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Discrepant Attentional Biases Toward Sexual Stimuli

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DISCREPANT ATTENTIONAL BIASES TOWARD SEXUAL STIMULI

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Abstract

There are at least two types of response to stimuli: an automatic response that happens before conscious thought (a Type 1 response) and a deliberative, intentional response (a Type 2 response). These responses are related to behavior associated with the affective loading of the stimulus presented. Prior research has shown, for example, that a Type 1 tendency to spend more time looking at fear-provoking stimuli is associated with higher levels of general anxiety, while a Type 2 tendency to spend more time looking away from happy faces is associated with higher levels of depressive symptoms. Some stimuli categories elicit mixed responses, indicated by discrepant Type 1 and Type 2 responses. For example, alcoholics in recovery tend to look toward alcohol-themed pictures in the first 200 milliseconds, then look away. This suggests that alcoholics in recovery have an automatic draw to alcohol that is overridden by the conscious application of a cognitive schema to avoid alcohol. Sexual response studies to date have measured Type 1 and Type 2 responses separately; however, no study has yet measured both types of response within the same person. This study was the first to examine both Type 1 and Type 2 responses to erotic stimuli within the same individual as a test of within-individual variation of attentional responses to sexual stimuli. Results do not support a connection between either attentional bias or conflicting Type 1 and Type 2 responses and sexual desire or distress. Implications of these non-findings are discussed in theoretical and methodological contexts, and future research is suggested.

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Introduction

Responses to sexual stimuli are many and complex, including physiological, cognitive and emotional responses (Adams, Haynes, & Brayer, 1985; Bancroft & Janssen, 2000; Janssen, Everaerd, Spiering, & Janssen, 2000; Prause, Janssen, & Hetrick, 2008; Wiegel, Scepkowski, & Barlow, 2007). Some of these responses happen without conscious awareness or control, and others are deliberate, occurring with intentional thought. Responses also vary in timing, occurring from a few milliseconds to several minutes after stimulus presentation. Usually, although not always, automatic responses happen more quickly than deliberative ones (Stanovich & Toplak, 2012). The cognitive research literature has labeled these automatic, relatively fast responses as Type 1, and deliberative, generally slower responses as Type 2 (Evans & Stanovich, 2013; Stanovich & Toplak, 2012). Attentional bias, or a pattern of shifting attention toward (approach) or away from (avoidance) a category of stimuli, such as 'alcohol-related,' 'anxiety-provoking,' or 'erotic,' can occur with both Type 1 and Type 2 responses (Bancroft, Graham, Janssen, & Sanders, 2009; Janssen et al., 2000; Prause et al., 2008). Both response types have been studied in a variety of domains, including willpower (Metcalfe & Mischel, 1999), anxiety (MacLeod, Mathews, & Tata, 1986), depression (Gotlib, Krasnoperova, Yue, & Joormann, 2004), and substance use (Ehrman et al., 2002), but remain less understood in the context of sexual arousal.

Few studies have explored Type 1 and Type 2 responses in the same person in any affective domain, and none have explored Type 1 and Type 2 congruence in response

to erotic stimuli. In the few instances in which both response types have been studied in person, the results have proved interesting. For example, in substance-craving participants in recovery, a Type 1 approach response was observed to be paired with a Type 2 neutral response (Stormark, Field, Hugdahl, & Horowitz, 1997). The conflict between response types was not seen in participants who were still active substance users (Type 1 and Type 2 responses were both approach responses, indicating an attentional bias toward the stimulus) or those who were not substance dependent (Type 1 and Type 2 responses were either avoidant or neutral, measured as an attentional bias away from the stimulus or the absence of such bias).

In that study, having different Type 1 and Type 2 responses to the same stimuli was seen as evidence of conflicting drives (Stormark et al., 1997), with one drive dominating the Type 1 response (an automatic craving response) and another dominating the Type 2 response (the application of a conscious schema of avoidance). That two-drive, automatic/deliberative distinction has not yet been demonstrated with sexual stimuli. Evidence of a single person having different Type 1 and Type 2 responses to sexual stimuli would suggest that, as with substance-specific stimuli, the two different responses are capturing two distinct (and conflicting) aspects of a person's reaction to erotic stimulation. This study will (1) demonstrate that the technique used to identify differing Type 1 and Type 2 responses to substance cravings can be applied to sexual arousal, and (2) explore the implications of the conflicting drives implied by having different Type 1 and Type 2 responses to sexual stimuli.

Defining and measuring Type 1 and Type 2 responses

The most recent review of dual-type (previously described as dual-process) theories posits that very few features necessarily distinguish between Type 1 and Type 2 responses. Automatic, or Type 1 responses (1) do not require working memory, and (2) always occur given a sufficient stimulus. Deliberate, or Type 2 responses, on the other hand, do require working memory and include the creation of multiple representations of mental objects for simulation purposes (Evans & Stanovich, 2013; Stanovich, 2009; Stanovich & Toplak, 2012). Broadly, then, theoretical models define Type 1 responses as automatic, reflexive reactions to stimuli that require (or benefit from) an immediate response (Evans & Stanovich, 2013; Öhman, Dimberg, & Esteves, 1989), such as threatening stimuli, or stimuli that suggest an imminent mating opportunity. Type 2 responses are those that require active mental simulation and representation, and the deliberative application of cognitive schemas (Evans & Stanovich, 2013; Öhman et al., 1989; Stanovich & Toplak, 2012), such as intentional decisions about what strategies to apply to a threatening situation, or whether to take advantage of a sexual opportunity. Cognitive schema, as defined by Beck and Beck (2011, p. 33), are "hypothesized mental structure[s] that [organize] information," and can be core beliefs, intermediate beliefs, such as rules attitudes and assumptions, or automatic thoughts. Schema at any of the three levels may interact with the erotic stimuli to alter Type 2 responses (see Figure 1 for a theoretical model).

There are a number of common correlates of Type 1 and Type 2 responses that are found in some (Evans & Stanovich, 2013; Stanovich & Toplak, 2012), but not all (Kruglanski, 2013; Osman, 2013) empirical studies. Type 1 responses are frequently thought to reflect underlying bias, premised on the idea that they occur too quickly for an automatic bias to be inhibited (Epstein, 1994), while Type 2 responses are believed to reflect a more thoughtful, intentional, and rational response. The absolute form of this distinction (in which Type 1 responses are always fast and Type 2 responses are never biased) has been rejected in more recent work that points to the variation of these responses (Evans & Stanovich, 2013; Kruglanski, 2013). For example, the Type 1 responses may be more likely to reflect underlying biases, but it may be the case that a Type 2 response reflects an underlying bias more than a Type 1 response in some circumstances.

Alternate terminology. Metcalfe and Mischel (1999) used the terminology 'hot' and 'cold' to describe fast, automatic, affective reactions (hot) and slow, conscious ones (cold). The hot/cold literature that largely regarded 'hot' Type 1 responses as always fast, and 'cold' Type 2 responses as always slow has been questioned as of late (Evans & Stanovich, 2013). These older terms map broadly and incompletely onto the more recent uncoupling of reaction time with response type. Metcalfe and Mischel's (1999) work – originally presented as a model of self-control – also presumes that the hot response is affective in nature, and that the cold response is inherently cognitive and 'thoughtful,' distinctions that the Type 1 and Type 2 framework does not require. Despite the outdated assumptions of these terms, the research and theory done within the hot/cold framework

has provided useful information on the underlying processes of responses to a wide variety of stimuli, including response to sexual arousal.

Type 1 responses as context for Type 2 responses. Given that the Type 1 response usually occur before the Type 2 response to the same stimuli, the results of a Type 1 appraisal are generally available to the Type 2 response processes as context or input (Janssen et al., 2000; Stanovich, 2009; Stanovich & Toplak, 2012). Thus an immediate fear reaction to a threatening stimulus may produce an increase in skin conductance and a rise in heart rate. When the Type 2 response appraisal processes are activated, those processes have as input not only the stimulus itself, but also the physiological reaction to that stimulus. For example, an immediate physiological reaction of pupil dilation in response to an erotic stimulus becomes part of the context in which that stimulus is appraised consciously (Janssen et al., 2000). Thus a Type 2 reaction to erotic stimuli is a reaction not only to the stimulus itself but to one's own Type 1 responses to that stimulus, and reflects the combined effect of a general attitude toward sexuality as well as an attitude toward one's own physical experience of sexual arousal.

Physiological responses are generally identified as Type 1 responses, and seen as a context for Type 2 responses. For example, an acoustic startle response in the context of affective reactions is the extent to which, in response to an unexpected white noise, the participant flinches or blinks (Jansen & Frijda, 1994), and is commonly assessed by electromyographic measurement of the speed and intensity of the blinking response. As

described in Fillion, Dawson and Schell (1998), startle reflexes, including the acoustic startle response, are decreased with greater positive affective activation and increased with greater negative affective activation. Thus a reliable method of assessing the affective valence of a stimulus is to induce a startle response, since a positive emotional reaction will be associated with less of a reflexive 'flinch' (Skolnick & Davidson, 2002). Other research (Giargiari, Mahaffey, Craighead, & Hutchison, 2005; Jansen & Frijda, 1994; 2000) found that the acoustic startle response was weaker when participants were shown erotic film clips, but that this effect reduced as the film clips were repeated, suggesting both that there was a positive affective response to the erotic films and that repeated viewings were less appetitive and engaging.

Further work found that participants with lower levels of sexual desire (as measured by the Sexual Desire Inventory; Spector, Carey, & Steinberg, 1996) showed less of a suppression of the startle response after erotic images than those with higher levels of sexual desire (Giargiari et al., 2005), which the authors theorize is supportive of the idea that people with lower levels of desire have diminished physiological reactions to sexual stimuli. This effect was also shown by a similar effect on prepulse inhibition. Prepulse inhibition refers to the response-minimizing effect that presentation of sound has immediately prior to the acoustic startle stimulus (Postma, Kumari, Hines, & Gray, 2001). That is, after training, the presentation of a burst of white noise immediately prior to the presentation of the supraliminal white noise has the effect of reducing the strength of the 'flinch' response. After being shown erotic images, participants lower in sexual desire showed a diminished prepulse inhibition effect (Postma et al., 2001). This study is

suggestive of a stronger emotional response generally being associated with greater prepulse inhibition.

Type 1 physiological responses form a context input for Type 2 responses. This means that a Type 1 response that occurs quickly must be considered when understanding the nature of a Type 2 response to the same stimuli that occur slowly. For example, an automatic negative appraisal to an unexpected presentation of an erotic stimulus may shade the slower Type 2 response by tingeing an otherwise sex-positive response with an element of shock.

Measurement of attentional biases. The majority of the research examining responses to affectively-laden stimuli has used a dot probe task (MacLeod et al., 1986) to assess Type 1 and Type 2 attentional bias responses to stimuli. In the dot probe task, two images (or, less frequently, words) are presented to the left and right of visual center. The stimuli remain for a variable amount of time, ranging from the subliminal 17 milliseconds to the (very) supraliminal 2000 milliseconds. The stimuli are then replaced with a dot, which appears where one of the two stimuli were. Participants are asked to specify whether the dot appears on the left or right side of the image. Since a participant whose gaze lingers on one type of image more than another will detect the dot that appears behind that image faster, lower response times when the probe dot is presented behind an image of a particular category means the participant preferentially gazed at images in that category over the timeframe of the presentation. This approach has been used extensively to explore attentional bias with both Type 1 and Type 2 responses. This

paradigm was developed in part as a response to the Emotional Stroop task (Ehlers, Margraf, Davies, & Roth, 1988; Mathews & MacLeod, 1985; Mogg, Mathews, & Eysenck, 1992; Mogg, Mathews, & Weinman, 1989; Watts, McKenna, Sharrock, & Trezise, 1986), which asks participants to name the ink color of emotionally-charged words (e.g., 'spider' or 'web' when presented to people afraid of spiders). The time it takes to identify the color, when compared to the time required to name the color of non-affectively-laden words, is interpreted as either an attentional bias toward that word category or a stronger general emotional response. Since the test was unable to distinguish between the two, the dot probe task was developed to isolate attention from pure affective activation (MacLeod et al., 1986). Since the dot probe task allows for the presentation of either words or images, it has seen far greater use in the attentional bias framework than has the emotional Stroop task. Although some dot probe tasks use subliminal presentation of stimuli to capture Type 1 responses (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992), other studies which also identify both Type 1 and Type 2 responses use stimuli presented at no faster than 200 ms., which is supraliminal (Cox, Hogan, Kristian, & Race, 2002; Mogg & Bradley, 2006). To capture two different types of responses, then, a gap in speed is required between the fast Type 1 and the slower Type 2, but research suggests that the faster stimulus need not be subliminal.

Type 1 and Type 2 responses and attentional biases across domains

As described above, an attentional bias is an unconscious, automatic tendency to spend more time looking at (or avoiding looking at) stimuli of a particular category

(MacLeod et al., 1986). An attentional bias is not generally the subject of conscious awareness, and is believed to represent underlying low-level informational processing tendencies (MacLeod & Mathews, 1988; MacLeod et al., 1986). These low-level processes are often described in evolutionary terms as processes that require fast action to ensure survival. Since fast action is required, the external stimulus triggers a necessary and automatic response: the same stimulus will produce the same category of response, at least until habituation. The response need not be binary; it could, instead, be a tendency – a tendency, for example, to spend more time looking at threatening stimuli than neutral stimuli (MacLeod & Mathews, 2012). Attentional biases have been associated with a broad range of correlates (Mogg & Bradley, 2006), such as anxiety disorders (MacLeod et al., 1986), substance use (such as alcohol, Cox et al., 2002; and nicotine, Ehrman et al., 2002), phobias (Mogg & Bradley, 2006), and, to a lesser extent, depression (Peckham, McHugh, & Otto, 2010).

Work on attentional bias is premised on the idea that biases in information processing that occur soon after the stimulus is presented have a significant effect on a person's experience and interpretation of the world (MacLeod & Mathews, 2012). The often-posited mechanism of action is that these attentional biases shift our internal emotional experiences by shifting our external experience of the world. Specifically, more attention paid to stimuli associated with a particular category or emotional response, such as anxiety, sadness, or sexual arousal, is expected to increase the average frequency with which one experiences that emotion. A tendency to spend more time looking at anxiety-provoking stimuli, for example, is expected to be an indication of

higher levels of anxiety since looking at anxiety-provoking stimuli provokes anxiety (MacLeod & Rutherford, 1992; Mathews & MacLeod, 2002). The interestingly circular pattern behind the argument is that those people who are high in trait anxiety place greater automatic salience on fearful stimuli, and thus focus on those stimuli – and that focus, in turn, increases state anxiety (MacLeod & Rutherford, 1992).

Research on the physiological response to erotic images has found that the subliminal presentation of erotic images can alter genital arousal (Janssen et al., 2000; Ponseti & Bosinski, 2010)[i]. Importantly, this same line of research has shown a different effect of stimuli when presented quickly and slowly. For example, Janssen, Spiering, Everaerd and Janssen (2000) found that in men, the facilitative effect of a sexual prime was negatively correlated to the accessibility of that prime. That is, the more the participant reported being aware of seeing an erotic prime, the less effective it was in reducing identification time for a later erotic image.

Duration of stimulus presentation matters in attention bias research. Different affective domains have different stimulus presentation speeds at which the bias is observable. For example, while anxiety-provoking stimuli are sufficient to demonstrate an attentional bias in people high in anxiety if presented subliminally, sad faces are preferred to happy faces by dysthymic participants only if the faces are presented slowly enough to be supraliminal (Mathews & MacLeod, 2005; Mogg, Bradley, & Williams, 1995). Other work specifically tested whether words associated with depression or anxiety would produce a bias effect if presented sub- or supra-

liminally, and found an effect only for the supraliminal presentation (Bradley, Mogg, & Lee, 1997). This effect has been explained in the context of the evolutionary function of anxiety and depression, with anxiety conceptualized as the avoidance of danger and depression as inspiring the discontinuation of the pursuit of failed goals (Oatley & Johnson-laird, 1987).

In that evolutionary context, a rapid, subliminal bias for anxiety-provoking stimuli would reflect a stronger orientation toward threat in order to identify and react to a threatening stimulus, such as a tiger, while depression would be unlikely to be as salient as rapidly, since goal discontinuation does not require decisions that are as rapid. Other work on an attentional bias associated with depression has posited that depressed people may be engaging in active thought suppression, which is blocking the detection of the effect. By inducing a cognitive load while probing for attentional bias – by way of a word search grid – researchers found evidence of an attentional effect. Participants who had previously experienced a depressive episode demonstrated a bias toward negative words comparable to that shown in currently dysthymic participants when under a cognitive load, but not when not under the cognitive load. This, the researchers theorize, is indicative of active thought suppression which is disrupted by the word search grid (Wenzlaff, Rude, Taylor, Stultz, & Sweatt, 2001). That work, however, does not preclude the possibility that it was the speed of presentation of their materials and not the cognitive load that allowed for the effect to be identified. Future research will be needed to clarify whether the effect is related to speed of presentation or cognitive load.

Cognitive bias detection methodologies have been applied to substance use (Field, Munafò, & Franken, 2009) and addictive behaviors (Van Holst et al., 2012). The duration of presentation of substance stimuli is again important. In one study (Stormark et al., 1997), alcohol or neutral words were presented, followed by a probe that was either behind the word presented (valid, in the terminology of the study) or not behind the word presented (invalid). The length of time it took to indicate which side the probe appeared on was measured, with shorter reaction times for invalid trials (in which the probe was not behind the category-relevant word) being suggestive of the participant looking toward the word, and longer reaction times for valid trials (in which the probe was behind the category-relevant word) suggesting the participant was looking away from the word. With short presentation of words (100 ms; not subliminal), alcoholics showed slower response times on invalid trials than social drinkers, which suggests that the alcoholics were more attentionally 'captured' by the alcohol words than the social drinkers were. However, with a longer presentation time (500 ms), this pattern reversed, with alcoholics showing faster response times on invalid trials than social drinkers, suggesting that, given the time for cognitive processing, alcoholics, more than social drinkers, would look away from alcohol words. The findings of Stormark et al. (1997) have been replicated with even shorter (although still not generally considered subliminal) duration exposure times of 50 ms (Noël et al., 2006). Additional work has found that much longer exposures (2000 ms) tend to 'capture' the attention of untreated heavy social drinkers (Field, Mogg, Zetteler, & Bradley, 2004), but not of non-drinkers. Taken together, these results suggest that different durations of exposure are measuring different responses. In this case, the

authors theorized that the shorter exposures of 50 or 100 ms were accessing attentional preferences before the participant had a chance to use avoidance strategies. Given time to implement avoidance strategies, the attentional bias is weakened or eliminated (Field & Cox, 2008; Noël et al., 2006; Stormark et al., 1997). Thus, in the case of substance use, the duration of presentation of affectively-laden stimuli determines the effect being measured, which is another example of a fast/automatic process producing a different end result than a slow/cognitively-mediated process. The importance of the length of stimuli presentation could therefore reveal important information on the effects of cognitive processes employed to suppress automatic responses. The length of stimulus presentation on sexual responses could thus reveal important information on the way in which humans process sexual stimuli.

