, Newhouse, Heiman, & Laan, 2012; Prause, Janssen, & Hetrick, 2008). Another important set of studies measured gender differences in attention and relied on eye-tracking methodology to measure which aspects of a sexual scene attract men and women's attention, revealing interesting gender differences in allocating attention to sexual and erotic pictures (Lykins, Meana, & Kambe, 2006; Lykins, Meana, & Strauss, 2008). More concretely, these studies have shown that heterosexual men looked significantly more often at female pictures than at male pictures, whereas heterosexual women looked equally often at male and female stimuli (Lykins, Meana, & Kambe, 2006; Lykins, Meana, & Strauss, 2008). In another study presenting sexual and non-sexual videos, it was found that only in videos depicting no sexual intercourse men observed the opposite sex significantly longer than women, with women observing the same sex longer than men (Tsujimura et al., 2009). Other evidence on attention allocation has revealed that men looked more often at female faces, women without contraceptive use looked more often at genitals, and women with contraceptives looked more frequently at contextual aspects of the stimulus (Rupp & Wallen, 2007). Overall, these studies have demonstrated that men and women attend to different aspects of the same visual sexual stimuli, indicating the relevance of studying pre-existing cognitive biases as a function of gender. Although highly relevant, these studies focused mainly on attention allocation to specific features of sexual stimuli, whereas the present study aims at investigating the basic process of orienting attention to sexual versus non-sexual pictures, with the ultimate goal of understanding how gender differences in visual attention contribute to different patterns of sexual arousal.

So far, the role of inhibitory control has remained largely unexplored. This is remarkable because regulation of sexual emotions often involves inhibition. Without inhibition, sexual responses would most likely develop and unfold automatically (Everaerd, Laan, Both, & Spiering, 2001), which would obviously interfere with important relational and societal concerns. Inhibitory processes are thus a natural, adaptive reaction to contextual factors (Bancroft, Loftus, & Long, 2003). Already some work has been done on inhibitory mechanisms in the context of sexuality, but these studies investigated inhibition mainly as a response-focused strategy (i.e., after sexual arousal has been triggered) and did not measure inhibition at the automatic level. The majority of research on inhibition is largely inspired by the dual control model, which states that sexual responsiveness depends on the interaction between excitatory and inhibitory systems (Janssen & Bancroft, 2007; Janssen, Vorst, Finn, & Bancroft, 2002). Using self-report measures developed to validate this model, it has been found that women show, on average, higher inhibition than men (Janssen et al., 2002).

There is one line of research that has some bearing on the concept of *automatic* inhibitory processing. Using primed and unprimed lexical decision tasks, it has repeatedly been found that erotic content slows down information processing time (i.e., decision times for word identification and dot probes, as well as overall reading times) (Geer & Manguno-Mire, 1996), a phenomenon which is called the sexual content-induced delay (SCID). It has been shown that the categorization of sexual targets is decelerated by sexual primes when participants were asked to ignore (versus focusing on) the prime (i.e., negative priming), which indicates that the SCID effect reflects a regulatory process that operates in the elicitation stage of sexual responding (Spiering, Everaerd, & Elzinga, 2002). The majority of studies indicate that the SCID effect is more pronounced in women, which would serve evolutionary dynamics (i.e., inhibition as a function of reproduction) (e.g. Geer & Bellard, 1996). To shed further light on the role of gender in inhibitory processing, more research is needed, using different tasks that can tap more directly into the attentional component of inhibitory responding.

Appraisal

Because sexual (arousal) responses are largely determined by our subjective evaluation or appraisal of the triggering stimulus (Both, Everaerd, & Laan, 2007; Janssen, Everaerd, Spiering, & Janssen, 2000; Toates, 2009), the study of sexual appraisal has by far attracted most research attention. When relying on self-report measures, evidence points towards the conclusion that women report greater negative attitudes towards sexuality than men, especially regarding premarital and casual sex (Oliver & Hyde, 1993; Petersen & Hyde, 2010). However, because women are socialized to inhibit expressions of sexual pleasure and desire, it may be misleading to draw inferences on sexual evaluation based on explicit reports only. This has encouraged researchers to apply implicit measures such as the Implicit Association Task to study how people evaluate sexual stimuli at the automatic level (Brauer et al, 2006; Snowden & Gray, 2012; Snowden, Wichter, & Gray, 2008). Although there are several studies using the IAT to measure implicit evaluations of sexual stimuli, there is only one study that included both men and women in their sample. In that study, an IAT was used to measure gender differences in the strength of implicit associations between sexual versus nonsexual attributes and positive versus negative targets. It was found that, even at the automatic level, women associate sexual words with more negative meaning than men, which suggests that women's negative attitudes towards sexual stimuli are quite pervasive (Geer & Robertson, 2005). Because this is the only study so far on gender differences in implicit sexual attitudes, this issue needs further exploration.

Approach-Avoidance Motivation

According to the emotion framework described earlier, the experience of sexual arousal is assumed to generate motivational action tendencies that are directed towards sexual approach behavior (Both , Everaerd, & Laan., 2007; Everaerd, et al., 2001). However, when sexual arousal is associated with negative emotions, sexual stimuli are more likely to evoke an avoidance response in order to stop ongoing sexual stimulation (Toates, 2009). These approach-avoidance action tendencies are likely to operate automatically and may or may not be translated directly into overt behavioral responses. Although in the context of incentive motivation theory scholars regularly refer to the appetitive and aversive system for explaining sexual motivation and motivated behaviour (Everaerd et al., 2001), there has been little empirical work that directly taps into the automatic as well as the behavioral component of sexual response generation. Also the role of gender differences in automatic action tendencies towards or away from sexual stimuli has rarely been explored.

So far, one of the most intriguing studies that operationalized sex as an automatic action tendency has relied on spinal tendinous (T) reflexes to draw inferences about motivated action in response to sexual stimuli (Both, Everaerd, & Laan, 2003). This study revealed that subjective approach tendencies and T-reflexes were facilitated by exposure to a sexual film and that the amplitude of T-reflexes was higher for sexual pictures than for neutral pictures as measured during a picture-rating task. No gender differences were found in Treflex magnitude, suggesting that men and women do not differ in their tendency to prepare for sexual action. However, because T-reflexes are involved in both appetitively and defensively motivated action (Bonnet, Bradley, Lang, & Requin, 1995), this measure is not well suited to study approach apart from avoidance tendencies. More research is needed to conclude on gender differences in automatic approach versus avoidance tendencies in response to sexual stimuli.

The Present Study

The present series of studies were set out to examine gender differences in attentional orientation, inhibition, appraisal, and approach-avoidance tendencies in response to sexual stimuli. Although all four processes are widely implicated in the activation and regulation of sexual responding and have been studied before, most studies so far did not include both men and women in their samples. To address this empirical gap, we aimed at providing a systematic test of gender differences in sexual processing. Because these cognitive-motivational processes often operate without conscious control, we relied on implicit paradigms to gain deeper insight into the impact of gender on automatic stimulus processing. To prevent habituation regarding the sexual stimuli, carry-over effects across different reaction time tasks, and fatigue, the four different regulatory processes were tested in separate studies. Given that we did not include measures of sexual arousal, this design does not allow examining whether attention, appraisal, and motivation are relevant to the activation and control of sexual arousal. We are also aware that this design does not allow us to test an important prediction of the model, namely that the different stages in the information processing system flow into each other (Janssen et al., 2000). However, because the present use experimental tasks that have not been applied in the sex field before, we gave priority to minimizing the influence of methodological confounds. Each sample included an equal number of men and women to directly test gender differences in implicit sexual information processing. For each study, we will provide a short introduction on the choice of paradigm.

Hypotheses

Drawing on the observation that men show higher levels of sexual arousal that are concordant across levels of responding (genital versus subjective arousal) (Chivers et al., 2010), we expect that men are hypervigilant (i.e., increased attentional orientation and deficient inhibition) towards sexual stimuli, evaluate sexual stimuli in more positive terms, and show stronger approach tendencies regarding sexual stimuli compared to women.

STUDY 1: ATTENTIONAL INHIBITION

Inhibition is a potentially important construct with high explanatory value for understanding gender differences in sexual responding. To measure whether or not men and women are able to gain inhibitory control over sexual interference, we used a variant of the negative priming paradigm (NAP; see Joormann, 2004). The most important difference with regular negative priming paradigms - on which the SCID effect is based - is the fact that we used a double-stimulus presentation task in which distractors and targets are presented simultaneously instead of sequentially. In the NAP task, inhibition can be indexed by the degree to which suppressing a reaction to the prime distractor causes a delay in responding to the probe target of the same identity. This procedure taps more directly into inhibitory responding than traditional negative priming paradigms because, in both the prime and probe trials, participants need to respond to a target in the presence of a distractor that needs to be inhibited. The crucial manipulation of the NAP task resides in the difference between experimental trials, in which prime distractors and probe targets share the same identity, and control trials, in which distractors and targets are unrelated. Accordingly, it can be assumed that any observed interference effect is primarily driven by inhibitory processes (Goeleven et al., 2006; Wentura, 1999). To test whether the inhibition effect is specific to sex stimuli and cannot be accounted for by valence or arousal, we also included sports pictures that are high in valence and arousal as well (see Van Lankveld & Smulders, 2008).