Sexual arousal and Type 1 and Type 2 responses. Sexual arousal is a complex, multifaceted phenomenon, consisting of a physiological genital response and a subjective or psychological response, either or both of which may be associated with behavior change (Bancroft et al., 2009; Bancroft & Janssen, 2000; Janssen, 2011; Janssen & Bancroft, 2007). This approach to sexual arousal is consistent with understandings of other emotions (Frijda, 1988, 1993; LeDoux, 1995) and appetitive drives (Stormark et al., 1997), in that it includes both an objective, and subjective or psychological (Ekman, 1993) component. Thus, sexual arousal – like other emotional responses – can be explored using a variety of techniques and within a variety of frameworks, including the Type 1/Type 2 attentional bias distinction described above.

Type 1 and Type 2 responses to erotic images have been explored in a variety of studies. First in men (Spiering, Everaerd, & Janssen, 2003) and then in women (Spiering, Everaerd, Karsdorp, Both, & Brauer, 2006), evidence was found that it is possible to produce an automatic and objectively observable sexual response to a subliminally-presented sexual image. The researchers tested whether an automatic identification of the image as sexual had occurred by measuring the time it took to identify an image presented immediately after the subliminal image as sexual. That is, the study explored whether a subliminal presentation of an erotic stimuli would activate the sexual meaning network. This was determined by the time it took to identify a subsequent stimulus as either sexual or neutral (i.e., whether the image was erotic or of a plant). For both men and women, researchers found that a subliminal sexual prime reduced the time it took to identify a subsequent image as erotic, despite the absence of conscious awareness of having seen the original, subliminally-presented erotic image (Spiering et al., 2003, 2006). This is consistent with other work that has found a similar effect with other affectively-loaded stimuli (Schacter & Badgaiyan, 2001). This effect meets Greenwald, Klinger and Schuh's (1995) evidentiary criteria for establishing that unconscious or automatic cognition has occurred, since an unconscious influence is observed in the absence of a consciously reported effect. Thus this evidence is consistent with the idea that non-conscious processing of erotically-charged stimuli does occur.

In addition to establishing that automatic processing of erotic stimuli occurs, studies also identified gender differences in the way these stimuli are interpreted when presented in such a way as to allow conscious cognitive processing. These gender

differences are of particular interest since experimental presentation of non-conscious stimuli (e.g., Spiering et al., 2003, 2006) did not show meaningful gender differences in effect. In these experiments, a distinction was made between 'male-oriented' and 'female-oriented' erotic stimuli (Spiering & Laan, 2004). 'Male-oriented' images include "heterosexual couples engaged in oral or genital sexual activity…with genitals of both sexes clearly visible" (Spiering & Laan, 2004, p. 373). The 'female-oriented' images showed "heterosexual couples making love as well as masturbating women. Characteristics of this category are: female's [sic] enjoyment, a general positive atmosphere, a pleasant background… and genitals not explicitly in focus" (Spiering & Laan, 2004, p. 373). Of particular note is that the 'male-oriented' stimuli were effective in activating sexual meaning when presented subliminally to both men and women, while women-oriented stimuli were not subliminally effective in activating sexually-related meaning in either men or women, although women did report greater subjective sexual arousal when the 'female-oriented' stimuli were presented consciously. That is, the male-oriented images produced an automatic response in both men and women, despite the fact that the female participants reported greater subjective arousal in response to the female-oriented stimuli, which suggests that, in addition to a within-person difference between automatic and conscious processing, there may be gender differences in the cognitive processing of erotic stimuli that are highlighted by using both subliminal and supraliminal presentation of stimuli.

These studies clearly demonstrate that there is an important distinction between responses to erotic stimuli when presented fast versus when presented slowly, and that

the timing of presentation seems to have important gender differences. Other work has extended these differences to look at how they map onto erotophobia and erotophilia. Erotophobia/erotophilia is operationalized as a single-axis scale measuring affective valence in response to sexual cues (Fisher, White, Byrne, & Kelley, 1988), and can broadly be considered a measure of how positive an individual feels toward sexuality. Macapagal and Janssen (2011) found that erotophobia/erotophilia did not predict the extent to which unconsciously presented erotic stimuli reduced the time it took to identify a later image as erotic, which supports the idea that the erotophobia/erotophilia distinction is a conscious one. In prior research, erotophilia has sometimes been described as an automatic approach/avoidance stance applied specifically to sex (Byrne, Fisher, Lamberth, & Mitchell, 1974), in the same way that a phobia is a bias toward avoidance, or an unconscious preference is a bias toward approach. Other work has characterized erotophilia as a personality trait (Fisher et al., 1988), or an explicit set of relatively fixed cognitive patterns associated with a "readiness to act in a certain way." This evidence is consistent with its characterization as a personality trait since its influence is felt relatively slowly, compared to the rapid activation of arousal by subliminal stimuli.

Macapagal and Janssen (2011) further found that amongst those high in erotophobia, priming with erotic stimuli produced faster identification of subliminally-presented images with a negative affective valence (such as frightening or disturbing pictures), which is consistent with erotic stimuli being associated with negative affect for those high in erotophobia. Interestingly, they also found that those high in erotophobia

had greater access to negative meaning networks generally. This finding is consistent with erotophobic participants either having a general processing bias toward negative interpretations or having a negative affective response to their participation in a sex study.

In summary, this work (Janssen et al., 2000; Macapagal & Janssen, 2011; Spiering et al., 2003, 2006; Spiering & Laan, 2004) has established that (a) it is possible to automatically activate sexual meanings, and (b) those automatically-activated sexual meanings need not coincide with the slower, cognitively-mediated sexual meanings derived from supraliminally presented stimuli. Other work, notably that of Prause, Janssen and Hetrick (2008), has measured the extent to which variability in attending to sexual stimuli is related to sexual desire. Using supraliminally-presented stimuli, Prause, Janssen and Hetrick (2008) found that participants with lower levels of sexual desire (as measured by the Sexual Desire Inventory, Spector et al., 1996) responded more quickly when a probe dot was in the area previously occupied by erotic stimuli, suggesting that the participants with lower levels of desire spent more time looking at the erotic images than participants with higher levels of desire. The authors present a variety of hypotheses for this intuitively confusing finding. They suggest three possibilities. First, that the erotic stimulus may have been perceived as more novel by the participants with lower desire; second, that they may have had a stronger emotional reaction and thus had a harder time disengaging from the stimulus; or third, that, since people generally do not return to a visual region once searched, people with higher desire levels may have been drawn to the erotic image first and then did not return to it. Although there are multiple

potential interpretations of these results, the central issue in the context of the present study is that a relationship was found between a self-report measure of sexual attitude and a cognitive measure of attention to sexual stimuli. Similarly, other work (Giargiari et al., 2005) has found related evidence supportive of a connection between non-consciously mediated responses to sexual stimuli and self-report measures of sexuality by using the acoustic startle response described above.

Implications of discrepant Type 1 and Type 2 attentional biases

Despite the strong evidence documenting Type 1 and Type 2 responses, little is known about how these response types coincide, as few studies in any affective domain have included measures of Type 1 and Type 2 responses within the same person. The studies that have analyzed concurrent measures have yielded interesting results. For example, in recovered, substance-craving participants, a Type 1 positive attentional bias was generally observed to be paired with a Type 2 neutral bias (Stormark et al., 1997). However, this response discrepancy was not present in participants with active substance use, who generally exhibited approach in both their Type 1 and Type 2 responses. Thus, the congruency of approach vs. avoidance in Type 1 and Type 2 responses varies with past vs. active substance abuse, with the discrepancy of response type being unique to recovered, yet craving participants. Having different Type 1 and Type 2 responses to the same stimuli has been described as suggestive of conflicting motivational drives (Stormark et al., 1997), with one drive dominating the Type 1 response (an automatic

craving response) and another dominating the Type 2 response (conscious controlled, or avoidant, behavior).

Researchers have only recently begun to study Type 1 and Type 2 responses to sexual stimuli (Brauer et al., 2011; Hoffmann, Janssen, & Turner, 2004; Janssen et al., 2000; Prause, 2006; Prause et al., 2008; Roberts & Prause, 2012). As with the majority of studies in other affective domains, the sexual response studies conducted to date have only assessed either Type 1 response or Type 2 response, but have not measured both response types within the same person. Thus, the variation of erotic response within an individual remains unknown. Evidence of a single person having different avoidant or approach biases across Type 1 and Type 2 responses to sexual stimuli may suggest, as with substance-specific stimuli, that the two different responses are capturing two distinct (and conflicting) aspects of a person's reaction to erotic stimulation. Additionally, it remains unknown whether dissonance between Type 1 and Type 2 responses to sexual stimuli is associated with distress.

Distress. Distress is a diagnostic component of the majority of the psychological disorders recognized by the Diagnostic and Statistical Manual (American Psychiatric Association, 2000, 2013), including most (although not all) sexual disorders, such as Female Orgasmic Disorder or Male Hypoactive Sexual Desire Disorder. Distress is of particular importance in the understanding of sexual function and dysfunction, given that two people's identical sexual experiences and capacities could be diagnosed as a disorder or not, hinging solely on distress (American Psychiatric Association, 2013, pp. 425–450).

While distress is implicitly and broadly defined across many branches of research as a "negative emotional state" (Simons & Gaher, 2005, p. 83), other researchers bemoan the lack of specificity in that definition (First & Wakefield, 2010; Mulder, 2008; Phillips, 2009; Stein et al., 2010). Given that one path to diagnosis for a psychological sexual disorder is some combination of otherwise potentially normative sexual behavior plus distress, the reliable identification and understanding of distress is of central clinical importance. The hypothesized relationship between conflicting attentional biases and distress is thus of both theoretical and clinical relevance.

Sexual distress. Sexual distress is a broad concept, and includes distress of a variety of etiologies and at varying degrees of specificity. Some are as specific as stress due to erectile difficulty (Aversa et al., 2012; Helgason et al., 1996), while others are broader, such as the Female Sexual Distress Scale (FSDS, DeRogatis, Rosen, Leiblum, Burnett, & Heiman, 2002) which includes largely general questions such as "How often did you feel distressed about your sex life?" The hypothesized relationship between discordant attentional biases toward erotic material and sexual distress is thus best tested by considering both a broad measure of sexual distress and one that considers the more specific aspect of sexuality that this conflict theory posits will be affected: desire.

Desire discrepancy distress. While the FSDS-R contains a single question about desire (DeRogatis, Clayton, Lewis-D'Agostino, Wunderlich, & Fu, 2008), that question posits a dissatisfaction with a low level of desire. This study is centered on the conflicting internal measures of desire and does not presume that conflict only exists

between a conscious-Type 2 high desire and an automatic-Type 1 low desire. Thus the study will consider both the level of desire the participant reports wanting and the level of desire the participant reports having – and the amount of distress related to that discrepancy.

This study. Due to the paucity of research jointly examining Type 1 and Type 2 responses within the same person, it remains unknown whether sexual stimuli may elicit conflicting Type 1 and Type 2 attentional biases, and whether the incongruity of responses is associated with an underlying distress. Therefore, the present study sought to elucidate response variation to sexual stimuli and how these responses are associated with distress. Specifically, the current study is a novel application of the dot probe task to sexual arousal stimuli as a means to (1) identify differing Type 1 and Type 2 responses to erotic stimuli as a means to distinguish the automatic/deliberate responses to sexual stimuli within an individual, and (2) explore the implications of the conflicting drives implied by having different Type 1 and Type 2 responses to sexual stimuli. These findings further the understanding of the nature of sexual distress per se, including the mechanisms by which sexual distress is related to sexual function and satisfaction. Should conflicting attentional biases be shown to be related to sexual distress, further research could explore whether the resolution of that bias is related to the resolution of that distress.

An additional novel aspect of this study is the use of Internet-based cognitive assessment techniques to capture responses to sexual stimuli. Although prior work has

established that on-line tools are effective at gathering both survey data (Buhrmester, Kwang, & Gosling, 2011; D. Shapiro, Chandler, & Mueller, 2013) and millisecond-accurate cognitive tasks (Crump, McDonnell, & Gureckis, 2013; Crump et al., 2013; Paolacci, Chandler, & Ipeirotis, 2010), no study to date has used these methods to evaluate response to erotic stimuli.

Covariates and secondary analyses

Several additional variables were captured for use as covariates or in secondary analyses. These include factors that are known to be associated with one or more of the variables of primary interest, or variables that are potentially connected with the processes implicit in the hypothesized relationship between distress and conflicting attentional biases.

Covariates. Gender was captured and included in analyses, both because confirmation of gender identity was required to confirm that the participant met inclusion criteria, and because research suggests that women experience more distress generally than men do (Mirowsky & Ross, 1995), and may experience it in different ways including, for example, different severity and types of psychopathology (Caspi et al., 2014; Nolen-Hoeksema, 2001). Similarly, since a central aspect of the proposed models is the experience of sexual desire, any gender differences in sexual desire would be relevant. There is mixed evidence of differences in sexual desire between men and women once social expectations are accounted for (Alexander & Fisher, 2003; Leiblum,

2002). Because of that, gender was captured and included in virtually every analysis unless the data demonstrated that gender differences were not meaningful.

Sexual satisfaction, while not a primary variable of interest in this study, was captured because of the theoretical (and empirically demonstrated) relationship between sexual desire and sexual satisfaction, with higher levels of sexual functioning being generally associated with higher levels of sexual desire (see Hurlbert, Apt, & Rabehl, 1993; Santtila et al., 2007; Sprecher, 2002, amongst many others). By including sexual satisfaction, some of that shared variability was accounted for to better highlight the predicted main effects.

Given both the strong relationship between depression and anxiety and gender (McLean, Asnaani, Litz, & Hofmann, 2011; Nolen-Hoeksema, 2001; Silverstein, 2002), and given the previously mentioned connection between the psychopathological expression of distress and gender (Caspi et al., 2014) given a specified level of distress, the inclusion of measures of depressive and anxious symptoms allows for greater analytic clarity. Of note is that no attempt was made to exclude participants with high scores on measures of depressive or anxious symptoms, since variability in distress is a key variable of interest.

Secondary analyses. The primary hypotheses seek to explore the relationship between attention toward erotic stimuli and distress. However, some clear candidates for the source of the cognitive schemas described as the mediators of that effect can be theorized, even prior to a complete understanding of the end points of that relationship.

Religiousness in general has long been explored as a factor associated with sexual attitude and behavior (Ahrold, Farmer, Trapnell, & Meston, 2011; Hale & Clark, 2013; Kinsey, Pomeroy, & Martin, 1948a, 1948b). Religious fundamentalism, or the belief that one particular set of religious beliefs is absolutely true (Altemeyer & Hunsberger, 1992) has been explored as a relatively straightforward way to assess the religiousness of an individual without having to explore the idiosyncratic beliefs of each particular type of religion (Altemeyer & Hunsberger, 2004). Given that the central hypotheses are intended to demonstrate the existence of this relationship, a full exploration of possible mediating factors would be premature. However, the inclusion of a measure of fundamentalism for exploratory purposes allows both an enhanced analysis of one possible mechanism of action and further information about the nature of the sample.

Hypotheses

Hypothesis 1. Consistent with prior research using the dot probe technique in a variety of affective domains, this study first tested Prause's model of the relationship between desire and attentional bias toward erotic stimuli. This is an application of the technique used by Noël et al. (2006) in the exploration of fast and slow responses to alcohol stimuli, and by Mogg and Bradley in their (2006) work with phobic stimuli. To support this hypothesis, findings from simultaneously collected measurements of attentional bias in different time frames should replicate previous findings reviewed above. Consistent with Prause's (2006) findings, I hypothesize that higher sexual desire

scores will be associated with an attentional bias away from erotic stimuli at the 500 ms presentation time. See Figure 2.

Hypothesis 2. I further hypothesize that, consistent with the alcohol and phobia literature (Mogg & Bradley, 2006; Noël et al., 2006), those respondents who have different attentional biases toward erotic material depending on the stimulus presentation time will report greater distress related directly to their desire discrepancy or to sexuality in general. This will be reflected directly in their self-report of sexual distress and/or desire discrepancy distress. Thus I hypothesize that the difference in attentional bias between fast and slow presentation in the same person will be predictive of sexual distress or desire discrepancy distress in that person. See Figure 3.

Methodology

Participants

Recruitment and compensation. Participants were recruited via two separate Mechanical Turk (MTurk) Human Intelligence Tasks (HITs). The first recruited for women between the ages of 25 and 35, and the second recruited for men between 25 and 35. Each allowed for 200 participants, for a total target sample size (before excluding those participants not eligible to complete the dot probe task) of 400. Consistent with the data quality management recommendations from Buhrmeister, Kwang and Gosling (2011), participants were not recruited if they had fewer than 90% of their previous HITs successfully completed, or fewer than 100 successful HITs completed. Upon completion of the survey, participants were paid $3.00, with another $2.00 available if they qualified for and completed the dot probe task. Of the 400 participants who started the MTurk HIT, 396 provided enough data on the survey to be evaluated for inclusion in all parts of the study. The four thus excluded did not answer any questions on the survey. As explained below, 174 participants completed the dot probe task.

Overview of inclusion and exclusion criteria. To be eligible for the study, participants must have been (a) be between the ages of 25 and 35; (b) report no significant head injury with loss of consciousness; (c) report no hand or arm movement limitations or disorders that would potentially affect speed of response; (d) report no deficits in visual acuity that cannot be corrected sufficiently to, for example, be able to drive a car; (e) be fluent in written English; (f) have at least one-time access to a

computer with a processor and monitor capable of providing millisecond-level timing, as assessed by Inquisit 4 Web experiment presentation software (Draine, 2013)[ii] and be willing and able to install the Inquisit plugin; (g) be willing to view sexually explicit images and answer questions about their sexual experiences and 'qualified' via Mechanical Turk to participate in adult-content HITs; (h) report being at least predominately heterosexual when answering the Kinsey sexual orientation scale (Kinsey et al., 1948a, 1948b); (i) have engaged in sexual activity in the last four weeks; and (j) not have any sexual dysfunction other than Hypoactive Sexual Desire Disorder. In addition, by creating one HIT each for men and women – and by clarifying that this requirement refers to cis[iii] gendered persons – transgendered people are excluded from participating. See for a breakdown of the number of participants excluded by each criterion.

Criterion A: Participants must be between 25 and 35. Evidence suggests that sexual function and dysfunction are strongly related to age, for both women (Laumann, Paik, & Rosen, 1999) and men (Lewis et al., 2010). By logical necessity, the number and variety of sexual experiences must also, when considering a population as a whole, increase with age. Thus, the younger a sample is, the more homogeneity of sexual function and experience one is likely to find. On the higher end of age, menopause has long been associated with changes in sexual function and satisfaction in women (Avis, Stellato, Crawford, Johannes, & Longcope, 2000; Davison, Bell, LaChina, Holden, & Davis, 2008), and age, particularly in men past middle age, has similarly been associated with changes in sexual function and satisfaction (Corona et al., 2010; Lewis et al., 2010). Thus, in order to keep consistent age ranges for both male and female participants, the

criterion must include people old enough to demonstrate sufficient variability in sexual experience, satisfaction and function, while excluding those participants whose age has begun to change their sexual function for reasons that may be unrelated to their psychological function. Note that both younger and older groups may be of interest to future studies; it is the mixing of these three groups (younger, older, and the targeted age rance) that presents challenges for interpretation. Thus, consistent with prior work in the field (Rellini, 2007), participants under the age of 25 are excluded to ensure sufficient variety in sexual experiences and function, and participants over the age of 35 were excluded to ensure no age or menopause-related changes in sexual function and satisfaction. Applying this criterion excluded 11.62% of participants.

Criteria B – E: Physical and language limitations. Participants must be physically capable of completing the tasks required of them in the study, and must read English with enough fluency to read, understand and follow directions. Since participants are being recruited on-line, physical limitations that may be evident to a researcher in person are not detectable prior to the start of the study. Making these exclusion criteria explicit and including them at the beginning of the study was intended to reduce the number of participants who begin the study but are unable to complete it. Since these criteria were specified prior to be the start of the study, there is no information about the number of potential respondents who did not meet these criteria.

Criterion F: Hardware and software compatibility. The Inquisit Web (the software to be used in this study) platform is very broadly compatible across computer

systems and software, with versions of their plugin available for all major Windows, Macintosh and Linux browsers, including Internet Explorer, Firefox, Chrome, Opera and Safari (Draine, 2013). These combinations of browsers and operating systems account for 99.57% of all Internet users (NetMarketShare, 2013), meaning that (assuming the users of MTurk do not have different browser usage patterns than the rest of the browser market, an assumption for which there is no competing evidence) 0.43% of potential participants will be using software that Inquisit does not support. Inquisit Web is capable of identifying hardware limitations that may exclude participants (such as an unusually low-resolution display) and preventing them from beginning the tasks; however, since the minimum requirement is an 800x600 display and recent evidence (w3schools.com, 2013) notes that 99.5% of web visitors are using displays with resolution of 800x600 or higher, even if there is no overlap between the 'unusual browser' group and the 'low resolution' group, only approximately 1% of potential participants would be excluded on the basis of technological limitations. Participants were instructed that they would be unable to complete the tasks as required using a phone, tablet, or other device with only a touch-screen interface, and the software did not allow users of such devices to begin the study. For that reason, there is no information about the number of potential respondents who did not meet this criterion.

Inquisit does require that a browser plugin be installed to complete the study. This requirement means that the user must have the (a) the technical skills required to install software on the computer they are using, (b) the software authority required to install software, and (c) the willingness to install a plugin. While each of these

conditions will likely exclude some participants, there is no reason to believe that this exclusion will skew results as, for example, there is no evidence or theory that suggests that people who are higher on erotophilia are less likely to have administrative rights on their laptops. Similarly, while 'installing a plugin' sounds as if it would require technical skills, statistics from Adobe suggest that, as of 2009, 98.9% of web users had installed the Adobe Flash plugin (Adobe, Inc., 2009), a procedure identical to the one required to install the Inquisit plugin. Running the experiment without a plugin would be preferable by far; the technology to do so does not yet seem to be commercially available, and manually programming the experiment in Adobe Flash is untenable (and would still require a plugin; Reimers & Stewart, 2007). There is no information about the number of participants who did not meet this criterion since they would have been unable to even begin the study.

Criterion G: Willingness to view sexually explicit materials. Previous studies have consistently and repeatedly demonstrated (Bogaert, 1996; Dunne et al., 1997; Fenton, Johnson, McManus, & Erens, 2001; Morokoff, 1986; Plaud, Gaither, Hegstad, Rowan, & Devitt, 1999; Wiederman, 1999; Wolchik, Braver, & Jensen, 1985; Wolchik, Spencer, & Lisi, 1983) that there are measurable differences between people willing to participate in sexuality research and people not willing to participate. Suggestions have been made to minimize the difference between responders and non-responders (e.g., Wolchik et al., 1985; minimize the literal and psychological instrusiveness of the measures) and others have noted the effect size of the difference between willing participants and those unwilling to participate is relatively small (e.g., Dunne et al., 1997)

and thus not important enough to disrupt research. Others note that the difference could be very important, since volunteers for studies with sexual content tend to be more sexually experienced and, problematically for the current study, have greater 'sexual self-esteem' (Wiederman, 1999).

Wolchik et al.'s suggestions (1985) have already been applied to this study: the measurements are the least intrusive necessary to gather the information required. Thus, given the (reasonable, ethical) requirement that participants be informed that they are taking part in a study with sexually explicit content, the potential for skewed results is unavoidable. This is a limitation of this and similar studies, and not one for which a solution has yet been found.

Although participants are already required to be 25 years of age, Mechanical Turk requires that tasks with adult content be clearly marked as such and that participants who wish to take part in such tasks have previously indicated that they are comfortable doing so and are at least 18 years old. This additional level of qualification may have enhanced the difference between participants willing to participate in sex research and those not, since presumably the majority of sexual-content tasks are not academic surveys. However, this topic has not been researched, and this is a structural requirement of using Mechanical Turk as a recruitment tool. This is, however, an important limitation of the study. Given current technical limitations, there is no way of determining either how many participants would have seen the MTurk posting and responded if the content had

not been sexually explicit or how those participants might have differed from the participants who did respond.

Criteria H – J: Sexual activity in the last four months, heterosexuality and sexual function. Both the Female Sexual Function Index (FSFI) and the International Index of Erectile Function (IIEF) are structured such that respondents must have had heterosexual, partnered sexual activity in the last four weeks in order to meaningfully complete the measure (Rosen et al., 1997, 2000). While other measurements could be used in place of the FSFI and the IIEF, the assessment of sexual function necessarily requires that there be a reasonable 'trial' of that function.

Similarly, the exclusion of participants who are not at least predominately heterosexual inherently limits the generalizability of the study. However, since men are visually 'category specific' in that they direct visual attention to images showing attractive people of the gender to which they report being attracted (Lippa, 2012; Lippa, Patterson, & Marelich, 2010), the inclusion of men who are not predominately heterosexual would complicate analysis. Further, since both the FSFI and the IIEF require heterosexual, penetrative activity to assess pain and erectile function (Rosen et al., 1997, 2000), respectively, potential participants who are not predominately heterosexual are less likely to have the required sexual experiences. This is a limitation of the study.

Participants whose scores on the FSFI or IIEF are indicative of sexual dysfunction other than Hypoactive Sexual Desire Disorder were excluded from participation in the

study. Sexual distress is a primary outcome measure, and the inclusion of participants with chronic disorders that themselves produce sexual distress potentially unrelated to the attentional biases being measured would introduce noise without adding explanatory power. Participants with HSDD were not excluded, since the present study is interested in exploring, amongst other things, the effects of desire on attentional bias discrepancies, and thus the exclusion of participants with low sexual desire would unnecessarily constrict an important factor in the analysis.

Of the 350 respondents who met criteria A through G, 22 (6.29%) indicated that they were not either exclusively or predominately heterosexual and were excluded from the cognitive task. Of the 328 respondents who remained, 53 (16.16%) indicated that they had not had penetrative sex in the past four weeks and were excluded. There were no significant differences in the proportions of men and women excluded based on any of the criteria from A through I.

Criterion J requires that the participant's sexual function be above clinical cut-offs for the FSFI and IIEF, excluding the Desire subscales for each measure. Since the clinical cut-offs for each measure were determined for the full-scale and not the subscales (Rosen et al., 1997; Wiegel, Meston, & Rosen, 2005), subscale cut-offs were calculated by using published distributions of each subscale (Rosen et al., 2000; Wiegel et al., 2005) and the IIEF (Rosen et al., 1997; Rosen, Cappelleri, & Gendrano, 2002) and establishing a cut-off two standard deviations below (higher scores on the FSFI and IIEF are associated with better sexual function) general population norms. For the FSFI, that

meant subscale cut-offs of 3.16 for the Arousal scale, 3.97 for Lubrication, 3.75 for Orgasm and 4.22 for Pain. For the IIEF, the cut-offs were 6 for the Orgasm scale, 9 for Intercourse and 19 for Erectile.

There was a significant difference between the proportion of men and women excluded by criterion J. More women (N = 47, 32.64% of those qualified based on criteria A through I) than men (N = 27, 20.61% of those qualified based on prior criteria) were excluded based on this criterion

After applying all inclusion and exclusion criteria, 97 women and 104 men qualified and were offered a chance to complete the dot probe task in exchange for an additional $2.00 in compensation. Of those offered, more women (N = 94, 96.91% of those qualified) than men (N = 79, 75.96% of those qualified) agreed to complete the cognitive task. See Table 1 for detail.

There were significant differences between participants who did and did not complete the task. See Table 2 and Table 3 for a comprehensive review and details. Broadly, participants who completed the task were less likely to report discrepant sexual desire, less likely to be distressed about that discrepancy, more sexually satisfied (as measured by the SSS), less sexually distressed (as measured by the FSDS), more erotophillic (as measured by the SOS) and reported lower levels of anxiety, depression and somatic symptoms (as measured by the BSI). They were also more likely to be in a relationship, but did not differ on age, number of children, income, education, fundamentalism or their rating of how erotic they found each image. This difference on

measures of interest is a significant limitation of the study, although, given the relationship between qualifying factors (e.g., sexual function, recent sexual experiences), such differences are both unsurprising and unavoidable.

Measures

Study-specific questionnaires. Participants completed one study-specific questionnaire first, which included both general demographic questions and questions about distress related specifically to desire.

Demographic questionnaire. Participants were asked for demographic information, which confirmed that participants met criteria for participation and gather age, gender, sexual orientation (Kinsey et al., 1948a, 1948b). Participants who provided answers that are not consistent with participation criteria, or who indicate that they started the wrong HIT (i.e., a participant selects the HIT for men and indicates that she is a woman) were excluded from the survey. For convenience, the demographics questionnaire also contained the two desire distress items, described below.

Assessment of sexual function and satisfaction and erotophilia. Participants were given one of the two following surveys, depending on their stated gender (and consistent with the particular HIT to which they responded). Thus, no single participant received both the sexual function scale for women and that for men. Of note is that the two scales were developed to be roughly comparable (Rosen et al., 1997, 2000), but that the scales do not align precisely. For example, the IIEF does not have a pain scale, and

distinguishes intercourse satisfaction from general satisfaction. For that reason, for analyses that required the use of a single measure of sexual function, IIEF and FSFI scores were separately z-scored and merged into a single measure.

The Female Sexual Function Index (FSFI). The FSFI (Rosen et al., 2000) measures female respondents' sexual function with six subscales: desire, arousal, lubrication, orgasm, satisfaction and pain, as well as a full-scale with a cut-off for clinically significant sexual dysfunction (Wiegel et al., 2005). Each subscale has a maximum score of 6, and minimum scores from 0 to 1.2. The full-scale has a maximum score of 36; scores below 26 are consistent with sexual dysfunction (Wiegel et al., 2005). The instrument itself consists of 19 multiple choice questions, and has high test-retest reliability (r = .79 - .86) and high internal consistency, with a Cronbach's alpha greater than .82 (Rosen et al., 2000).

The International Index of Erectile Function (IIEF). The IIEF (Rosen et al., 1997, 2002) is a 15-item self-report measure of sexual functioning in men, consisting of a full scale and five subscales: desire, erectile ability, orgasmic function, intercourse satisfaction, and overall satisfaction. Subscale scores have maximums that vary from 30 (erectile function), to 15 (intercourse satisfaction), to 10 (orgasmic function, sexual desire and overall satisfaction), with minimums varying from 0 to 2. The full scale has a maximum of 75 and a minimum of 5. The scale has been found to have high internal consistency, with a Cronbach's alpha greater than .91 (Rosen et al., 1997). The scale has seen extensive use internationally (Rosen et al., 2002), and has been validated in a wide

variety of populations (E.g., Kriston, Günzler, Harms, & Berner, 2008; Lim et al., 2003; Wiltink, Hauck, Phädayanon, Weidner, & Beutel, 2003).

The Sexual Satisfaction Scale for Women and Men (SSS-W/M). The SSS-W/M (Meston & Trapnell, 2005; Pukall, 2008) is a 30-item measure of sexual satisfaction with a full scale and five subscales: communication, compatibility, contentment, personal concerns and relational concerns. The women's version of this scale has shown adequate internal consistency, with a Cronbach's alpha greater than .74, and adequate test-retest reliability, with *r* between .58 and .79. The version for use with men and women has not been validated; however, it is a direct translation of the women's version, which has been well-used and cited (For example, Gerrior, Watt, Weaver, & Gallagher, 2015; Pechorro et al., 2015; Stephenson & Meston, 2015a, 2015b and ; Witherow, Chandraiah, Seals, & Bugan, 2015 all cite Meston & Trapnell, 2006 and were published in the first four months of 2015).

Sexual Opinion Survey (SOS). The SOS (Fisher et al., 1988; Gilbert & Gamache, 1984; White, Fisher, Byrne, & Kingma, 1977) is a 21-item, single-scale measure of erotophilia and erotophobia with a maximum score of 7 and a minimum score of 1 (items scores were averaged). Cronbach's alpha is good, with results between .88 and .90. Individual questions are scored from 1 (strongly agree) to 7 (strongly disagree).

The definition and measurement of sexual distress. Sexual distress, particularly in women, has seen a recent surge of research (Bancroft, Loftus, & Long, 2003; Bancroft et al., 2003; DeRogatis et al., 2008, 2008) in response, some researchers

theorize, to the development of medications that cause – and the possibility of medications that treat – sexual dysfunction in women (Bancroft et al., 2003). For women, the Female Sexual Distress Scale (FSDS, and FSDS-R) have proved to be well-validated and popular measurement instruments (DeRogatis et al., 2008, 2002). This measure, including psychometric validation, is described below.

In men, however, sexual distress is not well examined. Sexual distress in men is more often referred to as sexual bother (Evangelia et al., 2010; Kuwata et al., 2007; Nelson, Deveci, Stasi, Scardino, & Mulhall, 2010; J. F. Smith, Breyer, & Shindel, 2011), and is generally measured through instruments that assess erectile function (Aversa et al., 2012; Cooperberg et al., 2003; Lubeck, Litwin, Henning, & Carroll, 1997), one to three item idiosyncratic question sets (Nelson et al., 2010; J. F. Smith et al., 2011), or, far less frequently, a single purpose-built questionnaire (Ugolini et al., 2008), which has been cited once (Aversa et al., 2012) since its validation. Conflating erectile function and sexual distress seems problematic, since although erectile dysfunction is distressing (for example, Helgason et al., 1996 notes that the most distressing aspect of prostate cancer was waning erectile function), other aspects of the sexual experience have been demonstrated to be distressing to men, including low desire and premature ejaculation (Laumann et al., 1999), or conflict about to whom one is attracted or not attracted. In short, with men as with women, every aspect of sexual experience could be the source of distress, not just erectile function. One way to measure sexual distress in men, then, would be to use a portion of an existing scale as in Nelson, et al., (2010), which used the three-item Sexual Bother subscale from the Prostate-Health Related Quality-of-Life

Questionnaire (Befort et al., 2005), which asks how big of a problem erectile function is, whether the problem is embarrassing or shameful, and whether it made it difficult to enjoy life. While this approach has simplicity on its side, it introduces a theoretical and statistical imbalance between genders, since the FSDS-R, which is clearly the best choice to evaluate sexual distress in women, has 13 items, which cover a variety of aspects of distress, and has strong psychometric support.

Instead, the present study presented the FSDS-R to men without modification. In reviewing the 13 items of the FSDS-R, only one item even suggests a potential gender imbalance – item 13, "How often do you feel bothered by low sexual desire?" (DeRogatis et al., 2008). That item, which will, on its face, be easily understood by men, is only problematic in as much as low sexual desire is commonly thought of as more of a problem in women than with men (Segraves & Segraves, 1991). Thus, although the measure has not been validated in men, for this study, sexual distress in men will be assessed with the FSDS-R.

As discussed above, the FSDS-R measures general sexual distress; there are no validated instruments for assessing distress associated with a discrepancy between the level of sexual desire a person wants and the level they have. For that reason, two purpose-written items are included to assess desire discrepancy distress.

The Female Sexual Distress Scale – Revised (FSDS-R). The FSDS-R (DeRogatis et al., 2008) consists of 13 Likert-scale items. It differs from the original FSDS (DeRogatis et al., 2002) only in that it includes an additional item, "Bothered by

low sexual desire." The single full scale consists of the sum of all the items, and thus can vary from 0 (no distress at all) to 52 (as much distress as possible). The validation article notes that the FSDS-R has a cut-off score of 11 or greater to indicate sexual dysfunction in women. The FSDS-R has good psychometric properties, with four-week test-retest coefficient of .88, and Cronbach's alpha of between .92 and .96.

Desire discrepancy distress items. Two items specific to distress related to desire were included at the end of the demographic questionnaire. There are no validated measures that specifically assess the sought level of sexual desire and the actual level of sexual desire, and the distress related to that conflict, and thus these study-specific items are included to gather this information directly. The first question asks directly about the difference between the level of sexual desire the participant wants and the level of desire the participant has, providing a five-point Likert scale centered on "My level of sexual desire is about where I want it to be," and varying from "My level of sexual desire is much lower than I want it to be" to "My level of sexual desire is much higher than I want it to be." The second item asks on a four-point scale the amount of distress associated with that difference, from "It doesn't bother me at all" to "It bothers me very much." Note that if there is no reported discrepancy, the second question will not be asked.

Brief Symptom Inventory-18 (BSI-18). The BSI-18 (DeRogatis, 2001; Zabora et al., 2001) consists of 18 five-point Likert-scale items drawn from the substantially longer Brief Symptom Inventory (DeRogatis & Melisaratos, 1983). The full scale, or Global Severity Index (GSI) measures overall psychological distress. There are three additional

subscales, consisting of Somatization, Depression and Anxiety. Cronbach's alpha for the BSI-18 is good at .89. The BSI-18 is strongly correlated with the original BSI, $r = .84$.

Image ratings. Participants, whether they qualified for and completed the dot probe task or not, rated how erotic they found each erotic image used in the dot probe from zero to four, with zero being entirely non-erotic and four being very erotic.

Cognitive measurement of attentional bias with a Dot Probe task. Participants were then given instructions for the completion of the on-line attentional bias measure. Consistent with recommendations about instructional manipulation checks and MTurk, (Oppenheimer, Meyvis, & Davidenko, 2009) after viewing the instructions on-line, participants were given a brief quiz about those instructions. Participants who did not answer correctly will be sent back to the instructions page. Participants who answer all questions correctly will move on to the ten practice items, followed by the trials, consistent with Noel et al. procedure (2006). Although the system was designed to reject any participant who did not pass the instruction quiz twice in a row, no participant was thus excluded.

For this study, the dot probe task was conducted as per a slightly modified form of the methodology used to detect differences in attentional bias in alcoholics (Noël et al., 2006). In that study, 64 participants were presented with relevant (in the original study, alcohol; in this study, erotic) images paired with neutral images (plants). The images were presented for 50 ms, 500 ms, and 1,250 ms. The difference in direction of attentional bias was observed between 50 and 500 ms for the alcoholics, with the 500 and

1,250 ms responses for alcoholics being approximately equal. Each participant was given 10 practice trials, than a counterbalanced series of 180 trials including 120 trials during which each of the 40 pictures was presented at each of the three speeds of presentation, and 60 trials involving filler pictures. After collecting the data, reaction times of more than 2,000 ms were eliminated, as were reaction times that were more than 2.5 standard deviations above the mean. Attentional bias scores for each participant were calculated by subtracting the mean reaction time for alcohol pictures from the mean reaction time for neutral pictures within each presentation time, with trials in which the probe replaced the alcohol picture being identified as 'congruent' and trials in which the probe replaced the neutral picture being identified as 'incongruent.' The present study used this procedure with very minor modifications to generate attentional bias scores for erotic and neutral images at three different speeds for each participant.