Method

Participants

Twenty-six men (M_{age} = 20.78 years, *SD* = 1.89) and 28 women (M_{age} = 20.12 years, *SD* = 2.01) participated in this study in return for a monetary award of 8 euros. Participants were recruited from various campuses at Ghent University via an online subscription system. During recruitment, they were informed that the study would include sexual content. Due to a computer error, we lost data of 1 man and 2 women. One man reported to have a homosexual orientation and 1 woman was bisexual. Given the low prevalence of non-heterosexual participants, we did not vary the sexual stimuli according to sexual orientation in the service of standardizing the experimental paradigm. We did, however, exclude homosexual participants from our analyses because our sexual stimuli depicted only heterosexual intercourse. Bisexual participants were retained, bringing the total sample to 24 men and 26 women. Note that sexual orientation did not affect nor moderate the general pattern of results, in none of the experiments. Of men, 69.2 % were in a sexual relationship (*M* = 8.46 months, *SD* = 13.87). Of women, 65.4 % had a sexual relationship (*M* = 17.81 months, *SD* = 21.34). One man and 4 women never had sexual intercourse before.

Materials

For the sexual stimuli in the NAP task, we used 18 coloured pictures of a heterosexual couple engaging in penetrative sex, selected from the Rupp and Wallen (2007) stimulus-set. Each picture displayed an explicit sexual scene with a clear focus on the genitals and coitus. We also selected 18 control pictures, consisting of sport scenes depicting men and/or women in various branches of sports (running, swimming, water skiing, dancing, etc). Both sex and sports pictures included faces of men and women to ensure maximal comparability. 12 neutral pictures of furniture were used as distractors in the probe trials. All neutral pictures and part of the sports pictures were drawn from the IASP database (Lang, Bradley, & Cuthberth, 1999). Another 3 pictures of each category were selected for the practice trials. All were adjusted to the same size (326 pixels x 326 pixels) and were presented in a random order. Targets and distractors were presented in a black or grey frame such that a target with a black frame was combined with a distractor with a grey frame. All frames consisted of lines that were 3 mm wide. The NAP task was programmed using the INQUISIT Millisecond software Package (Inquisit 2.01, 2005) and presented on a Pentium II computer with a 19-inch TFT-color monitor that had a refresh rate of 60 Hertz. Participants were seated at a distance of approximately 60 cm from the screen and responded by pressing the q or m key of an AZERTY keyboard.

Procedure

After participants were informed about the explicit sexual content of the stimulus material, they signed the informed consent form[1]. Next, the NAP task was administered, starting with 12 practice trial-sequences, followed by 64 test trial-sequences. Figure 2 provides an overview of the different trial-sequences in the NAP task. Each trial-sequence in the NAP includes a succession of two separate trials: a prime and a probe trial, in which two stimuli are presented simultaneously, a target and a distractor. Each trial within a sequence started with the presentation of a fixation cross that was displayed for 1000 ms in the middle of the screen. Next, two pictures (one surrounded by a black frame, the other by a grey frame) were presented in the upper and lower half of the screen. Participants were instructed to ignore the distractor (picture with the grey frame) and to focus on and evaluate the content (sexual or not) of the target picture (picture with the black frame) as accurately as possible by pressing one of two corresponding keys. The spatial position of the target and the distractor in both the prime and probe trials were randomly assigned from trial to trial, with an equal number of presentations for each condition. Both pictures remained on the screen until a response was given. The inter-trial interval was 1000 ms.

In experimental trial-sequences, the distractor of the prime trial and the target of the probe trial share the same content, whereas in control trial-sequences prime distractors and probe targets are unrelated. Inhibition is indexed by the degree to which suppressing a reaction to the prime distractor in one trial causes a delay in responding to the probe target of the same content in a next trial. Reaction times on control sequences are subtracted from reaction times on experimental sequences such that a positive NAP score indicates stronger inhibition of the prime distractor, whereas a negative NAP score indicates weaker inhibition. Hence, the crucial manipulation in the NAP task is (1) the difference in reaction times between experimental and control conditions and (2) the content of the distractor in the prime trial, which differs from the content of the probe target in the control condition, but not in experimental NAP sequences. It is important to note that participants are not aware of the difference between prime and probe trials, which makes it less likely that they can consciously control the magnitude of the effects. Accordingly, it can be argued that this task measures inhibitory processes at a relatively automatic level (for an overview on automaticity, see Moors & De Houwer, 2006). The mean spilt-half reliability of the NAP effect for sexual stimuli was .64.

The experiment took 20 minutes to complete and was conducted by a female experimenter. Every participant was tested individually in a laboratory room that included two adjacent suites. In order to minimize the influence of the experiment leader’s presence, the participant sat alone in one of the rooms with the door closed, but had the opportunity to communicate with the experimenter via the intercom in case of questions or technical problems. The laboratory setting, the duration of the experiment, and the gender of the experimenter were similar throughout the four experiments.

Results

We analysed responses on probe trials only. In line with previous research using the NAP task, latencies below 300 ms and above 2000 ms (reflecting anticipatory and delayed responding respectively) were treated as outliers and removed from statistical analyses (Joormann, 2004; Goeleven et al., 2006). Moreover, because prime and probe trials are mutually related, only trial-sequences in which a correct response was given on both the prime and probe trial were taken into account (see Fazio, 1990). In total, 6.42 % of the data were removed for these reasons.

To examine gender differences in inhibitory processing of sexual information, we conducted a repeated measures ANOVA with stimulus type (sexual, sport) and type of trial-sequence (experimental, control) as within-subject variables and gender as between-subject variable. This analysis revealed a significant main effect of trial-sequence, $F(1,47) = 24.35$, $p = .00$. The mean reaction times show that participants were slower to react at experimental trials compared to control trials (see Table 1), which indicates a standard negative priming effect. Also the main effects of picture type, $F(1,47) = 29.65$, $p = .00$, and of gender, $F(1,47) = 10.13$, $p = .01$, were statistically significant, as well as the interaction effect between picture type and gender, $F(1,47) = 5.15$, $p = .03$. Overall, participants showed stronger inhibition of sex stimuli compared to sports stimuli and men showed stronger inhibition than women. To further interpret the NAP data, we calculated an inhibition index by subtracting reaction times on experimental trials from reaction times on control trials. Analyses on the means revealed that men ($M = 45.40$, $SD = 56.49$) showed stronger inhibition of sexual stimuli than women ($M = 16.35$, $SD = 37.02$), $t(48) = 2.17$, $p = .04$. No gender differences were found in the inhibition of sports stimuli, $t(48) = -.30$ $p = .77$ ($M = 17.28$, $SD = 59.37$ for *men* and $M = 21.39$, $SD = 37.86$ for *women*). When focusing on within gender-differences, neither men nor women showed a significant difference between inhibition of sex versus sports stimuli, $t(48)$

= 1.81, p = .08 for *men* and t(48) = .50, p = .62 for *women*. There were no changes in the pattern of results when including sexual status (i.e., being in a sexual relationship or not) and sexual experience in the analyses.

Discussion

Our results showed that men are better able to inhibit sexual information compared to women. Importantly, this inhibitory effect appeared to be specific for sexual stimuli. No gender differences were found in inhibitory processing of sports pictures. This contradicts previous research suggesting that women show stronger inhibition, as manifested in longer sexual content induced delays, of sexual cues than men (Geer & Bellard, 1996). One possible way to explain our finding is by assuming that men are better trained to inhibit sexual stimuli than women because they need stronger regulatory efforts to keep their sexual system quiescent in inappropriate social situations. In other words, given that men are more preoccupied with wanting sexual stimulation and display higher sexual arousability (Petersen & Hyde, 2010), it may be that inhibition processes are more functional to men than to women. Keeping sexual signals out of their focus of attention may enable men to prevent further activation of sexual arousal responses. On the other hand, one could also argue that men's lower threshold for sexual responding points to deficient inhibition and that lower sexual arousability in women actually results from stronger inhibition processes at the early onset of emotion regulation. The latter could be driven by social learning processes, encouraging women to inhibit sexual responding. Our results, however, do not support this conclusion because women did not show stronger inhibition of sexual stimuli and the NAP task is assumed to capture inhibition processes in the elicitation stage of emotion regulation, thus before sexual arousal responses become fully activated (i.e., an antecedent-focused strategy; Gross, 1998). It could be that women are not characterised by facilitated processing at the level of attention, but show biases in more strategic, elaborative processes. That is, motivational tendencies may likely influence their expression and reports of sexual arousal in the service of affect regulation. Further research is needed to substantiate these claims by examining the predictive value of inhibitory functioning in relation to sexual responding and to explore the physiological correlates of cognitive inhibition. Furthermore, although the NAP task has been proven to be a valid index of inhibitory function (De Raedt et al., 2012; Goeleven et al., 2006; Joormann, 2004) and our version of the task was able to detect gender differences in the inhibition of sexual stimuli, further research is needed to substantiate the validity of this task in the context of sexual responding. In this respect, it is noteworthy that alternative interpretations of the negative priming effect have been forwarded, ascribing an important role to episodic memory mechanisms and retrieval processes (Griss, Tipper & Hewitt, 2005). Given that men and women may process sexual information differently at different stages of the regulation process, it is important to ascertain whether the current findings should be interpreted in terms of memory rather than attentional processes.