For each trial, practice or actual, the procedure was the same, although the practice trials used all neutral pictures and the actual trials will use half neutral and half erotic images. The erotic images were half mildly erotic (kissing, touching, no visible genital contact) and half explicitly erotic (partnered sexual activity with genitals visible). Mildly erotic images were drawn from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) and more explicitly erotic images were drawn from other, similar work that has explored reactions to erotic images (Both, Spiering, Everaerd, & Laan, 2004; Prause, 2006; Prause et al., 2008; Spiering et al., 2003). The IAPS set provided both the mildly erotic images, which include naked men, women, and partnered mild sexual activity (e.g., kissing and touching), and neutral images, such as those of

landscapes and plants. The mildly erotic images selected all had positive "pleasant" ratings from both men and women and included both a clear male and female figure. Neutral images selected all had positive "pleasant" ratings from both men and women; given that criteria, the images with the highest (non-sexual) arousal ratings were selected to match the (non-sexual) arousal ratings associated with the erotic images. During the dot probe task, fixation cross was presented for 500 ms, followed by a pair of pictures that are presented for either 50, 500 or 1,250 ms. A probe dot then appeared behind one of the two images, and the participant's response time for correctly determining whether the dot appeared on the right or the left of the screen was recorded. Ten practice trials were conducted with pictures which will not again be used in the study, followed by a feedback screen. Next, 120 actual trials with erotic images paired with neutral images were presented as forty sets at three different presentation speeds. Filler trials, consisting of neutral images paired with other neutral images, were added to the sequence to bring the number of total trials to 190 trials: 10 practice, 120 actual and 60 filler.

Consistent with suggestions for conducting research on MTurk (Buhrmester et al., 2011; Crump et al., 2013; Goodman, Cryder, & Cheema, 2012; Paolacci et al., 2010; D. Shapiro et al., 2013), some minor modifications were made to the process to increase participant focus and engagement. Feedback was provided every 20 trials, giving participants a summary of their progress so far and reminding participants with unusually slow reaction times (average of greater than 750 ms for the past 20 trials) to respond quickly, and participants with inaccuracy rates of more than four incorrect out of the past 20 trials of the instructions to stay focused. Thus, over the course of 180 non-practice

trials, participants saw a feedback screen nine times, in addition to the post-practice feedback screen.

The dot probe task has been shown to produce results similar in direction and magnitude to the Emotional Stroop task (Peckham et al., 2010). There have been recent concerns about the reliability of the dot probe task, with one researcher finding low levels of test-retest reliability (Schmukle, 2005). The findings, while interesting, have yet to be replicated, and the author does not address the decades of work that has reliably shown, for example, an attentional bias toward fear stimuli under a variety of circumstances (see, for example, Nader Amir, Beard, Burns, & Bomyea, 2009; N Amir, Bomyea, & Beard, 2010; Broadbent & Broadbent, 1988; Colin, Lih, Elizabeth, & Lynlee, 2007; Derryberry & Reed, 2002; Mogg et al., 1995, 1992; Yiend & Mathews, 2001). Thus, although Schmukle's 2005 findings are important to consider, the preponderance of the existing evidence supports the use of a dot probe task as a measure of attentional bias.

Procedure

Approval from the University of Vermont Institutional Review Board was requested and received prior to the start of data collection. As the MTurk market is rapidly moving, the average hourly rate for participants increased between the original proposal and data collection. For that reason, an amendment was submitted and approved that increased the compensation to the rates described here: $3.00 for completion of the surveys and an additional $2.00 for completion of the dot probe. Participants were recruited via two HITs posted on MTurk, as described above, and were

given consent documents on-line. After providing an electronic signature indicating their consent to participate, participants were given the demographics questionnaire. Participants then completed the FSFI or IIEF, depending on their stated gender, followed by the SSS-W/M, the FSDS-R, the SOS, and the BSI-18. Participants who met criteria to continue (described above; see Table 1 for details) were be offered a chance to continue to the dot probe task. Participants who did not wish continue were then passed back to Mechanical Turk and paid $3.00. Participants who completed the dot probe task, described above, were passed back to Mechanical Turk and paid an additional $2.00. Through use of a randomly generated two word code in one of two distinct patterns (to determine the amount to be paid), no link between the participant identity (required via MTurk for compensation) and the study results (stored separately in the Inquisit system) was possible, ensuring anonymity.

Measurement of depression and anxiety. Given the absence of research demonstrating that psychopathology has an influence on attention to sexual images in particular, and given that neither dot probe research, whether in sexuality (Prause, 2006; Prause et al., 2008) or in other affective domains (e.g., Colin et al., 2007; MacLeod et al., 1986, in which mood disorders are assessed since the primary research question was the relationship between mood disorders and attention) has excluded participants with mental health diagnoses, participants will not be excluded because of current mental health diagnoses. Because of that, no attempt was made to assess participants for any particular diagnosis. However, that same body of evidence suggests that depression and anxiety in particular have a measurable effect on attention to stimuli which are associated with

anxiety or depression (MacLeod & Rutherford, 1992; Mathews & MacLeod, 2005; Mogg et al., 1995; Peckham et al., 2010). Thus, although there is no theory that currently suggests a differential effect on Type 1 or Type 2 responses to sexual stimuli, the use of a state measure of anxiety and depression as a covariate allows for the influence of those systemic factors to be considered.

Issues with the use of Mechanical Turk. The MTurk framework is an on-line marketplace to connect people interested in completing relatively small tasks for relatively small payment (roughly between $0.01 and $5.00 per task, varying broadly by task length and unpleasantness). The use of MTurk in the collection of data from participants is relatively new, but ample evidence suggests that participants and the data they provide are equivalent to in-person participants.

Research has shown that these participants are generally slightly more diverse than a standard internet sample, and significantly more diverse than a university sample (Buhrmester et al., 2011; Paolacci et al., 2010; D. Shapiro et al., 2013), and that the rapid pace of data collection possible with MTurk does not affect data quality, given compensation ranges within the (relatively low, compared to participants who are required to come to a laboratory to conduct an experiment) MTurk standard (Buhrmester et al., 2011; Crump et al., 2013). Research has further demonstrated that MTurk participants vary little in terms of their responses to 'classic' psychological measures, such as measures of time-value discounting and Big-Five personality traits, although MTurk participants were generally slightly less extraverted and had slightly lower self-

esteem (Goodman et al., 2012), factors unlikely to have an influence on the current research question.

Further, experiments requiring close attention and millisecond timing have been conducted using MTurk and the results found to match expectations and prior research, with relatively minor modifications discussed below. The results of 'classic' experiments, such as the visual cueing task (Klein, 2000; Posner & Cohen, 1984), an attentional blink task (Raymond, Shapiro, & Arnell, 1992; K. Shapiro, Raymond, & Arnell, 1997), and a masked priming task (Eimer & Schlaghecken, 1998, 2002) were each replicated (Crump et al., 2013), after the addition of a few simple modifications.

These studies recommend two additions to an MTurk task. First, Goodman, Cryder and Cheema (2012) recommend the inclusion of an 'Instructional Manipulation Check' (as per Oppenheimer et al., 2009), or a question that is visually similar to other questions presented, but requires a slightly different answer. For example, the original IMC was the instruction to write, "I read the instructions" somewhere on a paper and pencil survey form. On-line, the Oppenheimer, Meyvis & Davidenko IMC was a paragraph of text that instructs participants *not* to answer the question below the paragraph, but instead click on the title of the page to continue. This question was transformed somewhat for an MTurk study (Goodman et al., 2012), which instead quizzed participants on the content of the instructions themselves. Goodman et al. (2012) reported an increase in power when using the quiz approach that was similar to the Oppenheimer et al. approach (2009). The 'quiz' approach was applied here, with a brief

quiz about task instructions given to participants after they agreed to complete the dot probe task. Participants who missed one or more questions were given the instructions and quizzed again. If any participants had failed the quiz twice in a row, they would have been excluded from the study. None did.

Next, Crump et al. (2013) recommend that feedback be provided as continuously as possible to participants to maintain engagement. For example, they recommend providing prompts to encourage speedy responses (when reaction time is relevant) or providing summaries of results when changing tasks. For this study, personalized feedback screens were presented every 20 tasks, with data about accuracy rates and response times, and guidance, based on that data, to either pay more attention or focus on speed.

Given the evidence that data collected via MTurk replicated that collected via traditional methods with the addition of relatively minor devices to assess attention, and given the evidence of the speed and ease with which a diverse sample can be collected, Amazon's Mechanical Turk becomes not only a viable option, but potentially an option superior to other traditional methods. Consistent with the MTurk community standards and the amount of time required, participants were compensated $3.00 for completion of the surveys, with an additional $2.00 offered for the completion of the dot probe task. Almost all participants who responded to the Mechanical Turk (Amazon.com, Incorporated, 2005; Buhrmester et al., 2011; Crump et al., 2013; Goodman et al., 2012) posting completed all surveys and image ratings (four answered no questions on the

survey and were excluded), although only participants who met inclusion criteria were offered a chance to continue to the dot probe task. A total of 396 participants responded to the posting (189 men and 207 women). After applying inclusion and exclusion criteria (discussed below), 104 men and 97 women were offered a chance to complete the dot probe, and 79 men and 94 women completed the task.

Data analytic strategy

Sample size considerations. All of the research to date that has explored differences in attentional bias across time has used pre-identified, categorical group differences (e.g., Mogg & Bradley, 2006, who compared alcoholics and social drinkers; and Noël et al., 2006, who compared people afraid of spiders with those not afraid), which has allowed for the use of repeated measures ANOVAs to analyze group differences. In this study, the reaction time difference scores between presentation times are being used to predict a continuous variable, allowing for a multiple regression to be used to evaluate Hypothesis 2. For the purposes of power analysis, an effect size for the effect of presentation duration on reaction time was calculated using published data from the two most similar studies (Mogg & Bradley, 2006; Noël et al., 2006), yielding values of Cohen's *d* between 0.54 and 1.47. Since this study will use a regression model, the more appropriate effect size measurement is Cohen's f^2. Converting *d* to f^2 yields a target range of approximately $f^2 = .06.$ to $f^2 = .56$. Using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to calculate the required sample size at an alpha of .05 at both values yields sample sizes of between 26 and 219. 'Splitting the difference' gives a sample size

of 100, which was calculated to have a 95% chance of detecting an effect size of at least f^2 =0.13. Given that this sample is roughly twice as large as the most comparable studies (Mogg & Bradley, 2006; Noël et al., 2006), which had samples of 42 and 64, respectively, and substantially larger than comparable research using erotic material (Prause et al., 2008, with a sample size of 81), this approach seems adequately conservative. Given the speed of recruitment and the uncertainty associated with collecting data, sample sizes were doubled for recruitment purposes, with the goal of attaining a usable sample between 100 and 200. The final sample, as described above, was 174.

Data cleaning. As with Noël et al., (2006), I eliminated any reaction times of greater than 2000 ms, as responses longer than that are clearly reflective of a distracted participant or a technical problem. I also, again consistent with Noël's procedure, eliminated reaction times that are more than 2.5 standard deviations above the mean for each participant for each presentation time (calculated after eliminating any reactions over two seconds), and eliminated 'incorrect' trials in which the participant did not correctly identify on which side of the screen the dot appeared. Note that this procedure varies only very slightly from the one used by Prause (2008) and described by Bush, Hess and Wolford (1993) in which each participant's reaction times are z-scored and five percent trimmed within each person. The net effect of either of the two procedures is almost identical; the only significant difference is that in the Noël et al. approach, reaction times that are faster than average but still correct are included, while the Bush, Hess and Wolford approach would exclude them.

There were 31,500 individual non-practice reaction times recorded. Excluding reactions over 2,000 MS removed 301 trials, and excluding incorrect responses removed another 915 trials. Excluding responses with faster than 2.5 standard deviations above each participants mean excluded another 601 trials. The remaining 29,984 trials (or an average of approximately 500 trials per picture per response time) were reduced as below.

Data reduction. Consistent with both the Prause and the Noël et al. approaches, attentional bias scores for each participant for each presentation time were calculated by subtracting the mean response time for trials in which the dot was behind an erotic images from the mean response time for trials in which the dot was behind a neutral image. Thus, an attentional bias toward erotic stimuli is reflected as a positive number. Each participant has three primary attentional bias scores – one for each presentation time (50 ms, 500 ms, 1,250 ms, named AB50, AB500 and AB1250). Difference scores were then be calculated reflecting the difference in erotic attentional bias between each of the three time points – (D_1) 50 ms – 500 ms; (D_2) 500 ms – 1,250 ms; (D_3) 50 ms – 1,250 ms. These three difference scores are thus higher if a person shows a greater attentional bias toward erotic images during fast presentations. A zero for a difference score indicates that there was no difference between presentation speeds, and a negative number indicates a stronger erotic attentional bias for slower presentations.

Data reduction formulas and nomenclature. This is represented as below, with RT_{eijt} being the reaction time for the ith correct response to the presentation of an erotic

image for participant j at presentation time t. Similarly, RT_{nijt} is the reaction time for the ith correct response to the presentation of a neutral image for participant j at presentation time t. The total number of correct responses to erotic images by participant j is c_{ej}, and the total number of correct responses to neutral images by participant j is c_{nj}. Thus the formula for the average correct response time to erotic (RT_{ejt}) and neutral (RT_{njt}) images for participant j at presentation time t are:

$$RT_{ejt} = \frac{\sum_{i=1}^{c_{ejt}} RT_{eijt}}{c_{ejt}}$$

$$RT_{njt} = \frac{\sum_{i=1}^{c_{njt}} RT_{nijt}}{c_{njt}}$$

The attentional bias for participant j at time t (AB_{jt}) is thus:

$$AB_{jt} = RT_{njt} - RT_{ejt}$$

Since there are three time points (1 = 50 ms, 2 = 500 ms and 3 = 1,250 ms), there are three bias scores for each participant (AB_{j1}, AB_{j2}, AB_{j3}, named as AB50, AB500 and AB1250 below and following), and three difference scores between the three attentional bias scores, with $D1_j$ being the difference in attentional bias between the fastest and the medium presentation speeds, $D2_j$ being the difference in attentional bias between the medium and slowest presentation speeds, and $D3_j$ being the difference in attentional bias between the fastest and the slowest presentation speeds, each for participant j:

$$D1_j = AB50_j - AB500_j$$

$$D2_j = AB500_j - AB1250_j$$

$$D3_j = AB50_j - AB1250_j$$

Thus AB50, AB500 and AB1250 refer to the attentional bias scores at each of the three presentation times, and D1, D2 and D3 refer to the difference scores between the attentional bias scores at the three different presentation times. This nomenclature is used below is describing the models to be tested.

Hypothesis 1: Prause's model of the relationship between desire and attentional bias will be supported. Prause's (2008) model posited that people with higher levels of sexual desire have a negative attentional bias toward sexual stimuli. This was assessed through use of a series of regression models predicting attentional bias scores (described above) with sexual desire scores from the FSFI and IIEF. As described above, gender, depression and anxiety scores from the BSI (Dep and Anx in the formulas below), as well as sexual function scores from the FSFI/IIEF and sexual satisfaction scores from the SSS-W (Fun and Sat, below) were covariates (shown in brackets) in the analysis.

The regression models to test this hypothesis are as follows:

Model 1a. $AB50 = b_0 + b_1Des + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 1b. $AB500 = b_0 + b_1Des + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 1c. $AB1250 = b_0 + b_1Des + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 1d. $$\frac{AB50 + AB500 + AB1250}{3} = b_0 + b_1 Des + [b_2 Dep + b_3 Anx + b_4 Fun + b_5 Sat + b_6 Gend]$$

Prause's study used reaction times pooled across multiple presentation times (500, 750, 1,000 and 1,500 ms), and thus the hypothesis will be tested for each presentation time and for a pooled set of attentional biases across all presentation times, with the average across presentation times (Regression model 1d) the most direct replication of Prause's findings. If the regression models account for a significant portion of the variability in attentional bias and b_1 is a significant contributor to the model, the data gathered on-line have replicated Prause's results and Prause's model will be supported. See Figure 4.

Hypothesis 2: Distress will be associated with differences across attentional biases Hypothesis 2 posits that the difference in attentional bias scores between times will be predictive of sexual distress. That is, as with substance use (Noël et al., 2006) and phobias (Mogg & Bradley, 2006), I anticipated that one or more of the three difference scores (D_1, D_2 and D_3) will be predictive of either sexual distress as measured by the FSDS-R or desire discrepancy distress as measured by the desire discrepancy items (DD Distress, below). This was determined by use of a set of regression models predicting the continuous variable of sexual distress with each of the three difference scores, in six separate models as specified below. As above, gender, depression, anxiety, sexual function and sexual satisfaction were entered in the model as covariates (Dep, Anx, Fun and Sat, respectively).

Model 2a. $FSDS_{Distress} = b_0 + b_1D1 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 2b. $FSDS_{Distress} = b_0 + b_1D2 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 2c. $FSDS_{Distress} = b_0 + b_1D3 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 2d. $DD\ Distress = b_0 + b_1D1 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 2e. $DD\ Distress = b_0 + b_1D2 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

Model 2f. $DD\ Distress = b_0 + b_1D3 + [b_2Dep + b_3Anx + b_4Fun + b_5Sat + b_6Gend]$

If any or all of the models account for a significant portion of the variance and the b_1 coefficient itself is a significant contributor to the model, the hypothesis is supported. See Figure 5.

Because the measures of sexual function (the FSFI and the IIEF) are gender-specific, and because these models call for a single measurement of sexual function across genders, the FSFI and IIEF were z-scored (by gender) and combined into a single measurement.

Results

Demographics

See Table 4 and Table 5 for a breakdown of key variables by gender for the 174 completers. There were very few gender differences. Men were more likely to report their sexual desire was higher than they wanted, (0.29 for men vs -0.09, for women), and men showed slightly higher erotophilia (5.20 for women vs. 5.54 for men, as measured by the SOS) and were significantly less likely to be in a romantic relationship (95.79% of women vs. 79.75% of men).

See Table 6 for differences by gender and speed for the primary attentional measures (AB50, AB500, and AB1250) and Table 7 for difference in the primary difference scores (D1, D2, and D3) by gender and speed. For all participants, AB50 was significantly different than AB500 and AB1250, and differences between AB500 and AB1250 were not significant. That is, AB50 was significantly larger (more attentional bias toward the erotic) than either AB500 or AB1250 for men, women, and all participants. D1 (AB50 – AB500) was not significantly different from D2 (AB 500 – AB1250) for men or women when considered separately, but was for all participants. D3 (AB50 – AB1250) was significantly different from D1 and D2 for men, and from D2 for women.