STUDY 2: ATTENTIONAL ORIENTATION

Selective attention is a key process in extracting motivationally relevant information from our environment, thereby guiding our perception, appraisal, and behavior in sexual situations (see Lang, Bradley, & Cuthbert, 1997; Mogg & Bradley, 1998). Accordingly, the study of attention allocation may help clarifying potential pathways through which men and women differ in sexual arousal responses. Given that there is little research that directly compares men and women’s pattern of attentional orientation towards or away from sexual stimuli, the present study provides valuable information on the role of attention in the context of sexuality. Attention may serve two important functions in sexual responding: (1) the triggering of the sexual system by *directing attention* to sexual information, and (2) the regulation of sexual arousal responses by *maintaining attention* on sexual cues once they have captured the focus of attention. To measure gender differences in attentional orientation, we relied on the exogenous cueing task, which is one of the most widely used tasks in attentional research (Posner, 1980). Compared to other attentional tasks such as the dot detection paradigm, the exogenous cueing task has the advantage of capturing the underlying mechanisms of attentional processing. By presenting the stimuli in a one-by-one design, this task allows determining whether attention is drawn by sexual cues (i.e., attentional engagement) or whether, once detected, people have difficulties to disengage their attention from sexual cues, resulting in prolonged elaboration of sexual information (Fox, Russo, Bowles, & Dutton, 2001). Differentiating between these processes yields important information on the regulatory function of attention in the context of sexuality. In the same vein, it is important to differentiate between bottom-up and top-down influences on attentional processing. To capture both functions of attentional orienting, namely early vigilance (i.e., bottom up) and maintained attention (i.e., top-down), we measured the time course of attentional processing by presenting the stimuli at shorter and longer stimulus durations. In addition to the sex, sports, and neutral pictures that were used in study 1, we also included erotic pictures to explore whether men and women would attend differently to explicit sexual scenes versus erotic scenes that include touching and kissing but no direct reference to genital body parts and penetrative sex. Given that women may respond aversively to sexually explicit stimuli (Bradley, Codispoti, Sabatinelli, & Lang, 2001), we wanted to explore attentional processing of sexually non-explicit material as well.

Method

Participants

Twenty-nine men (M_{age} = 22.09 years, *SD* = 1.34) and 31 women (M_{age} = 21.52 years, *SD* = 2.38) participated in this study in return for a monetary award of 8 euros. Participants were recruited from various campuses at Ghent University via an online subscription system. They were informed about the sexual content of the study. Of men, 68.2 % were in a sexual relationship (*M* = 8.12 months, *SD* = 10.79). Of women, 52.4 % had a sexual relationship (*M* = 12.14 months, *SD* = 12.85). One woman never had sexual intercourse before. All participants reported to have a heterosexual orientation.

Materials

The stimuli for the exogenous cueing task were pictures of sexual (i.e. explicit pornographic pictures displaying sexual intercourse), erotic (i.e. non-explicit sexual pictures that include touching and kissing but no genital close-ups), sports, and neutral scenes. For the sex, sports, and neutral pictures, we used the same pictures as in study 1. The erotic pictures were drawn from the internet. All were adjusted to the same size (326 pixels x 326 pixels). 8 pictures (2 sex, 2 erotic, 2 sports and 2 neutral pictures) were selected for the practice trials and 40 pictures (10 pictures of each category) for the test trials. The exogenous cueing task was programmed using the INQUISIT Millisecond software Package (Inquisit 2.01, 2005) and presented on a Pentium II computer with a computer with a 19-inch TFT-color monitor that had a refresh rate of 60 Hertz. Participants responded by pressing the Q or M key of an AZERTY keyboard.

Procedure

After signing an informed consent form, participants were seated behind the computer at a distance of approximately 60 cm from the screen. Instructions on the computer screen informed them to respond as quickly and accurately as possible to the location of a target, which could appear on the right or left side of the computer screen. Participants were also informed that, before the target appeared, a picture would be presented at the same or the opposite location of the target. The location of the picture cued the spatial position of the target on 50 % of the trials (valid trials) and the opposite position on the other 50 % of the trials (invalid trials).

The task began with the presentation of 8 practice trials, followed by 168 test trials of a short stimulus presentation (250 ms). The second block presented the pictures for a longer time (1250 ms) and contained 8 practice and 168 trials as well. Figure 3 provides an overview of a valid trial-sequence in the exogenous cueing task. Each trial started with the presentation of two white frames (8.5 cm high by 7 cm wide) on a black background and located on both sides of a fixation cross. The frames remained on the screen throughout the entire trial. After 500 ms, a picture was presented for 250 ms in the short presentation block and for 1250 ms in the long presentation block, replacing one of the two frames. Next, the picture was masked for 50 ms by a white frame in order to prevent impaired target detection by after-effects of the picture. Then, the target (a black square of 1.1 x 1.1 cm, 1° x 1°) appeared and remained on the screen until the participant responded. To ensure that participants keep their focus on the fixation cross throughout the cueing task, the fixation cross was occasionally replaced by a digit that participants had to identify. Each block included 8 digit trials. The order of the trials was determined randomly. Each picture was presented four times and the inter-trial interval was 500 ms. Given that we were mainly interested in gender differences and not in the absolute values of the attentional bias indices, the order of the short and long presentation blocks was kept constant for all participants. Not counterbalancing the blocks minimizes error variance.

An attentional bias index is calculated by comparing reaction times on valid trials with reaction times on invalid trials. We also calculated different attentional components because sexual valence may (a) facilitate attentional *engagement* to the sexual cue compared with a neutral cue, leading to response benefits on valid trials, and/or (b) delay the *disengagement* of attention from the sexual cue to the target on invalid trials, leading to delayed responding on these trials (see Derryberry & Reed, 1994; Fox et al., 2001). The mean spilt-half reliability of the attentional bias effect for sexual stimuli was .42.

Results

In line with standard outlier analyses on the exogenous cueing task, latencies from trials with errors were removed as well as reaction times (RTs) shorter than 200 ms or longer than 750 ms (see Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004). Additionally, probe detection latencies that were three standard deviations above or below the individual mean were excluded from statistical analyses. In total, 4.3 % of the data were removed for these reasons.

To examine gender differences in attentional bias towards sexual stimuli, we conducted a repeated measures ANVOA with Picture Identity (sex, erotic, sport, neutral), Validity (valid, invalid), and Time (250-1250) as within-subjects variables and Gender as between-subjects variable. This analysis revealed significant main effects of Picture Identity, $F(1,57) = 8.46$, $p =.00$, Validity, $F(1,57) = 12.22$, $p = .00$, Time, $F(1,57) = 19.22$, $p = .00$, and Gender, $F(1,57) = 8.46$, $p = .01$. Means are presented in Table 2. Overall, participants showed the slowest reaction times to sexual stimuli and responded fastest to neutral stimuli. They were also faster to respond to valid trails compared to invalid trials and to shorter stimulus presentations compared to longer stimulus presentations. Men showed, in general, faster reaction times than women. Also the interaction effects between Picture Identity X Time X Gender, $F(1,57) = 4.01$, $p = .01$, and the interaction between Picture Identity X Validity X Time, $F(1,57) = 3.21$, $p = .03$, reached significance. To interpret these significant interaction effects, we calculated cue validity indices by subtracting reaction times on valid trials from reaction times on invalid trials. Means showed that, overall, participants showed a stronger attentional bias towards sexual pictures presented at 250 ms than at 1250 ms. For the other type of pictures, participants showed a stronger attentional bias when presented at 1250 ms than at 250 ms. At longer stimulus presentations, women responded generally slower to sexual pictures compared to the other type of pictures, whereas men responded slower to sexual pictures at shorter stimulus presentations. To conclude on gender differences in attentional bias as a function of picture type and time course, the 4-way interaction between picture identity, validity, time, and gender needs to be significant, which was not the case. To investigate the underlying mechanisms of attentional orientation as a function of gender, we calculated engagement (i.e., neutral valid trials – sex/erotic/positive valid trials) and disengagement indices (i.e., sex/erotic/positive invalid trials – neutral invalid trials). Analyses on the means revealed a significant gender difference in the engagement score for sexual pictures at 1250 ms, $t(57) = 2.25$, $p = .03$, indicating that men ($M = -9.10$, $SD = 28.18$) reacted faster to sexual stimuli than women ($M = -25.52$, $SD = 29.20$). None of the other engagement and disengagement scores revealed significant gender differences, $t < 1.49$, $p > .14$. Neither controlling for sexual status, nor sexual experience did affect the general pattern of results.

Discussion

Although men and women did not differ in their overall attentional bias regarding sexual or erotic stimuli, our results did provide some indication of gender differences in attentional processing of sexual stimuli. That is, men were faster to detect sexual stimuli presented at 1250 ms than women, indicating that women’s attention was drawn less by sexual pictures when presented long enough to allow more strategic processing. In general, these findings are in line with recent eye-tracking studies showing that men display a higher number of fixations and longer gaze time to sexual pictures than women (Lykins et al., 2008; Rupp & Wallen, 2007). Hence, both current and previous findings clearly suggest that erotic pictures are visually processed differently in men and women. Given that attentional processes are critically involved in the initiation and regulation of sexual arousal (Barlow, 1986; de Jong, 2009), gender differences in attentional orienting may partly explain the commonly observed sex drive differences between men and women. Drawing on a large body of research showing that the male sexual system is more readily active than the female system (Petersen & Hyde, 2010), it makes sense that men invest more attentional resources towards sexual stimuli than women. Interestingly, our results suggest that men and women do not differ in the initial stages of information processing, which are determined by bottom-up influences, but mainly in the regulatory processes that follow sexual system activation, which are determined by top-down influences. This indicates that sexual stimuli may automatically grab attention in both men and women, but when having sufficient time to elaborate on the sexual content of the stimulus, women are slower to respond.

Note that we have to be cautious not to draw far-reaching conclusions on gender differences in attentional processing of sexual stimuli based on the present data, because the overall attentional bias effect was not significantly different for men and women. Also note that no gender differences were found in disengagement from sexual stimuli. Given that men are seemingly preoccupied by sexual material (Petersen & Hyde, 2010), we expected that, once the sexual stimulus has captured the focus of attention, men would dwell more on sexual stimuli, resulting in more elaborate encoding of the sexual information. Although men did differ from women in terms of attentional capture at later stages of information processing, their displayal of maintained attention on sexual cues was not determined by difficulties in disengaging attention from these cues. Altogether, our results suggest that the study of gender differences in attentional orientation requires detailed analysis to allow for uniform conclusions. Although the exogenous cuing task allows for such in-depth investigation, other paradigms need to be explored in order to discern the specific components at which men and women differ.

STUDY 3: APPRAISAL

The subjective evaluation or appraisal of sexual stimuli plays a central role in the elicitation and unfolding of sexual (arousal) responses, which makes this a likely candidate for understanding the source of gender differences in sexual arousal (Both, Everaerd, & Laan, 2007; Janssen, et al., 2000; Toates, 2009). Because sexual appraisal depends on both automatic and controlled processes, we used a self-report measure as well as an implicit reaction time task to capture the cognitive evaluation of sexual stimuli at different levels of processing. Implicit evaluations were measured using the Implicit Association Task (IAT; Greenwald, McGhee, & Schwartz, 1998), which is a widely recommended measure of implicit evaluations that has proven to outperform other implicit measures in terms of reliability and effect size (e.g., De Houwer & De Bruycker, 2007). The IAT is a computer-based measurement technique that involves a dual classification task and assesses the strength of association between concepts in memory. The basic idea is that people will respond faster to concepts that are strongly associated in memory than concepts that are weakly associated. Because the IAT may be contaminated by extra-personal associations reflecting cultural instead of personal representations, we adopted a personalized version of the IAT, which we created by changing the *positive* and *negative* labels of the traditional IAT into *I like* and *I don't like* in combination with omitting the error feedback (see Olson & Fazio, 2004). This reduces the risk that participants will recode the labels into positive-negative and answer in a socially desirable way. Another adaption to the traditional format was the omission of the contrast category of the target concept. The traditional IAT requires two complementary categories for the attitude object (e.g., "Black" and "White") and responses to the contrast category may influence the IAT score, creating ambiguity in the interpretation of this score. Therefore, we eliminated the second contrast category such that we could measure evaluative associations with a single category object, namely sex (for more information on the validity of the single category IAT, see Bluemke & Friese, 2008; Karpinski & Steinman, 2006). Note that the single target version of the IAT has already been used successfully in sex research (Brauer et al. 2006).

Method

Participants

Forty-two men (M_{age} = 21.12 years, *SD* = 3.26) and 42 women (M_{age} = 21.02 years, *SD* = 2.98) participated in this study in return for a monetary award of 8 euros. Participants were recruited from various campuses at Ghent University via an online subscription system. They were informed about the sexual content of the study. Due to a computer error, we lost the data of 1 woman. Five man reported to have a homosexual orientation and 4 men and 1 woman were bisexual. Given the heterosexual nature of the stimulus material, the homosexual men were excluded from the analyses, bringing the total sample to 37 men and 41 women. Of men, 45.9 % were in a sexual relationship (*M* = 19.66 months, *SD* = 23.82). Of women, 53.7 % had a sexual relationship (*M* = 27 months, *SD* = 26.90). Four men and 1 woman never had sexual intercourse before.

Materials

For the labels of the liking SCIAT, we used the Dutch words for *sex*, *I like* and *I don't like*. As stimulus material, we selected five positive (Dutch words for *gift, vacation, laugh, summer, entertain*) and five negative words (Dutch words for *pester, extort, loneliness, distress, war*) for the evaluative dimensions and five words that referred to sex for the object dimension (Dutch words for *fuck, make love, arousal, intercourse, and orgasm*). Word stimuli were presented in the center of a black screen using white lowercase letters in an Arial font with a font size of 32. The labels were presented in the upper left and right corner using white uppercase letters in a Courier font size of 40. The SCIAT was programmed and presented using the INQUISIT Milliseconds software package (INQUISIT 2.01, 2005) on a Pentium II computer with a 19-inch TFT-color monitor that had a refresh rate of 60 Hertz.

Procedure

After signing an informed consent form, participants completed the implicit association task which consisted of three stages in which participants were instructed to categorize words as quickly as possible into different categories by pressing a left (Q) or right (M) key on an AZERTY keyboard. The items were presented equally often in a random order. To minimize error variance, the order of the blocks within each IAT was kept constant for all participants (see Hofmann, Gawronski, Gschwender, Le, & Schmitt, 2005). For this reason, we also did not counterbalance the explicit and implicit appraisal measures. In the first stage, which consisted of 15 trials, participants discriminated target items by pressing a right key for *I like*-words and a left key for *I don't like*-words. This functioned as a training block to help participants become familiar with the procedure. Next, a combined block was presented in which *I like* words and *sex* words were categorized on the right key and *I don't like* words were categorized on the left key. In the final stage, the sex category switched position so that *I like* words were categorized on the right key and *I don't like* and *sex* words were categorized on the left key. The 30 trials in each combined condition were preceded by 15 training trials. The SCIAT-effect was computed by subtracting the mean latencies of the initial combined tasks from the mean latencies of the reversed combined tasks, so that a positive SCIAT score indicated a stronger association between *I like* and *sex* than *I don't like* and *sex*.

Each stage was preceded by a short instruction of the subsequent task, reminding the participants of the dimensions of the categorization task and the exact key-assignment. A stimulus remained on the screen until a response was registered. In each block, the labels of categories assigned to the left key were printed in the top left corner of the screen whereas the labels of the categories assigned to the right key were presented in the top right corner of the screen. Labels were presented continuously throughout each block. Once a response was given, the next stimulus appeared after an interval of 400 ms. In accordance with Olson and

Fazio (2004), we personalized the IAT by omitting the error feedback for the liking words. The mean spilt-half reliability of the IAT index was .82.

After completing the SCIAT, participants reported on the extent to which they “like to have sex” by placing a mark on a 10 cm-line. Because explicit measures may prime the concept under study, the implicit measure was always presented first.

Results

The SCIAT scores were computed using the D-score algorithm for IAT data (Greenwald, Nosek, & Banaji, 2003). The D600 measure includes RTs on (mixed) training blocks and an error penalty and, for each participant, latencies were corrected for individual variability.

Independent t-tests revealed that men and women did not differ in IAT liking scores, $t(76) = .12$, $p = .90$, ($M = .58$, $SD = .51$ for men, and $M = .56$, $SD = .49$ for women). At the explicit level, a significant gender difference was found in explicit liking scores, $t(76) = 2.02$, $p = .04$, with men ($M = 6.9$, $SD = 1.84$) reporting greater liking of sex than women ($M = 5.9$, $SD = 2.19$). The explicit and implicit scores were not significantly correlated, neither for men, $r = -.10$, $p = .57$, nor for women, $r = .03$, $p = .84$. The general pattern of results did not change as a function of sexual status and sexual experience.

Discussion

At the explicit level, men reported greater liking of sex than women, which fits with regular findings that men display more open and positive attitudes towards sexuality than women (Baumeister et al., 2001). Interestingly, no gender differences were found in implicit liking of sex, suggesting that men and women evaluate sex as equally pleasurable when measured at the automatic level. The latter finding contradicts other research using the IAT that did reveal a gender-stereotypical pattern of implicit sexual appraisal (Geer & Robertson, 2005; Snowden, & Gray, 2013). This divergence in results may possibly be explained by methodological differences across studies. In the present study, we used a personalized SCIAT because this version of the IAT has been described as less sensitive to self-presentation issues and societal views than the traditional IAT (Olson & Fazio, 2004). Note, however, that the personalized IAT has been criticized in its own respect because it would turn the IAT into a more explicit measure (Nosek & Hansen, 2008). Although different opinions may exist on the sensitivity of the traditional versus personalized IAT, it is worth noting that the explicit and implicit measures of appraisal were not related, suggesting that both are tapping into different constructs (Hoffmann et al., 2005). This indicates the importance of differentiating between levels of responding when making inferences about gender differences in sexual outcomes.