See Table 8 for a review of the correlations, means, standard deviations, minimums, maximums, skewness and kurtosis for all primary study variables. Note that

several study variables were meaningfully skewed (negatively skewed: SSS, SOS; positively skewed: FSDS, BSI Anxiety, BSI Depression, AB50, D1). See Figure 6 through Figure 24 for histograms of each variable of interest. For the survey measures, this skewness reflects the relatively healthy nature of the sample. For the attentional bias measures, this appears to reflect a general bias toward the erotic when presented quickly, which is broadly consistent with other studies (Prause, 2006; Prause et al., 2008). These levels of skewness are not generally problematic (Tabachnick & Fidell, 2007), although transformations were conducted and tested (see below). Similarly, several study variables had kurtosis measurement that differed meaningfully from zero (platykurtic: Age; leptokurtic: Desire discrepancy, SSS, BSI Anxiety, BSI Depression, SOS, AB50, AB1250, D1, D2, D3). Although regression is, as a technique, not sensitive to the distribution of the variables themselves, requiring only that the residuals be normally distributed (Tabachnick & Fidell, 2007), in every case where a highly skewed or kurtoticly-distorted variable was used in a regression model, log-transformations, inversion and reflections were used to test the value of a more normal distribution. In every case, these transformations did not meaningfully alter the end result of the analysis in significance, direction or magnitude. Thus, for ease of interpretation, the untransformed versions of each variable was used for all of the models described below.

As shown in Table 8, correlations amongst study variables were run to determine if the study variables related to each other as expected. The measures of sexual function, satisfaction and desire were highly correlated with each other, and in the expected directions. For example, sexual satisfaction (as measured by the SSS) is highly

negatively correlated with sexual distress (as measured by both the FSDS and DDD) and positively correlated with sexual function (FSFI/IIEF). Similarly, anxious and depressive symptoms (as measured by BSI Anxiety and BSI Depression) were negatively correlated with measures of satisfaction (SSS) and positively correlated with sexual function (FSFI/IIEF). These relationships suggest that these participants as assessed by these techniques are relatively consistent with previous work.

Amongst the less frequently used measures, erotophilia (as measured by the SOS) was, as makes intuitive sense, positively correlated with level of sexual desire (DD) and negatively correlated with age[iv]. Fundamentalism was positively correlated with age and negatively correlated with anxious symptoms[v], but was not, as is discussed above, related to either attentional biases or attentional bias difference scores.

Hypothesis 1

Four hierarchical linear regression models were run to test Hypothesis 1. The models varied only by the outcome variable. In the first model, AB50 was predicted, while in the second AB500 was predicted, and in the third AB1250. The fourth model – the most direct replication of Prause's work – predicted the average of AB50, AB500 and AB1250. In each model, variables were entered in an identical series of five steps. In the first step, gender was added. In step two, BSI Anxiety and BSI Depression were added, while step 3 added SSS and step 4 added the z-transformed version of the FSFI/IIEF scales that excluded the Desire subscales. Step five added the z-scored FSFI/IIEF Desire subscale. Detailed results of these models are shown in Table 9, Table 10, Table 11, and

Table 12. None of the models as run predicted a significant amount of the variability in the relevant outcome variables, with r^2 values all being under .04, or explaining roughly 4% of the variability in the outcome variable. Model 1, shown in Table 9 and predicting ABAll has an r^2 of .04, while for Model 2, shown in Table 10 and predicting AB50, r^2 = .03, for Model 3, shown in Table 11 and predicting AB500, r^2 = .01, and for Model 4, shown in Table 12 and predicting AB1250, r^2 = .02. Hypothesis 1 was not supported.

Hypothesis 2

Six hierarchical linear regression models were run to test Hypothesis 2 in two sets of three. Each model predicted one of the attentional bias difference scores (D1, D2, or D3) using a number of covariates and distress, either measured by FSDS or DDD. The first set predicted FSDS, while the second set predicted DDD. The first step of the regression models are identical for each set, with Gender, BSI Anxiety, BSI Depression, SSS, the FSFI/IIEF (excluding Desire) z-scored measure, SOS and Fundamentalism added. Within each set, one model was run with the fifth step adding D1, another with D2 and the third with D3. See Table 13, Table 14, Table 15, Table 16, Table 17, and Table 18 for details.

Within each set of models, the first step of each regression model is identical, varying only with the addition of the attentional bias difference score in the final step. The first set of models all strongly predicted FSDS, with r^2 values of approximately 0.75 for each of the three models. However, as is shown in Table 13, Table 14 and Table 15, the addition of the attentional bias difference score in Step 2 did not meaningfully

improve any of the models, with Δr^2 values for Step 2 all rounding to 0.00, and none of the three difference scores significantly predicting FSDS in any of the final models. Anxious and depressive symptoms (BSI Anxiety and BSI Depression) were both positively related to distress (more anxious or depressive symptoms was related to more distress), while erotophilia (SOS) was negatively related to distress (more erotophila was related to less distress).

The second set of models all predicted DDD, with *r*2 values of approximately 0.29 for each of the three models. Note that the majority of respondents indicated a Desire Distress Discrepancy (DDD) of zero, meaning that they were happy with their level of sexual desire. These models were run twice, one using all respondents and once using only respondents who had a response to desire discrepancy other than zero. The models did not vary significantly in magnitude or sign of coefficients, and for ease of interpretation, the models shown are those that included all respondents. As is shown in Table 16, Table 17, and Table 18, the addition of the attentional bias difference score in Step 2 did not meaningfully improve any of the models, with ΔR^2 values for Step 5 all rounding to 0.00, and none of the three difference scores significantly predicted DDD in any of the final models. Effectively all of the variability accounted for by each model is captured by the relationship between sexual satisfaction (SSS) and desire discrepancy distress (DDD), with more satisfaction being related with less distress.

Although the models run to test Hypothesis 2 all meaningfully predicted distress, whether measured by FSDS or DDD, none of the attentional variables added measurably to the model. Hypothesis 2 is not supported.

Secondary analyses

A number of secondary analyses were run, both planned and ad hoc. These analyses served one of two purposes. First, they expanded on the analyses conducted to test the hypotheses to diagnose whether the lack of support is reflective of the data or of an insufficiently sophisticated data analytic plan. Second, they tested relationships and models related to the primary hypotheses but not directly involving the variables of primary interest.

Diagnostic and exploratory analyses. As described above, each participant (including those who did not complete the cognitive task, although those participants are obviously excluded from these analyses) rated each erotic image used on a scale from zero to four, with four being the most erotic. As shown in Table 4, participants rated about half of the images used either a three or four and about one quarter of the images used a four. By recreating the attentional bias and bias difference scores using only the images rated a three or four (e.g., AB5034, AB50034, AB125034) or four (e.g., AB504, AB5004, AB12504) and re-calculating some key relationships with study variables, I attempted to determine if the relationships became stronger if only the images that each individual participant rated as somewhat (xx34) or very (xx4) erotic was used.

First, a series of paired sample t-tests were run to see if the attentional biases using the more erotic images were significantly different than the attentional biases using all of the images. See Table 19. Even though this result suggests that further analysis is not warranted, due to the high level of noise in the attentional bias data, another more subjective test was used. Limitations to this test include that there is an obvious reduction in power and reliability, since either 50% or 25% of the original trials were used, and some potential issues with self-selection, since participants rated a different number of images highly, and those who rated images more highly generally may be inherently more erotophillic. In addition, there is not an established statistical test to confirm that these relationships are getting stronger, given the difficulties associated with assessing a difference between difference scores based on averaged difference scores. Nevertheless, a visual indication of a reliable intensification in relationship strength would be consistent with the notion that the relationship is dependent on the erotic-ness of the image. Correlations were run for the attentional biases and difference scores and DD, DDD and FSDS for each of the three levels of erotic images (all images, 3 and 4 only, 4 only). See Figure 25 through Figure 30 for graphs of these changes for AB50, AB500 and AB1250 and D1, D2 and D3. The interpretation of these graphs is inherently subjective. While some graphs seem to show a clear directional relationship (e.g., AB500 and AB1250, and FSDS and DDD for D2 and D3), the pattern was not consistent or unambiguous enough to support further analysis, particularly in the context of the paired sample t-tests. In addition, the correlations involved remain very small and

consistently clustered around zero. For that reason, no further analyses of attentional biases or difference scores using image-restricted data was attempted.

Fundamentalism. As discussed, fundamentalism was theorized to be related to distress about sexuality. Although there has been relatively little research about the relationship between fundamentalism and sexual function, satisfaction and distress, the existing research broadly supports the idea that religious beliefs are not connected with sexual function (e.g., Filocamo et al., 2014), but that fundamentalism is broadly associated with reported sexual behaviors (Farmer, Trapnell, & Meston, 2009).

Relationships between fundamentalism and other study variables. Given the exploratory nature of these analyses, simple correlations were run to test whether fundamentalism was related to other study variables in the expected direction. As seen in Table 8, fundamentalism was positively correlated with age ($r = .22$, $p = .01$) and negatively correlated with erotophila ($r = -.38$, $p < .01$) and anxious symptoms ($r = -.16$, $p = .03$). This suggests that older participants (even within the restricted band of ages tested) had more fundamentalist beliefs, and that more fundamentalist participants were less likely to be pro-sexuality (SOS) and had fewer anxious symptoms. Also consistent with existing research, fundamentalism was not found to be related to sexual function (FSFI/IIEF) or satisfaction (SSS).

Mediating effects of Fundamentalism. First tested was a model that tested whether the relationship between attentional bias (AB50, AB500 and AB1250) and sexual distress (FSDS) was mediated by fundamentalism (Fund). Although the main

effect has already been implicitly tested as part of the primary hypotheses, these mediation model tests the possibility of suppression, or the possibility that the direct and indirect effects countered each other, producing a net main effect of zero. Using PROCESS (Hayes, 2012), three mediation models were run predicting FSDS with AB50, AB500 and AB1250, respectively and independent, with Fundamentalism mediating the relationship. For AB50, the model did not predict a significant about of variability, r^2 = .02, p = .78. The bootstrapped standardized indirect effect was 0.00 (95% CI -0.03, 0.02), and the bootstrapped direct effect was -0.01 (95% CI -0.01, 0.01). Similarly, the model using AB500 did not predict a significant amount of variability, $r2$ = .11, p = .33. The bootstrapped standardized indirect effect was 0.00 (95% CI -.01, 0.04), and the bootstrapped direct effect was -0.01 (95% CI -0.07, 0.04). Finally, the model using AB1250 also did not predict a significant amount of variability, r^2 = .11, p = .36. The bootstrapped indirect effect was -0.01 (95% CI -0.05, 0.01), and the bootstrapped direct effect was -0.01 (95% CI -0.06, 0.05). There was not sufficient evidence to suggest that fundamentalism mediates the relationship between attentional biases toward the erotic and distress.

Discussion

The central research question at its most basic is: does a conflict in fast and slow attentional responses to the erotic relate to sexual distress? This hypothesized relationship is premised in part on the idea that subjective or psychological sexual desire plays out through attention; that sexual desire consists of the application of a cognitive schema that preferences the erotic meaning of a stimulus over the non-erotic meanings (Janssen et al., 2000). Thus, a functioning cognitive mechanism for sexual arousal turns attention toward the more erotic and away from the non-erotic during sexual arousal. This work is theorized to operate on both automatic and conscious levels (Janssen et al., 2000; Prause et al., 2008). That conflict is the heart of this study: are conflicting fast and slow sexual responses associated with internally conflicting responses to the sexual, and thus related to distress about sexuality?

There were two hypotheses tested. Hypothesis 1 sought to replicate Prause's 2006 work which found a relationship between sexual desire and attentional bias away from erotic stimuli. Hypothesis 2 proposed that a discrepancy between fast and slow attentional biases toward erotic stimuli would predict distress about sexuality, whether that distress was about sexuality generally or was distress about a discrepancy between the level of sexual desire the participant had and the level of sexual desire the participant wanted. Neither hypothesis was supported by these data. Secondary and post-hoc analyses were used to explore these findings, but these additional findings also did not support the primary hypotheses.

These results are discussed below. First, I consider that these hypotheses were not supported because the relationships and mechanisms they imply are not real, and second I explore whether there could be methodological issues that prevented this particular study from finding these effects. Both possibilities are considered in the proposal of future research.

Speculation: The effect is not real

The first possibility to consider is that the reason this effect was not found is because it does not exist. While there certainly were people with significant differences between fast attention to the erotic (AB50) and slow attention to the erotic (AB1250), as seen in the distribution of D3 (AB50 – AB1250), as shown in Figure 24, that difference was not correlated with any of the other study variables[vi]. However, the differences between the attentional biases were as expected, with a stronger positive attentional bias toward the erotic at 50ms than at 1250ms. That is, there is evidence that these data are capturing attentional biases toward the erotic as they were intended to do.

Combining that with the evidence that using only trials involving images rated as more erotic does not consistently increase the effects, these results are consistent with the idea that differences in attentional biases toward the erotic, regardless of how erotic the images are, are not associated with distress. Since Janssen's attentional theory of desire is consistent with other theories of emotion and memory (Frijda, 1988, 1993; Janssen et al., 2000) and has been supported by empirical data in over 100 studies (see Chivers, Rieger, Latty, & Bailey, 2004; H. A. Rupp & Wallen, 2007; H. Rupp & Wallen, 2008; P.

Smith & Waterman, 2004 for example), it is more likely that this study has misapplied that theory than that it demonstrated a limitation of the theory. In either case, the solution is further research.

These questions should be explored using the Implicit Relational Assessment Procedure (IRAP, Barnes-Holmes et al., 2006; Levin, Hayes, & Waltz, 2010), which has the ability to test implicit cognitive congruence with propositional statements (e.g., "I want to be a sexual person," or "I am distressed by my desire") by measuring reaction time when assessing whether that statement is true or false for the respondent[vii]. In this case, such a measure can be used to identify the aspects of sexual distress that are most implicitly salient – for example, whether the physical experience of arousal is itself distressing, or if there are memories associated with arousal that are distressing. By better exploring the meaning of sexual distress, this future research can explicate the phenomenon of sexual distress.

Speculation: The effect is real, but was not found

Methodology: Data collection. This study was novel not only in the question being asked but in the application of an existing (but relatively new) data collection methodology to sexuality research. Mechanical Turk is widely used in the collection of survey data (Buhrmester et al., 2011; Goodman et al., 2012) and work has demonstrated Mechanical Turk's effectiveness in the conduct of precision-timed tasks by replicating classic cognitive 'effects,' albeit with slightly smaller effect sizes (Crump et al., 2013). In fact, 23 articles citing Inquisit (and thus capturing precision-timed data) and using

Mechanical Turk as a participant source were published between January, 2014 and April, 2015[viii]. However, as discussed above, conducting an experiment in 400 different homes instead of a single laboratory must of necessity reduce standardization in a number of ways. Most of the existing research has suggested that decrease in standardization is outweighed by the ease and speed of recruitment, but that might be less true than previously believed.

Very recent work (Schatz, 2015) suggests that variability in computer hardware will add more noise than previously estimated to the data collection. Although Inquisit collects significant information about the computer hardware being used, not enough is known about the effects of specific hardware and software configuration to be able to attempt to either exclude participants with particularly 'noisy' hardware or correct for that variability. This is consistent with previous findings that effect sizes are generally smaller when data from cognitive tasks are collected via Mechanical Turk.

Methodology: Sample selection. Of necessity, only those who are comfortable completing a sexually-explicit task are willing to complete such a task. This is an inherent limitation in data collection in sexuality research, and it means that researchers are likely gathering data from participants who are more comfortable with their sexuality than the general population. That alone may mask the hypothesized effect. In this case, however, we have additional information. Since the study involved both survey data and a cognitive task, with a hidden qualification gate between the two, there is additional information about who qualified and who did not. After application of the inclusion and

exclusion criteria, participants were offered a chance to complete the study. The vast majority of those offered the chance took it, but there were a number of important differences between those who met criteria and those who did not. In particular, those who did not qualify and/or did not choose to complete the task reported lower levels of sexual desire, more distress about their sexual desire, less sexual satisfaction, more general sexual distress, and were more anxious and depressed. In addition, they rated the images as less erotic overall (See Table 2 and Table 3). Many of these variables are central to the research question, and these differences represent a significant confound. By excluding participants with higher levels of general sexual dysfunction, for example, this study may have excluded those participants with higher levels of distress about sexuality.

The net result is that these methodological uncertainties mean that this null finding is as likely to represent the limitations of the way the study was conducted as it is to suggest the hypothesized effect does not exist.

Future research

This uncertainty presents a clear direction for future research. Whether the reason the hypotheses were not supported is because of a technical or sample selection methodological limitation or because the effect is not as theorized, future work is required to increase certainty. One line of that work should use the same surveys and dot probe task, ideally with the same set of stimuli, but should (a) be conducted in a laboratory setting, using computer hardware with known performance characteristics, (b)

use fewer exclusion criteria, including not excluding participants based on sexual function (or lack thereof). Under these circumstances, the results from a similarly powered study could be compared directly to these results.

To further explore the theory underlying this study, a measure such as the IRAP (discussed above) could be used to explore the implicit meaning associated with desire and distress. The IRAP can, with its subtler ability to test for implicit agreement with more complex propositional statements such as "I want to be a sexual being," or "I find my sexuality distressing," tell us more about the implicit structure of the phenomenal experience of distress and desire.

Conclusion

The study hypotheses were not supported, but there is insufficient information in these results to suggest either that this lack of support is due to a flaw in the theory or a limitation of the approach. If the former, research using techniques such as the IRAP to better understand the phenomenology of sexual distress can help explicate how distress itself is experienced. If the latter, future research, replicating this study with a broader sample under more controlled conditions, could help resolve that question.

Although this study did not produce firm conclusions, it did produce a set of clear recommendations for future research to better understand the phenomenon of sexual distress.

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Tables

Table 1. Application of inclusion and exclusion criteria.

	Female			Male			All		
	N	% of original	% of previous step	n	% of original	% of previous step	n	% of original	% of previous step
Started survey	207			189			396		
Criterion A: Age between 25 and 35 years	184a	88.89%		166a	87.83%		350	88.38%	
Criterion H: Either exclusively or predominately heterosexual	168a	81.16%	91.30%	160a	84.66%	96.39%	328	82.83%	93.71%
Criterion I: Penetrative sex in the last four weeks	144a	69.57%	85.71%	131a	69.31%	81.88%	275	69.44%	83.84%
Criterion J: Sexual function is above cut-off	97a	46.86%	67.36%	104b	55.03%	79.39%	201	50.76%	73.09%
Completed task:	94a	45.41%	96.91%	79b	41.80%	75.96%	173	43.69%	86.07%

Columns not sharing a superscript are significantly different at $p < .05$.

Table 2. Differences between participants who completed the dot probe task and those who did not in continuous study variables.

	Did not complete task		Completed task		All participants	
	Mean	SD	Mean	SD	Mean	SD
Age	30.46a	5.88	30.08a	3.23	30.29	4.89
Number of children	0.55a	1.03	0.71a	1.17	0.62	1.09
Income	$49,213a	32,934	$49,482a	$27,972	$49,332	$30,804
Sexual desire higher or lower	-0.29a	0.94	0.08b	0.73	-0.13	0.87
Desire distress discrepancy	0.48a	1.07	0.02b	0.85	0.28	1
SSS Full Scale	106.18a	30.01	127.81b	18.88	116.66	27.43
FSDS Full Scale	15.53a	11.08	8.92b	8.65	12.37	10.51
BSI Anxiety	3.90a	4.42	2.08b	2.75	3.05	3.84
BSI Depression	5.32a	5.73	2.82b	3.56	4.14	4.98
BSI Somatic	2.44a	3.65	1.25b	1.95	1.88	3.03
SOS Full Scale	4.95a	1.57	5.35b	1.08	5.14	1.37
Fundamentalism Full Scale	40.24a	26.34	41.74a	27.62	40.94	26.92
All images	2.50a	0.95	2.53a	0.78	2.52	0.87
# of images rated 3 or 4	10.37a	7.22	11.78b	5.71	10.99	6.63
# of images rated 4	4.30a	5.23	4.88a	4.79	4.55	5.04

Columns not sharing a superscript are significantly different at $p < .05$.

Table 3. Differences between participants who completed the dot probe task and those who did not in categorical study variables.

	Did not complete task		Completed task		All Participants	
	Mean	SD	Mean	SD	Mean	SD
	N	%	N	%	N	%
Relationship status						
Not in relationship	69a	31.08%	20b	11.49%	89	22.47%
In relationship	153a	68.92%	154b	88.51%	307	77.53%
Education						
High school or less	31a	14.09%	21a	12.14%	52	13.23%
Some college	89a	40.45%	69a	39.88%	158	40.20%
College	81a	36.82%	71a	41.04%	152	38.68%
Advanced degree	19a	8.64%	12a	6.94%	31	7.89%

Columns not sharing a superscript are significantly different at $p < .05$.

Table 4. Differences by gender in continuous study variables.

	Female		Male		All participants	
	Mean	SD	Mean	SD	Mean	SD
Age	30.42a	3.02	29.67a	3.44	30.08	3.23
# children	.81a	1.16	.59a	1.17	0.71	1.17
Income	49,947a	26,670	48,924a	29,625	49,482	27,972
Sexual desire +/-	-.09a	0.72	.29b	0.7	0.08	0.73
Desire distress disc.	.06a	0.87	-.03a	0.82	0.02	0.85
SSS Full Scale	128.75a	18.81	126.69a	19.01	127.81	18.88
FSDS Full Scale	8.80a	8.66	9.06a	8.69	8.92	8.65
BSI Anxiety	1.96a	2.79	2.23a	2.71	2.08	2.75
BSI Depression	2.61a	3.65	3.06a	3.44	2.82	3.56
BSI Somatic	1.21a	1.95	1.29a	1.96	1.25	1.95
SOS Full Scale	5.20a	1.12	5.54b	1.00	5.35	1.08
Fundamentalism	42.65a	28.45	40.62a	26.72	41.74	27.62
All images	2.49a	0.78	2.58a	0.78	2.53	0.78
Explicit images	2.67a	1.01	2.91a	0.89	2.78	0.96
Mild images	2.30a	0.81	2.20a	0.86	2.26	0.83
Images rated 3 or 4	11.57a	5.85	12.04a	5.57	11.78	5.71
Images rated 4	4.61a	4.57	5.20a	5.04	4.88	4.79
AB50	25.81a	29.38	18.32a	28.3	22.41	29.05
AB500	10.00a	24.01	6.26a	24.38	8.3	24.18
AB1250	5.82a	25.19	2.68a	23.18	4.39	24.28
D1 (AB50 – AB500)	15.81a	33.82	12.05a	39.36	14.1	36.38
D2 (AB500 – AB1250)	4.18a	30.35	3.58a	29.75	3.91	29.99
D3 (AB50 – AB1250)	19.99a	37.51	15.64a	39.71	18.01	38.47

Columns not sharing a superscript are significantly different at $p < .05$.

Table 5. Differences by gender in categorical study variables.

	Count	%	Count	%	Count	%
Relationship status						
Not in relationship	4a	4.21%	16b	20.25%	20	11.49%
In relationship	91a	95.79%	63b	79.75%	154	88.51%
Ethnicity						
Caucasian	75a	78.95%	62a	78.48%	137	78.74%
African American	7a	7.37%	7a	8.86%	14	8.05%
Asian	5a	5.26%	3a	3.80%	8	4.60%
Hispanic	7a	7.37%	4a	5.06%	11	6.02%
Multiple	1a	1.05%	3a	3.80%	4	2.30%
Education						
High school or less	8a	8.51%	13a	16.46%	21	12.14%
Some college	42a	44.68%	27a	34.18%	69	39.88%
College	35a	37.23%	36a	45.57%	71	41.04%
Advanced degree	9a	9.57%	3a	3.80%	12	6.94%

Columns not sharing a superscript are significantly different at $p < .05$.

Table 6. Differences in attentional biases by speed and gender.

	AB50		AB500		AB1250	
	Mean	SD	Mean	SD	Mean	SD
All participants (n = 174)	22.41a	29.06	8.30b	24.18	4.39b	24.28
Men (n = 79)	18.32a	28.30	6.26b	24.38	2.68b	23.18
Women (n = 95)	25.81a	29.38	10.00b	24.01	5.82b	25.19

Columns not sharing a superscript are significantly different at $p < .05$.

Table 7. Differences in attentional bias difference scores by speed and gender.

	D1		D2		D3	
	Mean	SD	Mean	SD	Mean	SD
All participants (n = 174)	14.10a	36.38	3.91b	29.99	18.01a	38.47
Men (n = 79)	12.05a	39.36	3.58a	29.75	15.63b	39.71
Women (n = 95)	15.81a,b	33.82	4.18a	30.35	19.99b	37.51

Columns not sharing a superscript are significantly different at $p < .05$.

Table 8. Descriptive statistics and correlations for continuous study variables for participants who completed the dot probe task.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Age		-0.09	0.03	0.06	-0.14	-0.06	0.04	-0.09	-0.15	-.17*	.22**	-0.01	0.02	0.09	0.12	0.01	-0.01	0.08	0.05
2 DD			-.1`	.51**	.24*	.27**	-	0.01	-0.05	.18*	-0.05	.28**	.43**	0.06	0.03	.16*	0.03	-0.11	-0.06
3 DDD				-.51**	-.28*	-.51**	.52**	.20**	.32**	-0.11	0.04	-.37**	-.16*	-0.01	-0.04	-0.04	0.02	0	0.02
4 FSFI							.77**	-	-	-	0.02	0.1	.95**	.63**	0.03	0.13	-0.04	-0.07	0.14	0.05
5 IIEF							.71**	-	-	-	0.1	0	.87**	.49**	-0.03	-0.13	0.05	0.06	-0.14	-0.05
6 SSS								-	-	-	0.13	0.02	.70**	.29**	0.08	-0.02	0.03	0.08	-0.05	0.04
7 FSDS									.49**	.62**	0.03	-0.11	-.65**	-.30**	-0.04	-0.03	-0.03	-0.01	-0.01	-0.01
8 BSI A										.62**	0.08	-.16*	-.37**	-0.13	-0.07	-0.04	-0.03	-0.03	-0.01	-0.04
9 BSI D											0.07	-0.11	-.51**	-0.14	-0.05	-0.15	-0.04	0.06	-0.09	-0.02
10 SOS												-.38**	0.04	0.06	0.04	-0.03	0.01	0.05	-0.03	0.02
11 Fund													0.08	0.03	0.02	-0.03	0.06	0.04	-0.08	-0.02
12 FunNDz														.29**	0.02	0.07	0.01	-0.03	0.05	0.01
13 FunDz															0.051	-0.04	-0.08	0.06	0.03	0.09
14 AB50																0.08	-0.03	.75**	0.09	.78**
15 AB500																	.23**	-.60**	.62**	-0.09
16 AB1250																		-.18*	-.62**	-.66**
17 D1																			-.34**	.68**
18 D2																				.46**
19 D3																				
Mean	30.08	0.08	0.02	31.18	67.65	127.81	8.92	2.08	2.82	5.35	41.74	0.61	0.34	22.41	8.3	4.39	14.1	3.91	18.01
SD	3.23	0.73	0.85	2.86	4.59	18.88	8.65	2.75	3.56	1.08	27.62	0.25	0.77	29.05	24.18	24.28	36.38	29.99	38.47
Skew	0.02	-0.04	0.59	-0.8	-0.69	-1.23	1.11	1.86	1.51	-1.67	0.81	-1.15	0.04	1.74	0.52	0.13	0.6	0.42	1.4
SE Skew	0.18	0.18	0.18	0.25	0.27	0.19	0.18	0.18	0.18	0.18	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Z Skew	0.09	-0.2	3.22	-3.23	-2.53	-6.59	6.03	10.1	8.23	-9.08	4.37	-6.23	0.21	9.46	2.8	0.68	3.27	2.27	7.6
SE Kurt	0.37	0.37	0.37	0.49	0.54	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 9. FSFI/IIEF Desire does not predict average attentional bias (ABAll).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.04				.51
Constant		14.53	12.65		0.25
Gender		-4.94	2.60	-0.15	0.06
BSI Anx		0.04	0.58	0.01	0.95
BSI Dep		-0.56	0.50	-0.12	0.26
SSS		-0.02	0.10	-0.02	0.87
SexFunct w/o Desire (z)		-0.27	7.51	0.00	0.97
SOS		0.51	1.30	0.03	0.69
Fundamentalism		0.02	0.05	0.03	0.71
Step 2	.003				.473
Constant		13.12	12.82		0.31
Gender		-5.06	2.61	-0.16	0.05
BSI Anx		0.03	0.58	0.00	0.96
BSI Dep		-0.54	0.50	-0.12	0.28
SSS		-0.01	0.10	-0.01	0.94
SexFunct w/o Desire (z)		0.63	7.62	0.01	0.94
SOS		0.57	1.30	0.04	0.66
Fundamentalism		0.02	0.05	0.03	0.71
FSFI/IIEF Desire (z)		-1.26	1.75	-0.06	0.47

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 10. FSFI/IIEF Desire does not predict attentional bias at 50ms (AB50).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.03				.68
Constant		3.47	23.02		0.88
Gender		-7.31	4.72	-0.13	0.12
BSI Anx		-0.60	1.06	-0.06	0.58
BSI Dep		0.10	0.91	0.01	0.92
SSS		0.17	0.18	0.11	0.36
SexFunct w/o Desire (z)		-9.30	13.65	-0.08	0.50
SOS		1.31	2.36	0.05	0.58
Fundamentalism		0.03	0.09	0.03	0.73
Step 2	.00				.78
Constant		4.49	23.36		0.85
Gender		-7.23	4.75	-0.12	0.13
BSI Anx		-0.59	1.06	-0.06	0.58
BSI Dep		0.08	0.91	0.01	0.93
SSS		0.16	0.18	0.10	0.38
SexFunct w/o Desire (z)		-9.95	13.88	-0.08	0.47
SOS		1.27	2.37	0.05	0.60
Fundamentalism		0.03	0.09	0.03	0.73
FSFI/IIEF Desire (z)		0.91	3.19	0.02	0.78

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 11. FSFI/IIEF Desire does not predict attentional bias at 500ms (AB500).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.06				.22
Constant		46.22	18.78		0.02
Gender		-4.35	3.86	-0.09	0.26
BSI Anx		0.73	0.87	0.08	0.40
BSI Dep		-1.57	0.74	-0.23	0.04
SSS		-0.27	0.15	-0.21	0.07
SexFunct w/o Desire (z)		14.07	11.14	0.14	0.21
SOS		-0.89	1.93	-0.04	0.64
Fundamentalism		-0.04	0.07	-0.05	0.57
Step 2	.00				.55
Constant		44.48	19.05		0.02
Gender		-4.49	3.87	-0.09	0.25
BSI Anx		0.72	0.87	0.08	0.41
BSI Dep		-1.54	0.74	-0.23	0.04
SSS		-0.26	0.15	-0.20	0.08
SexFunct w/o Desire (z)		15.17	11.32	0.15	0.18
SOS		-0.82	1.94	-0.04	0.67
Fundamentalism		-0.04	0.07	-0.05	0.58
FSFI/IIEF Desire (z)		-1.55	2.60	-0.05	0.55

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 12. FSFI/IIEF Desire does not predict attentional bias at 1,250ms (AB1250).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.01				.96
Constant		-6.09	19.58		0.76
Gender		-3.16	4.02	-0.06	0.43
BSI Anx		-0.02	0.90	0.00	0.98
BSI Dep		-0.21	0.77	-0.03	0.78
SSS		0.06	0.15	0.05	0.70
SexFunct w/o Desire (z)		-5.57	11.61	-0.06	0.63
SOS		1.12	2.01	0.05	0.58
Fundamentalism		0.07	0.08	0.07	0.40
Step 2	.01				.25
Constant		-9.61	19.79		0.63
Gender		-3.46	4.02	-0.07	0.39
BSI Anx		-0.05	0.90	-0.01	0.95
BSI Dep		-0.15	0.77	-0.02	0.84
SSS		0.08	0.15	0.06	0.61
SexFunct w/o Desire (z)		-3.34	11.76	-0.03	0.78
SOS		1.26	2.01	0.05	0.53
Fundamentalism		0.07	0.08	0.07	0.39
FSFI/IIEF Desire (z)		-3.14	2.70	-0.10	0.25

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 13. D1 (AB50 – AB500) does not predict FSDS Distress.

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.76				.00
Constant		44.60	3.43		0.00
Gender		-0.66	0.70	-0.04	0.35
BSI Anx		0.30	0.16	0.10	0.06
BSI Dep		0.41	0.14	0.17	0.00
SSS		-0.31	0.03	-0.66	0.00
SexFunct w/o Desire (z)		-2.98	2.03	-0.08	0.14
SOS		0.77	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.54
Step 2	.00				.44
Constant		44.91	3.46		0.00
Gender		-0.64	0.71	-0.04	0.37
BSI Anx		0.31	0.16	0.10	0.05
BSI Dep		0.40	0.14	0.16	0.00
SSS		-0.31	0.03	-0.67	0.00
SexFunct w/o Desire (z)		-2.81	2.05	-0.08	0.17
SOS		0.76	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.52
D1		0.01	0.01	0.03	0.44

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 14. D2 (AB500 – AB1250) does not predict FSDS Distress.

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.76				.00
Constant		44.60	3.43		0.00
Gender		-0.66	0.70	-0.04	0.35
BSI Anx		0.30	0.16	0.10	0.06
BSI Dep		0.41	0.14	0.17	0.00
SSS		-0.31	0.03	-0.66	0.00
SexFunct w/o Desire (z)		-2.98	2.03	-0.08	0.14
SOS		0.77	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.54
Step 2	.00				.65
Constant		44.88	3.49		0.00
Gender		-0.67	0.71	-0.04	0.35
BSI Anx		0.31	0.16	0.10	0.06
BSI Dep		0.40	0.14	0.17	0.00
SSS		-0.31	0.03	-0.67	0.00
SexFunct w/o Desire (z)		-2.88	2.05	-0.08	0.16
SOS		0.76	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.52
D1		-0.01	0.01	-0.02	0.65

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 15. D3 (AB50 – AB1250) does not predict FSDS Distress.

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.76				.00
Constant		44.60	3.43		0.00
Gender		-0.66	0.70	-0.04	0.35
BSI Anx		0.30	0.16	0.10	0.06
BSI Dep		0.41	0.14	0.17	0.00
SSS		-0.31	0.03	-0.66	0.00
SexFunct w/o Desire (z)		-2.98	2.03	-0.08	0.14
SOS		0.77	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.54
Step 2	.00				.71
Constant		44.57	3.44		0.00
Gender		-0.65	0.71	-0.04	0.36
BSI Anx		0.30	0.16	0.10	0.06
BSI Dep		0.41	0.14	0.17	0.00
SSS		-0.31	0.03	-0.66	0.00
SexFunct w/o Desire (z)		-2.97	2.04	-0.08	0.15
SOS		0.77	0.35	0.09	0.03
Fundamentalism		-0.01	0.01	-0.03	0.55
D3		0.00	0.01	0.02	0.71

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 16. D1 (AB50 – AB500) does not predict desire discrepancy distress (DDD).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.29				.00
Constant		2.66	0.57		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.20
SSS		-0.02	0.00	-0.42	0.00
SexFunct w/o Desire (z)		-0.29	0.34	-0.08	0.39
SOS		-0.02	0.06	-0.03	0.73
Fundamentalism		0.00	0.00	0.03	0.66
Step 2	.00				.95
Constant		2.65	0.58		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.21
SSS		-0.02	0.00	-0.42	0.00
SexFunct (z)		-0.29	0.34	-0.09	0.39
SOS		-0.02	0.06	-0.03	0.74
Fundamentalism		0.00	0.00	0.03	0.66
D1		0.00	0.00	0.01	0.95

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 17. D2 (AB500 – AB1250) does not predict desire discrepancy distress (DDD).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.29				.00
Constant		2.66	0.57		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.20
SSS		-0.02	0.00	-0.42	0.00
SexFunct w/o Desire (z)		-0.29	0.34	-0.08	0.39
SOS		-0.02	0.06	-0.03	0.73
Fundamentalism		0.00	0.00	0.03	0.66
Step 2	.00				.95
Constant		2.65	0.58		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.21
SSS		-0.02	0.00	-0.42	0.00
SexFunct (z)		-0.29	0.34	-0.09	0.39
SOS		-0.02	0.06	-0.03	0.74
Fundamentalism		0.00	0.00	0.03	0.66
D2		0.00	0.00	0.01	0.95

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 18. D3 (AB50 – AB1250) does not predict desire discrepancy distress (DDD).

	ΔR^2	*B*	*SE B*	*β*	*P*
Step 1	.29				.00
Constant		2.66	0.57		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.20
SSS		-0.02	0.00	-0.42	0.00
SexFunct w/o Desire (z)		-0.29	0.34	-0.08	0.39
SOS		-0.02	0.06	-0.03	0.73
Fundamentalism		0.00	0.00	0.03	0.66
Step 2	.00				.630
Constant		2.65	0.58		0.00
Gender		-0.13	0.12	-0.08	0.28
BSI Anx		-0.02	0.03	-0.05	0.53
BSI Dep		0.03	0.02	0.12	0.21
SSS		-0.02	0.00	-0.42	0.00
SexFunct (z)		-0.29	0.34	-0.09	0.39
SOS		-0.02	0.06	-0.03	0.74
Fundamentalism		0.00	0.00	0.03	0.66
D3		0.00	0.00	0.03	0.63

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 19. Paired-sample t-tests comparing attentional biases calculated using all images to those which used only images rated highly (34) or very highly (4) erotic demonstrate no significant differences.

	Mean	SD	t	df	*p*
AB50 - AB5034	-1.08	19.18	-0.71	160	0.48
AB50 - AB504	-5.57	41.46	-1.43	112	0.16
AB5034 - AB504	-4.09	36.69	-1.19	112	0.24
AB500 - AB50034	-0.80	23.68	-0.43	161	0.67
AB500 - AB5004	-2.18	42.45	-0.55	112	0.59
AB50034 - AB5004	-1.87	40.36	-0.49	112	0.62
AB1250 - AB125034	-1.57	25.17	-0.80	162	0.43
AB1250 - AB12504	4.71	53.51	0.96	117	0.34
AB125034 - AB12504	5.42	44.84	1.31	117	0.19

*= $p < .05$; ** = $p < .01$; *** = $p < .001$

Figures

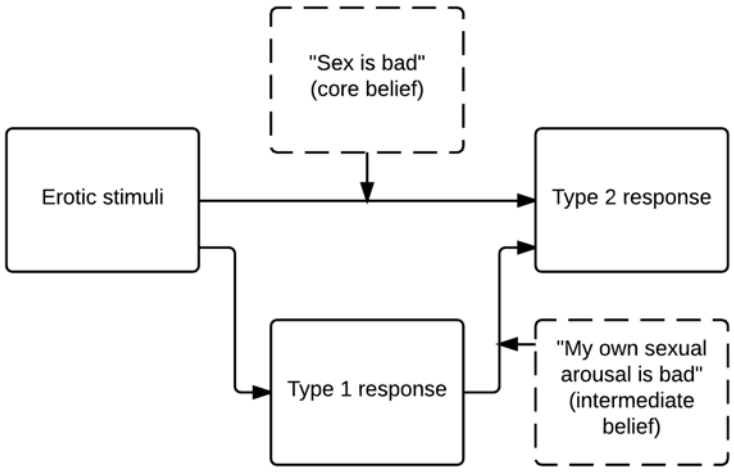

Figure 1. The relationship between erotic stimuli, cognitive schema and Type 1 and Type 2 responses.