In general, our results suggest that, at least at the automatic level, men and women are much more alike than when strategic and controlled processes are involved. Accordingly, we may wonder whether the observed gender differences in self-reported sexual appraisal partly reflect socialization experiences that encourage men to report on their sexual urges whereas women are socialized to refrain from expressing sexual desire. Also note that the stimuli were presented in a neutral, non-sexual context, which implies that the sexual stimuli may have been less relevant to the participant's current concerns and goals. In relation to this, previous research has shown that implicit appraisal processes do differ between men and women when varying momentary motivational state and when focusing on the motivational (i.e., wanting) instead of the affective valence (i.e., liking) of sexual stimuli (Dewitte, in press).

STUDY 4: APPROACH-AVOIDANCE MOTIVATION

Being a core element in the regulation of the sexual system, the study of motivational tendencies may be highly relevant for understanding the underlying dynamics of sexual behavior (Both et al, 2007; Everaerd et al., 2001). Considering that societal and relational concerns often prevent us from acting on sexual urges, it is useful to make a distinction between the level of action tendencies and the level of actual behavior and to organize these motivational tendencies along an approach-avoidance continuum (Cooper et al., 2006; also see Carver & Scheier, 1981, 1998; Carver, 2006; Elliot, 2006). Furthermore, conceptualizing sexual motivation in terms of *automatic* approach-avoidance tendencies allows for a more valid test of this mechanism as a central regulatory process in sexual response generation. To measure gender differences in approach-avoidance action tendencies that operate at the automatic level, we used a stimulus response compatibility task (SRC task) in which sexual versus sports pictures are presented (see Mogg, Bradley, Field, & De Houwer, 2003). In this task, participants are instructed to make an approach or avoidance response depending on a certain feature of the presented stimuli (i.e., sexual versus non-sexual content in the present study). Although this task does not tap directly into behavioral responses, participants are assumed to identify with the manikin, thereby "walking" symbolically towards or away from a sexual versus sports picture. The advantage of this specific version of the approach-avoidance task over other tasks using the joy stick and/or arm and leg flexion is that the latter may be confounded by interpretation difficulties. Pulling a stick or arm towards the body can be interpreted both in terms of moving away from the picture ànd bringing the picture closer to the body. Note that the validity of the SRC task has been established in previous work, showing that smokers could be differentiated from non-smokers on the basis of their approach responses regarding pictures of cigarettes (Mogg et al., 2003).

Method

Participants

Forty-four men (M_{age} = 20.27 years, *SD* = 3.05) and 42 women (M_{age} = 20.53 years, *SD* = 2.10) participated in this study in return for a monetary award of 8 euros. Participants were recruited from various campuses at Ghent University via an online subscription system. They were informed about the sexual content of the study. One woman and 2 men reported to have a homosexual orientation and 1 man and 1 woman were bisexual. The homosexual participants were excluded from the analyses because of the heterosexual nature of our stimuli, bringing the total sample to 42 men and 41 women. Of men, 41.9 % were in a sexual relationship (*M* = 16 months, *SD* = 17.41). Of women, 76.9 % had a sexual relationship (*M* = 25 months, *SD* = 15.41). Six men and 2 women never had sexual intercourse before.

Material

The stimulus material for the approach-avoidance task consisted of two categories of pictures. We selected 8 pictures depicting a sexual scene of a heterosexual couple having sexual intercourse and 8 pictures depicting a sports scene. For both categories, we used the same pictures as in study 1. The manikin consisted of a white circle for the head, an ellipse for the body and lines that represented arms and legs. It was about 2.8 cm high and 1.5 cm wide (arms inclusive). Participants could make the manikin move upwards by pressing the “8” key of the numeric part of the keyboard and could make it move downwards by pressing the “2” key. When one of these keys was pressed, the manikin “walked” towards the picture presented at the centre of the screen or away from the picture (towards the upper or lower edge of the screen). The approach-avoidance task was programmed and presented using the INQUISIT Milliseconds software package (INQUISIT 2.01, 2005) on a Pentium II computer with a 19-inch TFT-color monitor that had a refresh rate of 60 Hertz.

Procedure

After signing the informed consent, participants completed the approach-avoidance task, consisting of 8 practice and 32 test trials of a first response assignment, and 8 practice and 32 test trials of a second response assignment. Instructions informed the participants that on each trial they would see a picture that displayed a sexual or non-sexual scene. A manikin would also appear either below or above the picture. Their task was to move the manikin towards or away from the picture depending on the nature of the picture. In the *compatible* block, participants were instructed to make the manikin run towards sexual stimuli and away from non-sexual stimuli. In the *incompatible* block, instructions were reversed, that is, they had to move the manikin away from sexual stimuli and towards non-sexual stimuli. Again, the order of the blocks was kept constant for all participants in order to minimize error variance. Each trial started with the presentation of the manikin that appeared in the centre of the upper or lower half of the screen. The starting position of the manikin (above or below) was determined randomly and throughout the task the manikin appeared equally often above and below the pictures. After 750 ms, a picture was presented at the centre of the screen. All pictures disappeared as soon as the manikin reached the centre of the screen (the location of the picture) or the edge of the screen. The inter-trial interval was 1000 ms. The latency between the onset of the picture and the first key press was registered as the reaction time. The mean spilt-half reliability of the approach-avoidance index was .76.

Results

In line with previous work on the SRC task, latencies from trials with errors were removed. Reaction times that were shorter than 200 ms or more than 3 SD above the individual mean were treated as outliers and excluded from analyses (see Mogg et al., 2003). 6.2 % of the data were removed for these reasons.

To examine gender differences in approach-avoidance tendencies towards or away from sexual stimuli, we conducted a repeated measures ANOVA with compatibility (approach versus avoidance) as a within-subjects variable and gender as a between-subjects variable. The relevant mean reaction times are presented in Table 3. This analysis yielded a significant main effect of compatibility, $F(1, 81) = 27.44$, $p = .00$, and of gender, $F(1, 81) = 5.85$, $p = .02$, as well as a significant interaction effect between compatibility and gender, $F(1, 81) = 5.50$, $p = .02$. To interpret this statistical significant interaction effect, we calculated an approach-avoidance index by subtracting reaction times on the compatible block form reaction times on the incompatible block. Analyzing the means revealed that men showed stronger approach tendencies towards sexual stimuli than women. Including sexual status did not affect the general pattern of results. However, when including sexual experience as a covariate in the analyses, a significant 3-way interaction was found between the approach-avoidance index, gender, and sexual experience, F (1, 80) = 4.81, p = .03. Analyses on the means revealed that men without sexual experience showed a stronger approach response towards sexual stimuli (M = 356.97, SD = 336.53) than men with sexual experience (M = 120.29, SD = 193.43), t(42) = -2.48, p = .02. For women, no significant difference in approach-avoidance responses was found between women with (M = 63.33, SD = 110.01) and without sexual experience (M = -29.21, SD = 241.66), t(40) = 1.03, p = .31.

Discussion

As predicted, men showed a stronger approach response towards sexual stimuli than women, which fits with previous work on sexual motivation and behavior (Everaerd et al., 2001; Petersen & Hyde, 2007). The study of motivational mechanisms is highly relevant for understanding the common finding that men display more frequent sexual desire, initiate sex more, and prefer more various sexual practices than women (Petersen & Hyde, 2010). According to incentive motivation theory, the processing of a sexually competent stimulus automatically energizes emotional systems, which results in motivational, autonomic, and endocrine responses that prepare for sexual action (Both, et al., 2007). Although participants made only symbolic approach-avoidance movements, our results do suggest that such appetitive responses towards sexual stimuli are more easily triggered in men than in women. These gender differences in sexual motivation may, on the one hand, reflect differences in societal standards, encouraging women to be more cautious when approaching sexual encounters. On the other hand, they may reflect differences in the pathways to reproductive success, inclining men and women to employ different strategies for dealing with sexual arousal and engaging in sexual activity (Buss, 1995). In this respect, it has been argued that men and women pursue different motives for engaging in sex, which has encouraged many researchers to identify the variety and specificity of sexual motives as a function of gender (Hatfield, Luckhurst, & Rapson, 2010; Meston & Buss, 2007; Stephenson, Ahrold, & Meston, 2011). Although the majority of research on gender differences in sexual behavior underscores specificity, there is also research showing that both men and women seek sex to pursue a relatively small number of goals which can be classified along an approach-avoidance and self-other continuum (Cooper, Shapiro, & Powers, 1998). According to this line of research, pleasure would be the primary motivation for engaging in sexual activity and given that men and women do not anticipate the same amount of pleasure from sex (Rye & Meaney, 2007), men are more strongly motivated to approach a sexual situation than women. In other words, men and women would not differ in the specific type of sexual motives but rather in the energizing force of these motives to trigger action tendencies towards sexual behavior. In relation to this, it is worth noting that – although men and women show differences in the motivational strength of sexual stimuli at a relatively automatic level - these gender differences are not necessarily translated into overt behavioral responses. Because overt behavior is subject to both controlled and automatic determinants, several other competing goals (and resulting appraisals) may obscure the relation between action tendencies and actual behavior. The latter may, for example, be influenced by conscious deliberation about the expected outcome of sexual behavior or other contextual (e.g. stress) and relational processes. This highlights the importance of measuring implicit goals and action tendencies in order to understand the underlying dynamics of gender differences in sexual behavior.

Another interesting finding is that men without sexual experience showed a stronger approach response towards sexual stimuli than men with sexual experience. This may suggest that the outcome of the SRC task is indeed tapping into motivational processes because sexual stimuli may be more novel and salient to sexually inexperienced men, which is likely to increase the incentive salience (or level of wanting) of the sexual stimulus. Although this line of reasoning seems plausible and attests to the validity of our task, more work is needed to substantiate these claims because it may also be that pornographic pictures are not necessarily novel to non-sexually experienced men as they may have more experience with watching porn than sexually experienced men. Also note that the amount of participants without sexual experience was much smaller than the group of sexually experienced men and women. Furthermore, although our results are clearly in line with previous motivational research, alternative explanations of our findings need to be excluded because it has been argued that the outcome of the SRC task would be more sensitive to the valence of stimuli independent of their motivational properties (De Houwer, 2003; Eder & Rothermund, 2008). In this respect it is important to note that our results are not compatible with the study of Both and colleagues showing that men and women did not differ in their tendency to prepare for sexual action as measured by T-reflexes. The divergence in results between our study and the aforementioned study may indicate that the SRC task taps into other processes than behavioural reflexes, which indicates the need for further research on the exact mechanisms underlying the approach-avoidance compatibility effect.

GENERAL DISCUSSION

The primary aim of this study was to provide a direct test of gender differences in implicit sexual stimulus processing in order to better understand the commonly observed gender differences in sexual outcome variables. Our results showed that men were more strongly motivated to approach sexual stimuli than women, and were also better in inhibiting sexual information as to prevent activation of the sexual system. With regard to attentional orientation, men were more easily drawn by sexual cues than women, yet only when the cues were presented long enough to allow more elaborative processing. No gender differences were found in attentional disengagement and attentional capture at short stimulus presentations neither did men and women differ in their implicit evaluation of sexual information.

General Overview of Gender Differences in Attention, Appraisal, and Motivation

Contrary to previous research showing stronger inhibition in women (Geer & Bellard, 1996), our results suggest that men have a better developed inhibitory system in response to sexual stimuli. Although replication of this result is warranted, there might be a plausible way to explain this finding. Given that without inhibition sexual responses would unfold automatically whenever sexual signals or opportunities arise (Bancroft et al., 2003; Everaerd et al., 2001) and men more actively seek for such sexual stimulation than women (Baumeister et al., 2001), it may be that men have developed a cognitive strategy to gain mental control over their sexual behavior, thereby preventing inappropriate sexual behavior and saving important social relationships. Yet, once their sexual system gets activated, they seem strongly motivated to act on their sexual emotions. The finding that this motivational tendency to approach sexual stimuli was more pronounced in men than in women fits with the general observation that men want more sex than women (Baumeister, et al., 2001; Petersen & Hyde, 2010).

No support was found for the assumption that men are characterized by a stronger attentional bias towards sexual stimuli and more positive implicit appraisals. This is not fully in line with previous attentional research suggesting that men and women show different attentional patterns towards sexual pictures (Lykins et al., 2008; Rupp & Wallen, 2007). However, when decomposing attention into its component features, our findings did reveal that men were faster to detect sexual cues than women, particularly when presented long enough to allow conscious awareness of the stimulus material. Longer stimulus presentations may elicit top-down, goal-oriented attentional responses, inclining people to encode information in terms of past experiences and goals and to direct their attention towards those stimuli that are most relevant to their current concerns (e.g., Higgins & King, 1981). Given that men are generally described as being preoccupied with sexual cues, seeking greater exposure to sexually explicit material, and showing better memory for sexual stimuli (Kimmel & Plante, 2002; Leitenberg & Henning, 1995; Petersen & Hyde, 2010), it is apparent that sexual stimuli are highly relevant cues that will maintain their attention. At the early, automatic stages of attentional processing, however, no differences were found across gender. Parallel with the finding that men and women did not differ in their implicit appraisal of sexual stimuli but only in their explicit reports of sexual evaluation, this may suggest that gender differences are particularly pronounced when more strategic processes are involved. Considering that men and women are socialized to deal differently with sexual emotions, it is plausible that motivational tendencies influence the processing of sexual information when allowed sufficient time to elaborate on the sexual content of the stimuli, thereby triggering gender-role expectations. Our results on gender differences in attentional orientation should, however, be interpreted with caution because no solid conclusions can be made across attentional components. Clear gender differences were found in maintained attention to sexual cues, but men and women were not different in their overall attentional bias and early vigilance towards sexual cues, neither did they differ in their tendency to disengage from sexual stimuli once these have captured attentional focus. Also note that, overall, sexual stimuli did not attract more attention than erotic, positive, and neutral stimuli, neither in men nor women. This indicates the need for more in depth research on attentional processing of sexual content. Although the exogenous cuing task is highly effective in recasting attention allocation, other tasks are available that measure different aspects of attention, using different SOA's and different stimulus material (Armstrong & Olatunji, 2012; Rupp & Wallen, 2007;

Yiend, 2010). Such multi-method approach is highly needed to better account for the diversity with which men and women encode sexual information.

Turning to our results on sexual appraisal, no gender differences were found in implicit evaluations of sexual stimuli, although men did evaluate sexual stimuli as more positive than women at the self-report level. This may seem surprising given that gender differences are most consistently found in the sexual attitudes domain (Petersen & Hyde, 2010). However, previous work on sexual attitudes typically relied on self-report questionnaires, which are limited to measuring processes that people can consciously introspect and articulate. Sociocultural pressure may incline women to underreport their sexual preferences so as to conform to the social norm (Alexander & Fisher, 2003), thereby creating an artificial gap between men and women. We used an implicit measure that is assumed to circumvent such social desirability biases and tap into a different level of sexual appraisal. Note that our results fit with a recent study in which we also found that men and women did not differ in their level of implicit liking of sexual stimuli. They did, however, want sex to a different degree, depending on the motivational context in which the stimuli were presented (Dewitte, in press). Hence, when studying the explanatory power of sexual appraisal in relation to sexual arousal, it may be more useful to focus on the reward value rather than the affective value of sexual stimuli, which is likely to depend on different motivational factors in men and women.

The Dynamic Nature of Gender Differences in Sexual Responding

Drawing on the common finding that men show higher sexual arousability than women (Petersen & Hyde, 2010) and assuming that all 4 regulatory processes work together to determine sexual arousal responding (Janssen et al., 2000), it may seem inconsistent that some processes reflect gender differences and others do not. However, conceptualizing the sexual system as an emotion regulation device that is inherently dynamic in nature (Gross, 1998; 2002), it is most likely that gender differences do not appear on all process stages. Emotion regulation is not a linear process, but includes positive and negative feedback loops, creating emotional circuits that allow for continuous change of the state of the system (Freeman, 2000). Furthermore, regulatory processes can operate in different ways at different levels of responding and the regulation of emotions is determined by one's currently active goals (Bargh, 1984; Frijda, 1986). These goals and motivational triggers are likely to differ between men and women, with men being more sensitive to explicit sexual contexts and women being more responsive to romantic cues (Carroll, Volk, & Hyde, 1985; Dewitte, in press; Hill & Preston, 1996; Meana, 2010; Oliver & Hyde, 1993; Peplau, 2003; Stephenson, et al., 2011). Note that, in the present study, stimuli were encountered in a neutral, non-sexual environment, making it less relevant for men and women to adopt different regulatory strategies. This clearly indicates that we should be cautious not to overgeneralize gender differences in sexual responding, but need to specify the conditions and processes in which differences will or will not occur. The present investigation aimed at systematically identifying at which process stages gender differences play a role and which not. Although the sexual system is assumed to function similarly in men and women, it is likely that differences exist in the type of stimuli that trigger the system, the ease with which the system gets activated, and the relative importance of certain regulatory processes. Accordingly, research on gender differences in sexual responding needs to consider the moderating impact of contextual influences instead of treating these differences as stable and immutable entities (Conley, Moors, Matsick, Ziegler, & Valentine, 2011; Hyde, 2005).

Another possible explanation for the lack of gender differences in all process stages is that men and women differ much less than common wisdom would suggest (Hyde, 2005; Leigh, 1989). In fact, cognitive social learning theory holds that gender differences are decreasing because modern society promotes more permissive models of sexual expression for both men and women (Chia, 2006; Zurbriggen & Morgan, 2006; Wells & Twenge, 2005). Over time, men and women may internalize these changing standards for gender-appropriate behavior, ultimately influencing the cognitive-motivational processes involved in the activation and regulation of the sexual system.