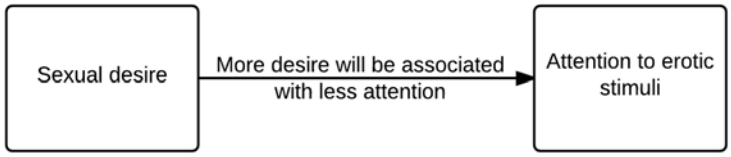

Figure 2. Hypothesis 1: Sexual distress will be associated with less attention toward erotic stimuli.

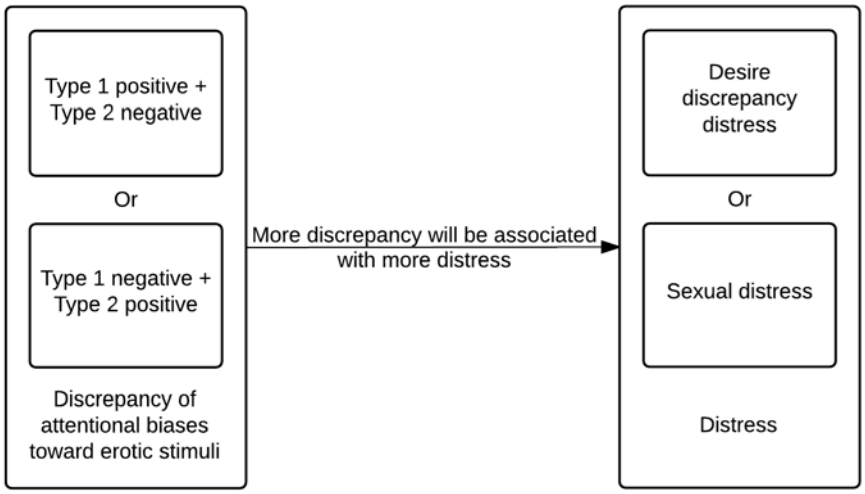

Figure 3. Hypothesis 2: Conflicting attentional biases are hypothesized to be associated with sexual distress.

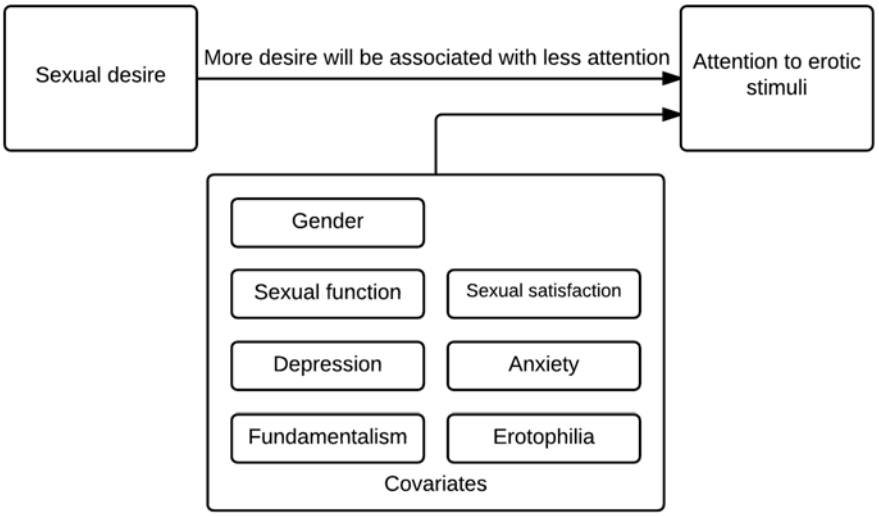

Figure 4. Hypothesis 1, shown with covariates.

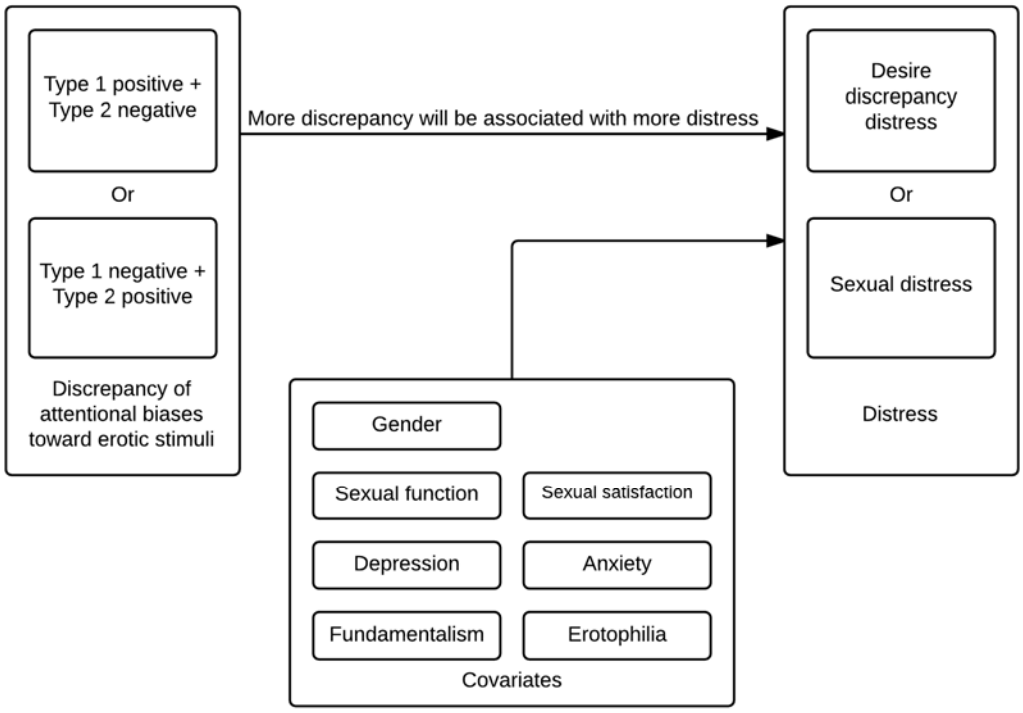

Figure 5. Hypothesis 2, shown with covariates.

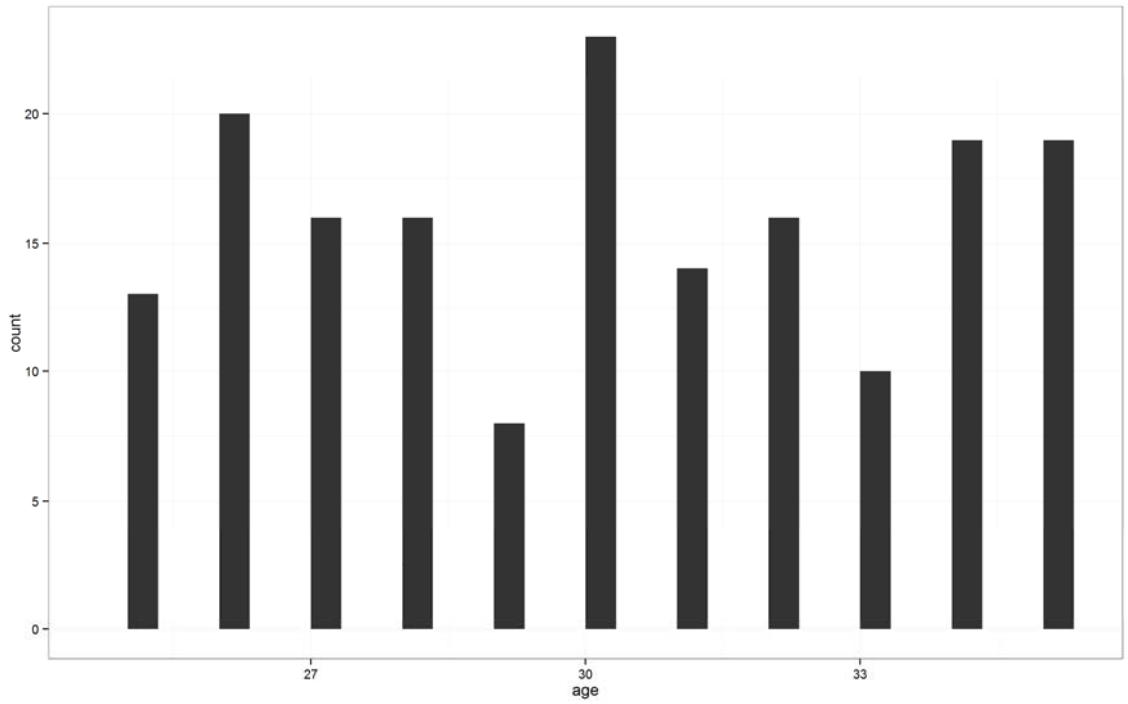

Figure 6. Distribution of Age.

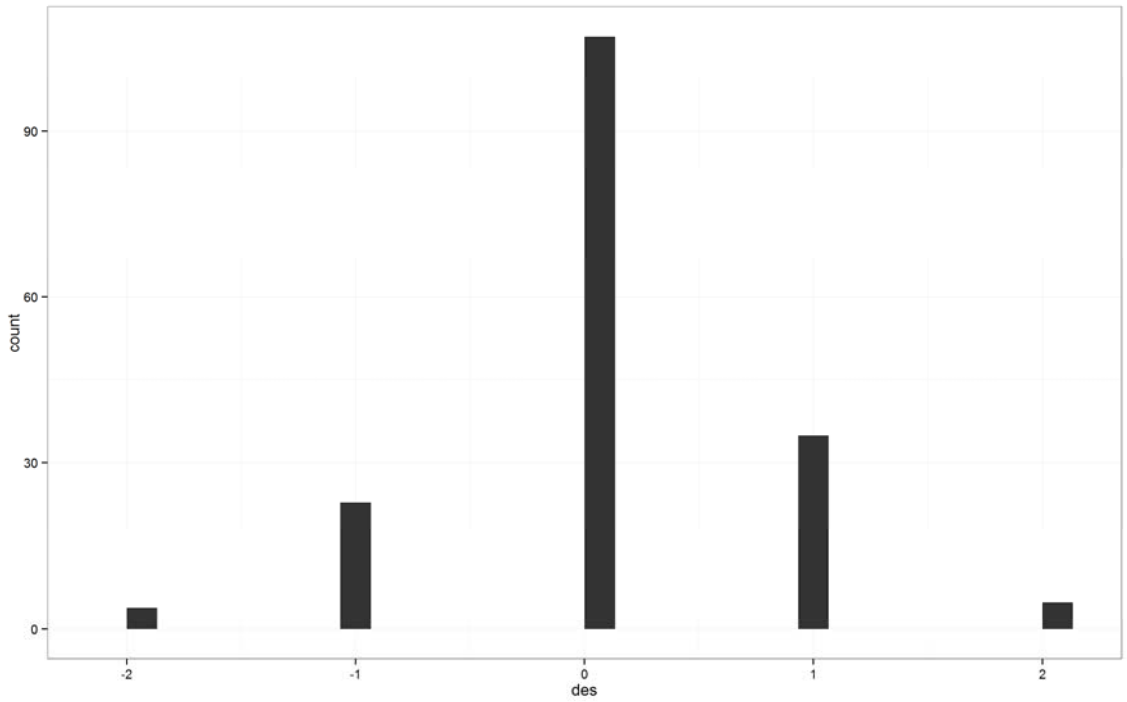

Figure 7. Distribution of Desire Discrepancy (DD).

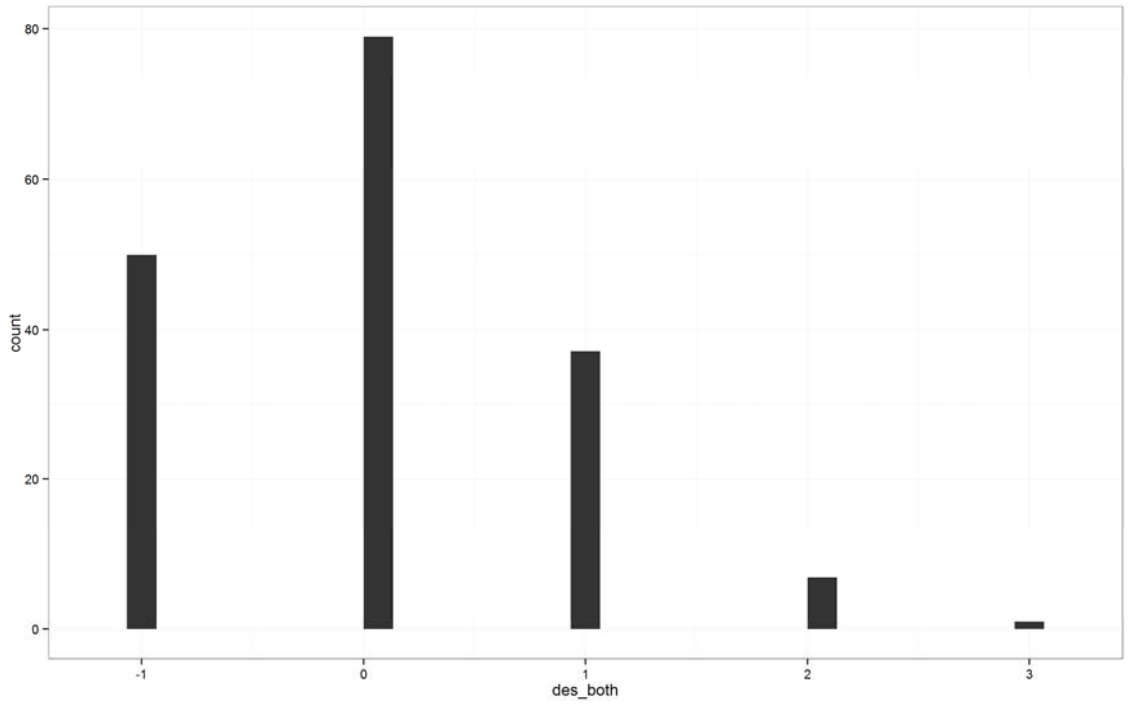

Figure 8. Distribution of Desire Discrepancy Distress (DDD).

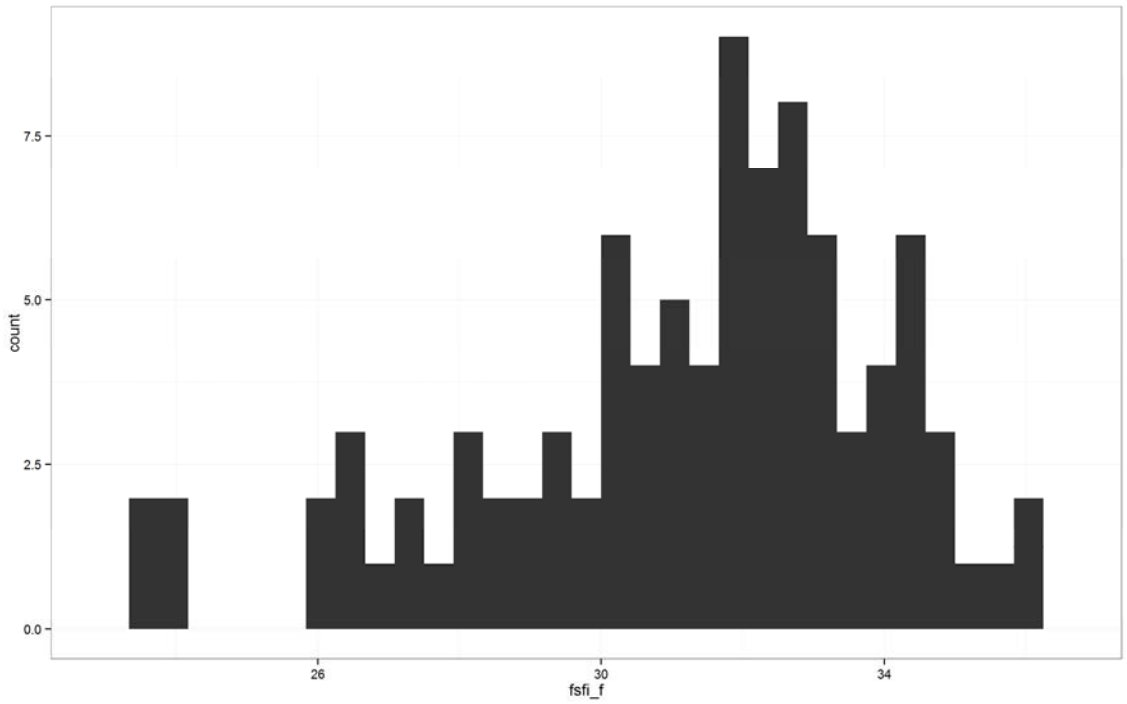

Figure 9. Distribution of Female Sexual Function Index (FSFI).

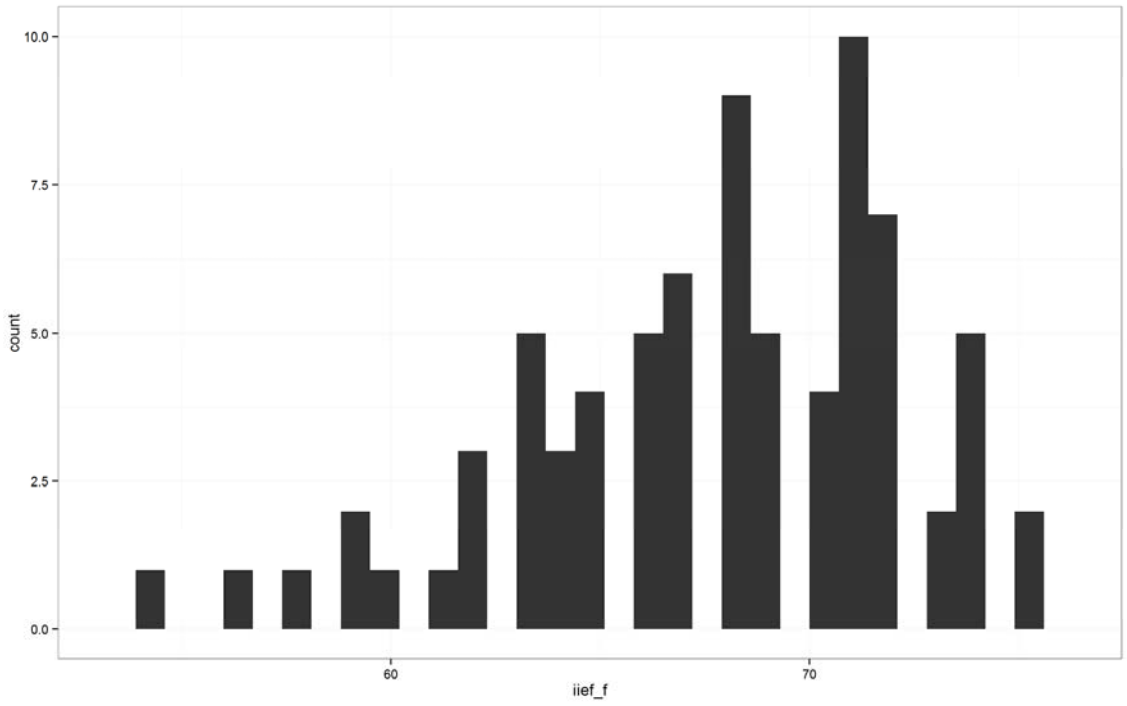

Figure 10. Distribution of International Index of Erectile Function (IIEF).