Limitations

The present investigation makes an important contribution to the literature because we provided a systematic test of gender differences in automatic sexual stimulus processing using a series of implicit paradigms. Such detailed analysis is highly needed to understand the exact mechanisms through which differences in sexual arousal responding unfold in men and women. Unfortunately, we did not include measures of subjective and genital sexual arousal which prevented us from drawing definite conclusions on the role of attention, appraisal, and approach-avoidance motivation in activating and regulating sexual arousal. Another limitation of our study is that attention, appraisal, and approach-avoidance motivation were measured in different samples. Studying single components of the sexual response independently of each other prevented us from linking these different components and studying the specific pathways between sexual stimuli and responses. Although this procedure did not allow us to test the dynamical sequence of sexual arousal responding as a function of gender, we decided to measure each process separately because these specific implicit tasks were used for the first time in the context of sex research, inclining us to control for methodological confounds such as fatigue and carry-over effects. Future research should adopt a multi-method design to formally test the interplay between cognitive, emotional, and motivational responding in relation to sexual arousal and as a function of gender. Such design would also be useful to establish the validity of our measures. Although we had good arguments to select these specific paradigms for measuring the processes under study, we are aware of the heterogeneity of implicit measures that can be applied. Further work is needed to validate the current measures, especially because we used modified versions of the tasks instead of relying on traditional formats.

We are also aware that several studies had rather low power and each process was covered by only one specific implicit procedure and not replicated across studies. Also note that the mean reliability of several tasks was rather low, especially the reliability of the exogenous cueing task. Considering that sufficient reliability of measures is a prerequisite for research on individual differences, the low reliability of these tasks seriously limit the strength of the effects one can expect to observe. Although we did find meaningful results throughout the four experiments, drawing solid conclusions on gender differences in implicit processing of sexual stimuli requires an in-depth analysis of each process using different paradigms and experimental conditions. We did, however, decide to cover all four processes in this paper and demonstrate how to measure them at the implicit level because (1) no research so far has systematically examined these processes in a sample of *both* men and women and (2) it allowed pointing towards the conceptual relevance of differentiating between the cognitive-motivational processes that activate and regulate sexual responding.

Our results on gender differences in sexual information processing may also be limited by the use of a young student sample who probably hold more permissive sexual attitudes than the general population. Furthermore, given that participants were informed about the sexual content of the study, it is likely that those who consented to participate were more open to sex or sexually more arousable, resulting in a selection bias that may influence the overall pattern of results. Another potential bias may be related to the fact that we did not match the gender of the experiment leader to the gender of the participant and we included only heterosexual stimuli, which, for some participants, caused a mismatch between the sexual stimuli and their sexual orientation, obliging us to exclude these participants from the analyses. However, because the study was conducted in a private room without interference of the experimenter's presence and because controlling for sexual background variables did not affect the general pattern of results, we believe that the effect of these biases was limited.

We also did not consider the impact of possible moderating variables such as level of sexual functioning, sexual experience, and trait variables that are known to affect sexual responding (e.g., sexual excitation/inhibition, erotophobia/erotphilia) (Fisher, White, Byrne, & Kelley, 1988; Janssen, et al., 2002). In addition, it would be interesting to include more general personality measures such as sociosexuality, neuroticism, and extraversion/introversion to test whether personality traits affect sexual behavior via their impact on sexual information processing. Future research on cognitive-motivational processing should include more heterogeneous samples that vary in age, personality, level of sexual functioning, and sexual background variables. It is possible that a different pattern of results will emerge in a clinical sample in which regulatory efforts towards sexual arousal are more functional or disabling.

General Implications

Although more research is needed to determine the specificity, robustness, predictive validity, and malleability of the cognitive-motivational processes underlying sexual arousal, we believe that the present series of studies indicate the importance of incorporating information-processing mechanisms and emotion regulation strategies into the conceptualization of the sexual system. In addition to its relevance for understanding gender differences in sexual arousal, systematic research on the specific processes involved in the activation and regulation of sexual responses may also increase our understanding of sexual problems. That is, because sexual problems may be directed at specific phases in the cascade of sexual responding, understanding why and when people adopt specific regulatory strategies to deal with sexual emotions could help developing interventions that target defensive, inflexible, and/or negative types of sexual information-processing. This is particularly important when considering that cognitive and motivational processes mediated by affect regulation have the secondary effect of biasing interpretations and memories of sexual experiences (Barlow, 1986). These cognitive biases can function as positive feedback loops, becoming increasingly resistant to change and associated with increasingly dysfunctional emotional states and behaviors (Janssen et al., 2000). We hope this investigation may pave the way for further research on the source of differences in sexual arousal responding by using implicit measures that can tap into the automatic nature of its underlying processes.

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FOOTNOTES

[1] This study, as well as the other 3 studies, was part of a larger battery of tests. However, because the task on sexuality was always administered first and the following tasks were unrelated in terms of procedure and stimulus material (i.e., no tasks or questions about sexuality), the pattern of results could not be affected by this sequence of events.

[2] The pictures that are depicted in this figure do not represent the actual pictures that were used in the NAP task. Because of publication reasons, we replaced the pornographic pictures by less explicit erotic pictures.

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FIGURE CAPTION

Fig.1. An Emotion-Motivational Model on Sexual Arousal based on the models of Barlow (1986), Janssens and colleagues (2000), and Öhman (1993)

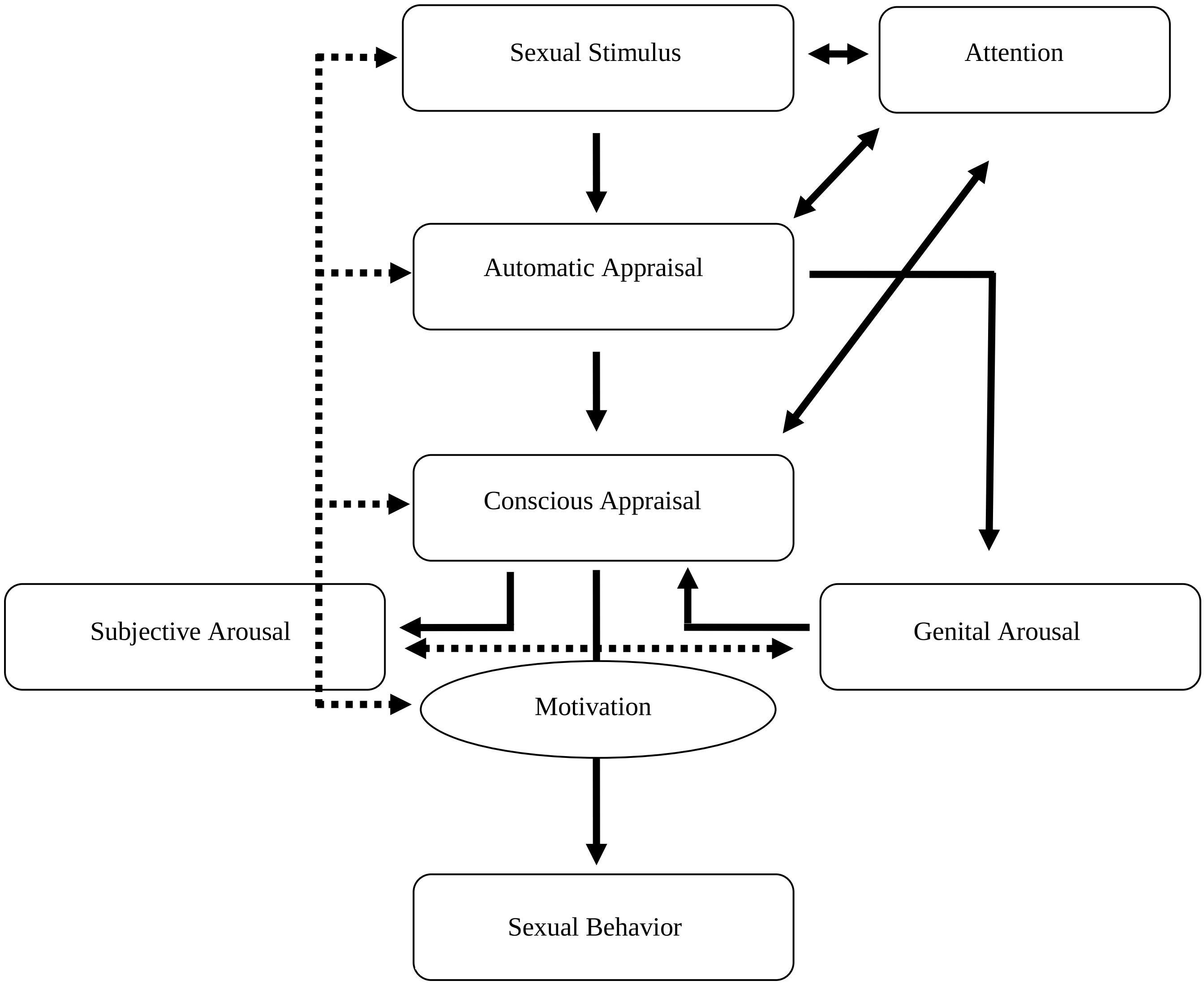

Fig.2. Negative Affective Priming Design: Succession of a Prime and Probe Trial[2]

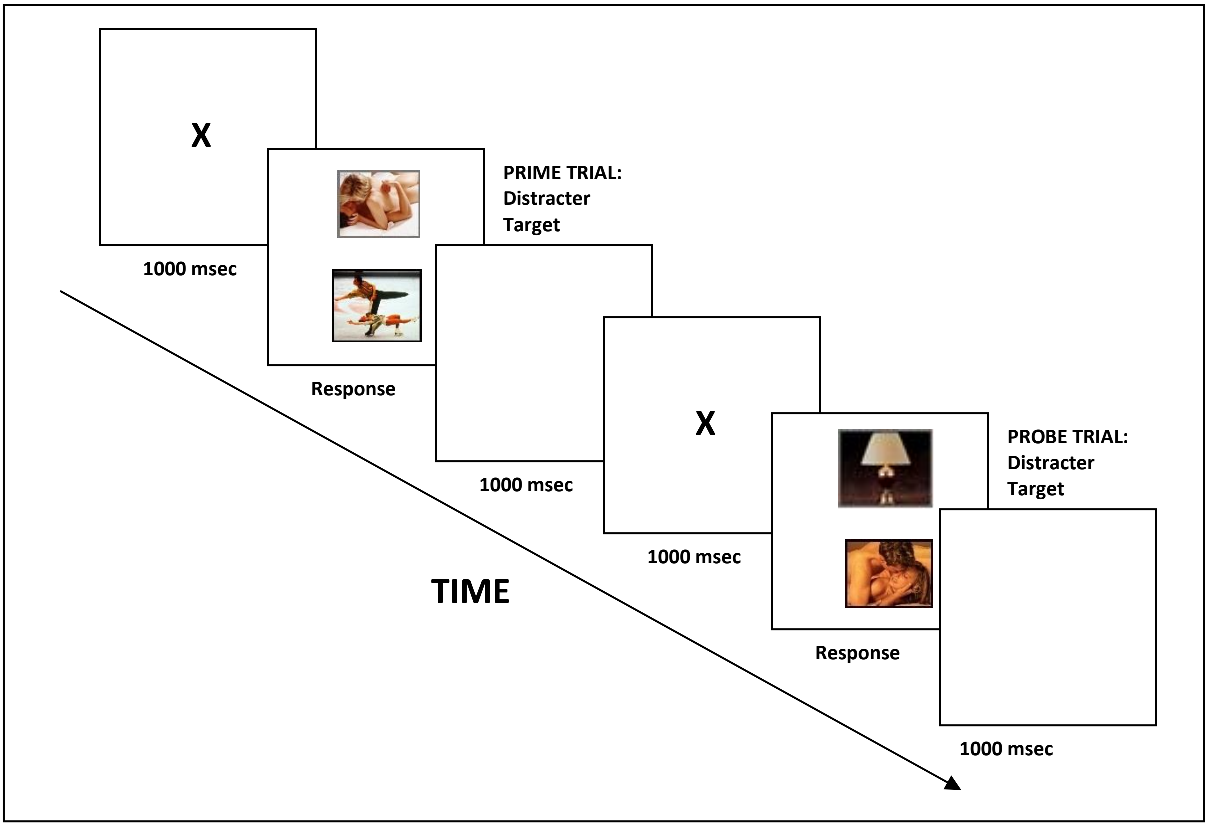

Fig.3. Exogenous Cueing Design: Succession of a valid trial

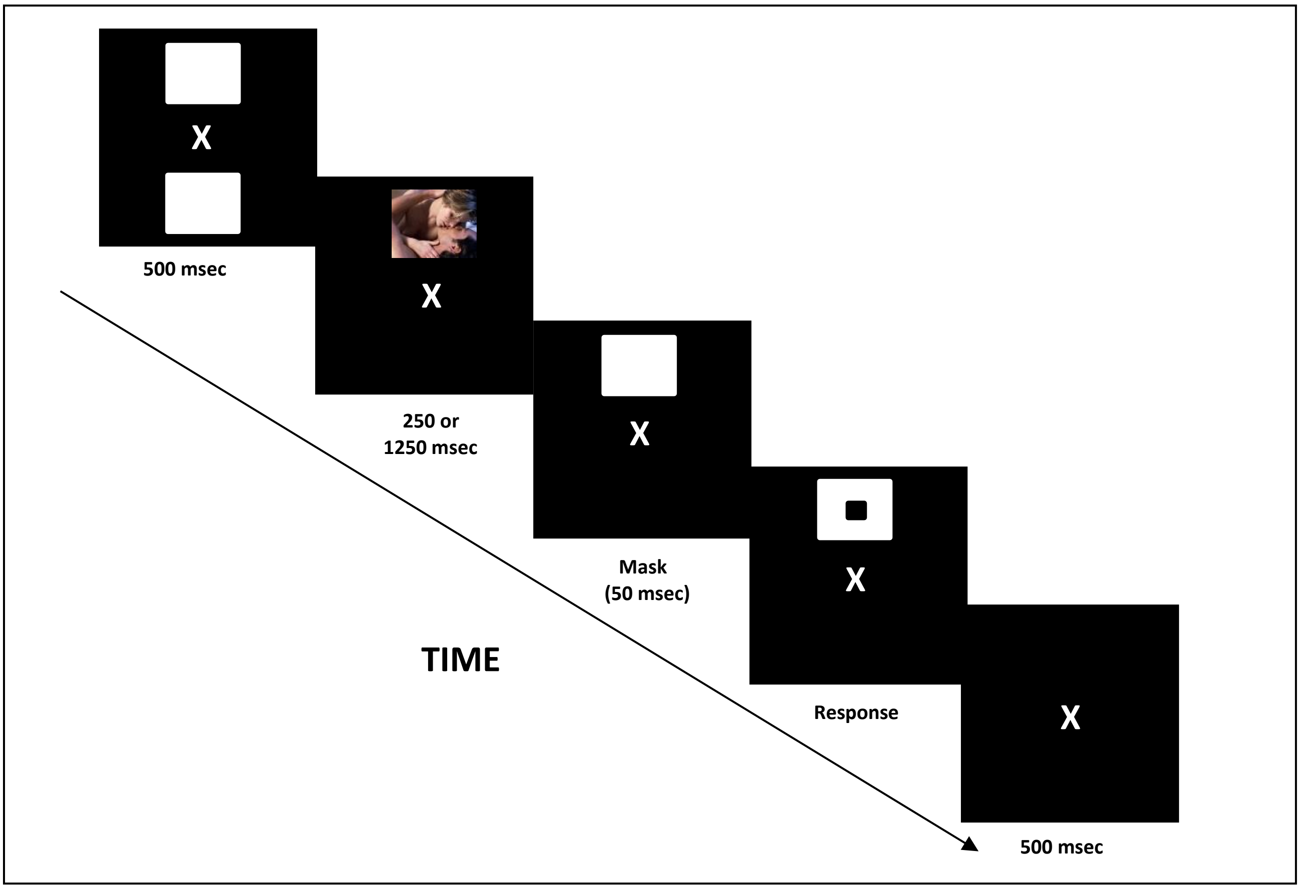

Table 1. Mean reaction times (in ms) and standard deviations of target responses in the NAP task as a function of gender

Type of Trial Sequence	Men		Women		*t*
	M	*SD*	*M*	*SD*	
Sex control	732.95	176.11	612.82	91.18	3.05**
Sex experimental	778.51	184.95	629.16	98.03	3.59**
Sport control	679.02	152.10	582.28	80.21	2.83**
Sport experimental	696.30	155.41	603.67	85.92	2.62*

* $p < .05$, ** $p < .01$

Table 2. Mean reaction times (in ms) and standard deviations of target responses in the exogeneous cueing task as a function of gender

Type of Trial	Men		Women		*t*
	M	*SD*	*M*	*SD*	
Sexvalide250	365.78	46.13	394.73	53.75	-2.31*
Sexinvalide250	372.49	41.62	406.52	58.77	-2.49*
Eroticvalide250	364.64	39.22	394.50	51.82	-2.63*
Eroticinvalide250	365.54	41.77	401.82	56.18	-2.78**
Sportvalide250	364.51	42.14	396.80	50.71	-2.77**
Sportinvalide250	360.82	39.65	402.55	61.01	-3.04**
Neutralvalide250	359.02	43.78	391.79	51.45	-2.69**
Neutralinvelaide250	363.75	42.54	405.42	60.89	-3.60**
Sexvalide1250	383.82	67.90	426.58	56.71	-2.62*
Sexinvalide1250	390.10	56.43	427.94	55.89	-2.59*
Eroticvalide1250	384.47	69.13	411.54	54.22	-1.68
Eroticinvalide1250	394.02	60.10	420.49	55.25	-1.76
Sportvalide1250	376.45	61.65	410.02	55.16	-2.20*
Sportinvalide1250	393.99	61.42	422.07	53.60	-1.87
Neutralvalide1250	374.72	64.44	400.67	48.88	-1.74
Neutralinvalide1250	387.30	51.03	421.44	55.52	-2.46*

* $p < .05$, ** $p < .01$

Table 3. Mean reaction times (in ms) and standard deviations of the responses on the SCR approach-avoidance task as a function of gender

	Men		Women		*t*
	M	*SD*	*M*	*SD*	
Approach	817.27	248.00	750.73	187.15	1.38
Avoidance	971.39	303.19	809.55	172.05	2.98**
Approach-avoidance index	154.10	229.73	58.82	123.79	2.34*

* $p < .05$, ** $p < .01$