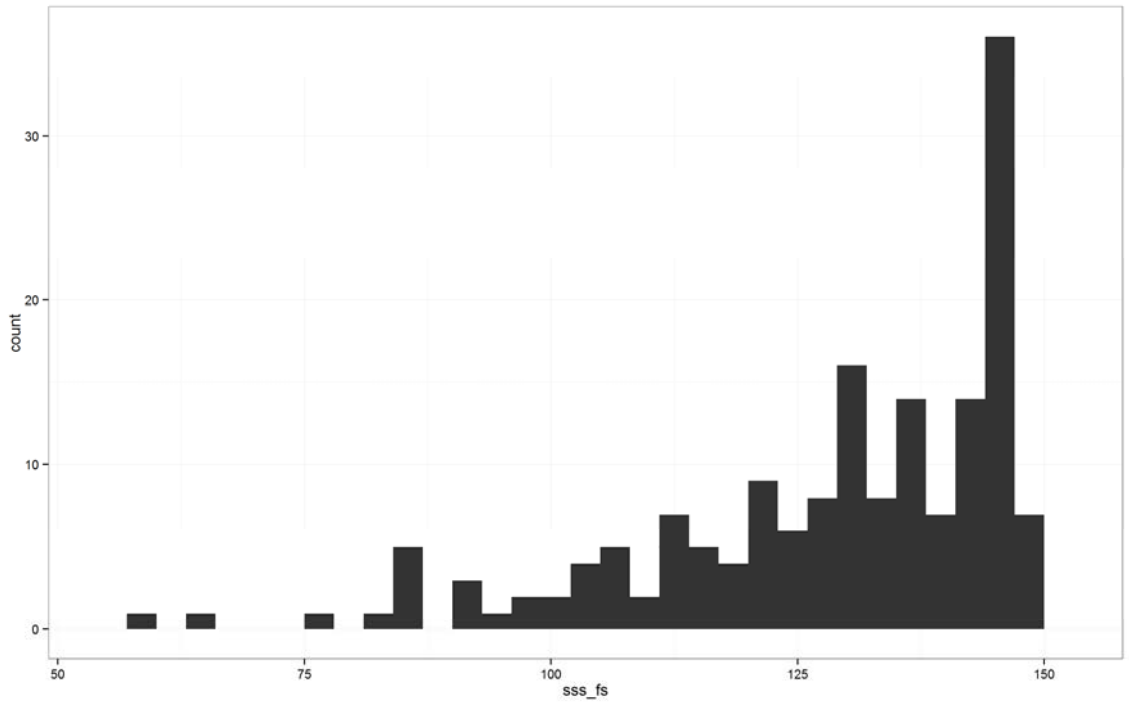

Figure 11. Distribution of Sexual Satisfaction Scale (SSS).

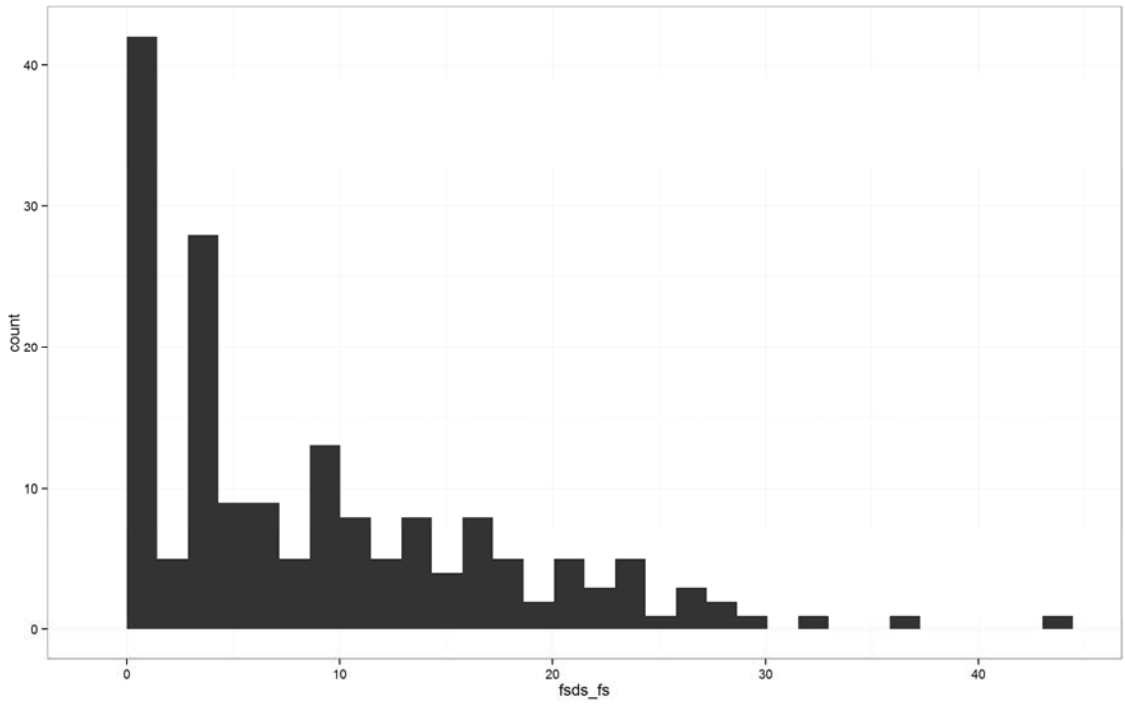

Figure 12. Distribution of the Female Sexual Distress Scale (FSDS).

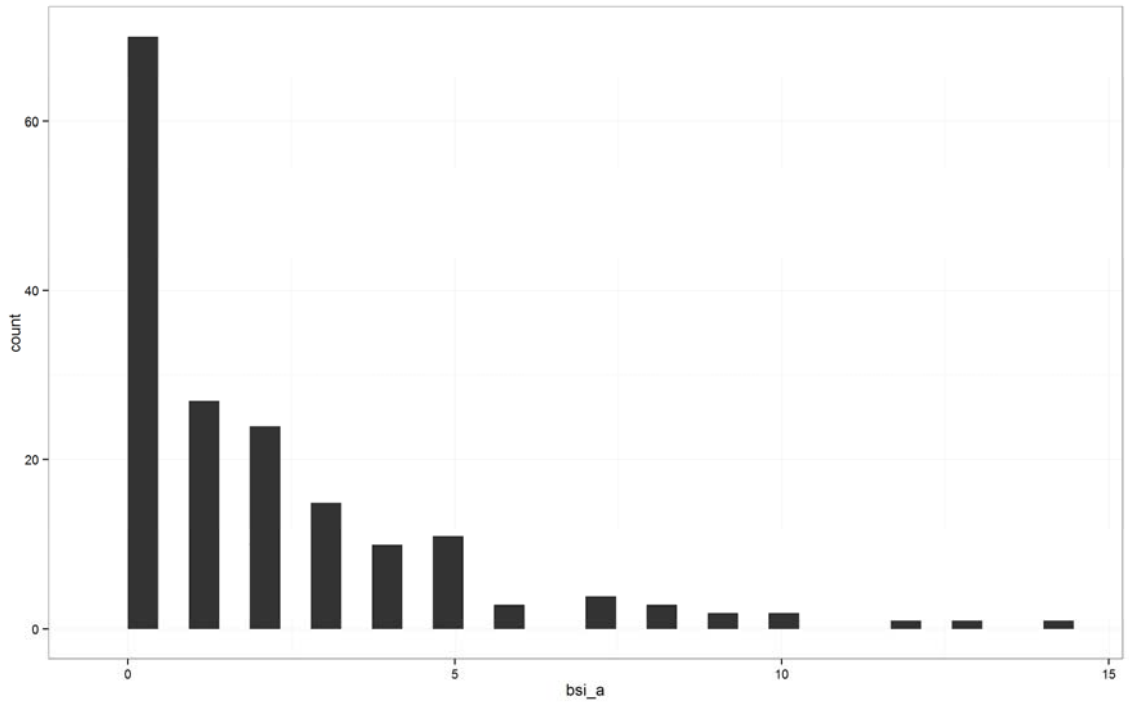

Figure 13. Distribution of the Brief Symptom Inventory 18 – Anxiety (BSI-A).

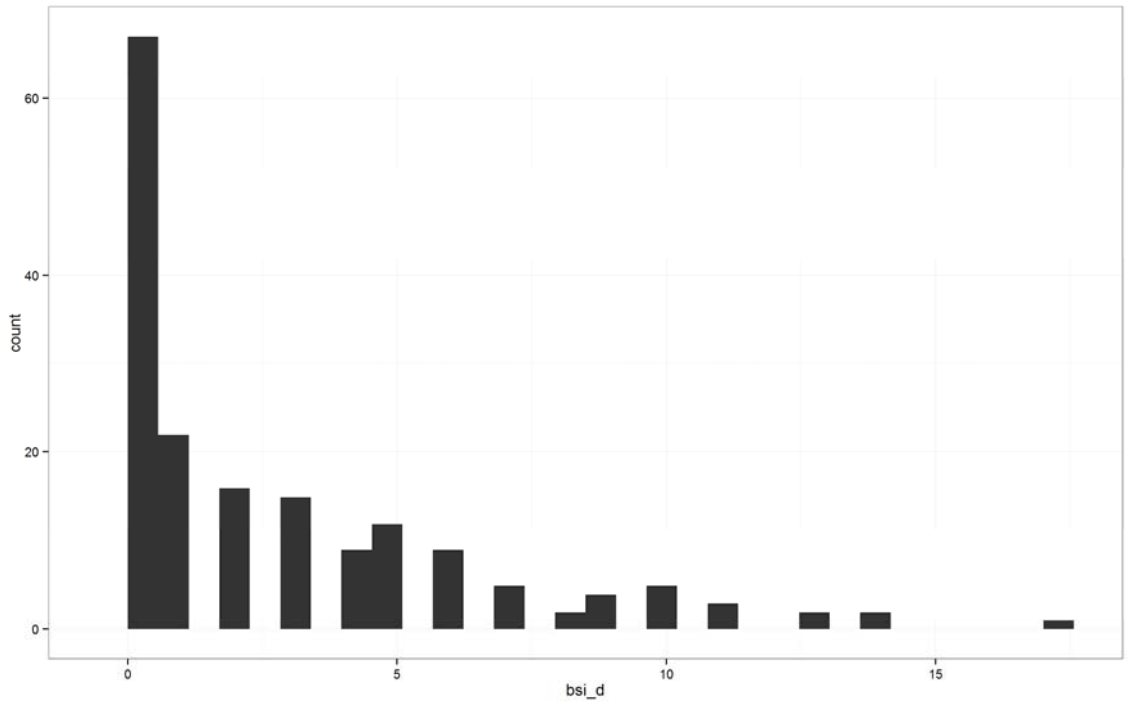

Figure 14. Distribution of the Brief Symptom Inventory 18 – Depression (BSI-D).

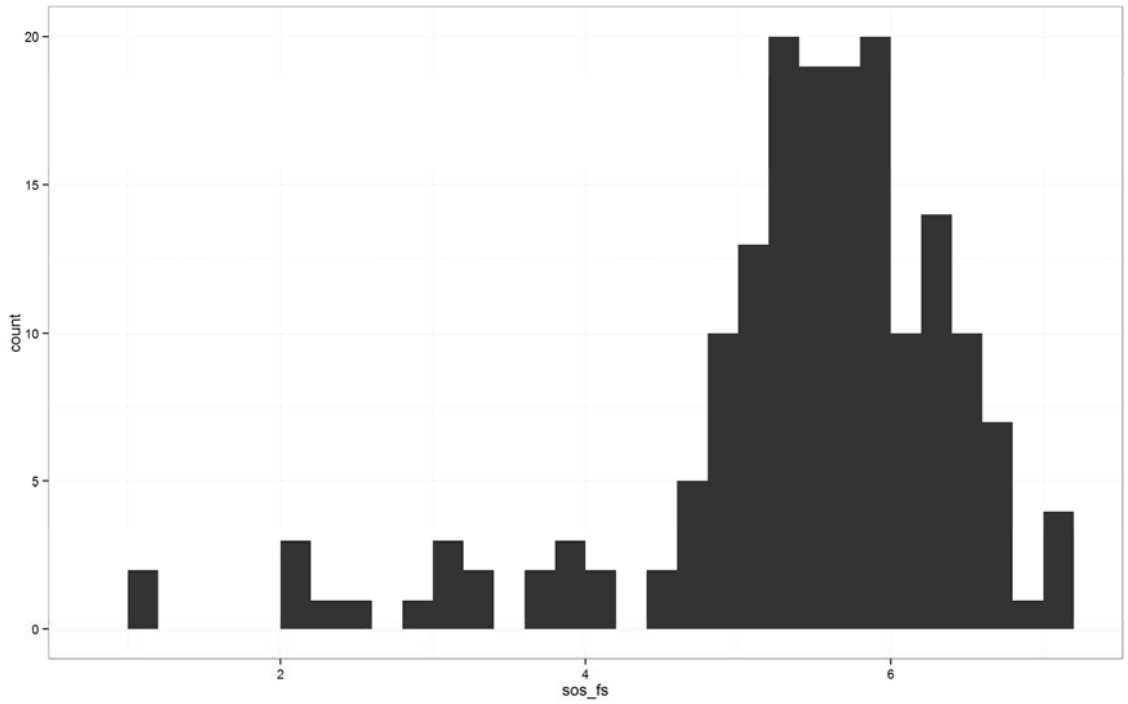

Figure 15. Distribution of the Sexual Opinion Survey (SOS).

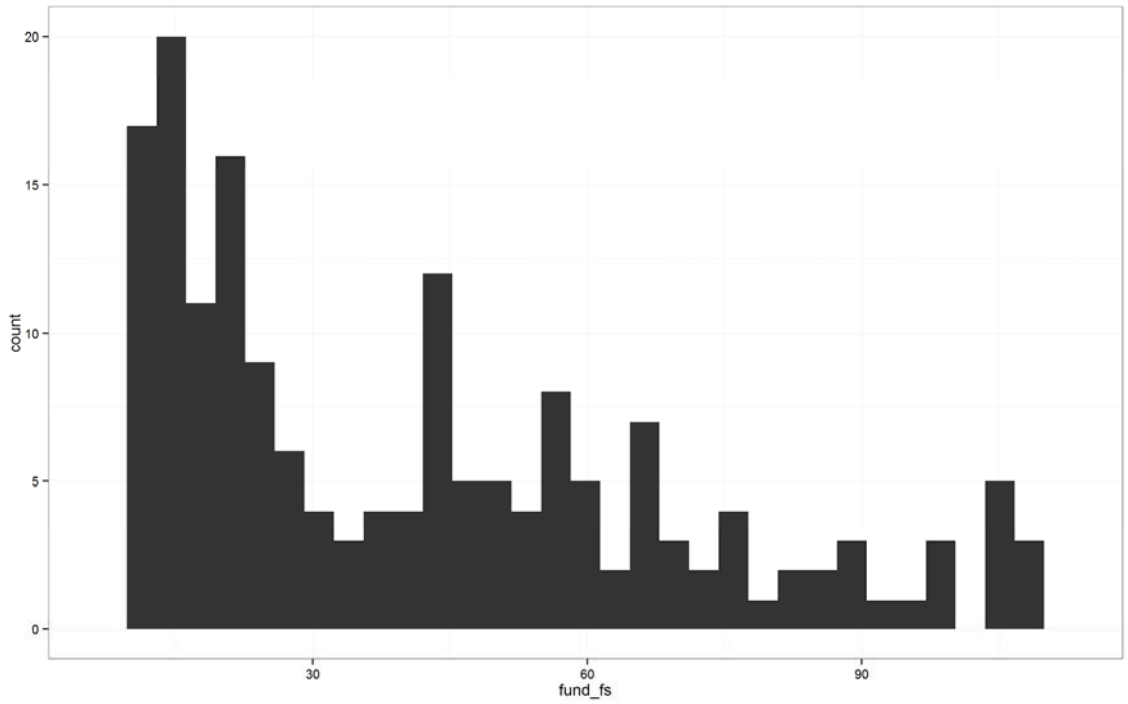

Figure 16. Distribution of Fundamentalism.

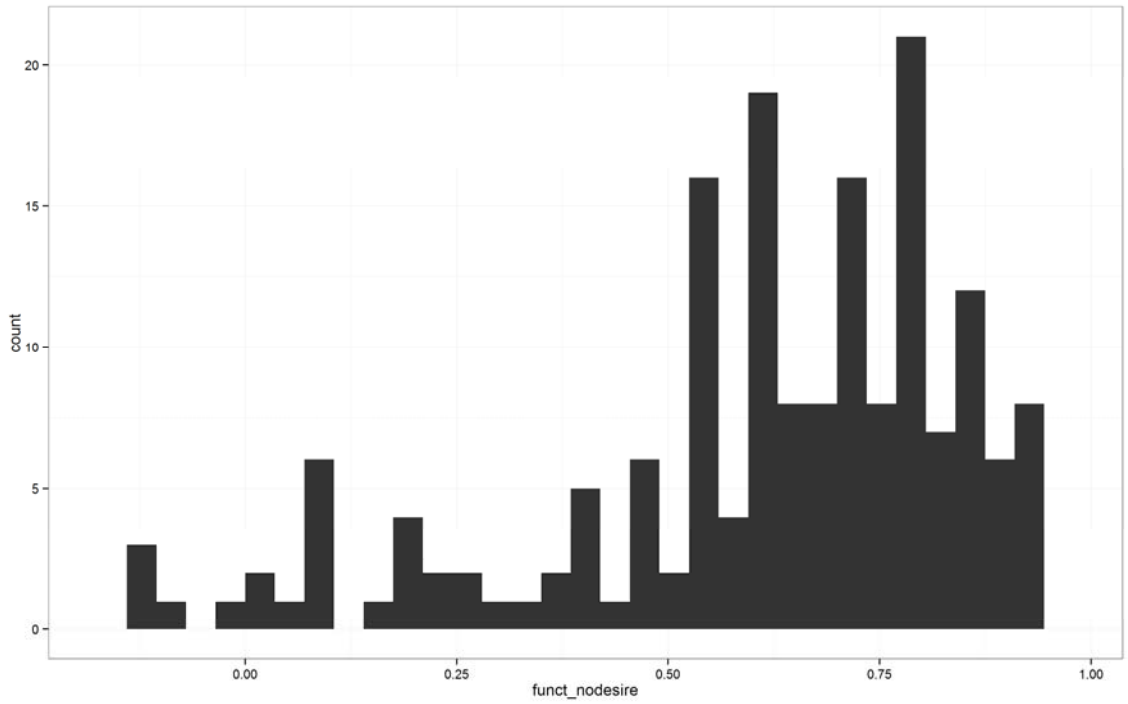

Figure 17. Distribution of sexual function without desire.

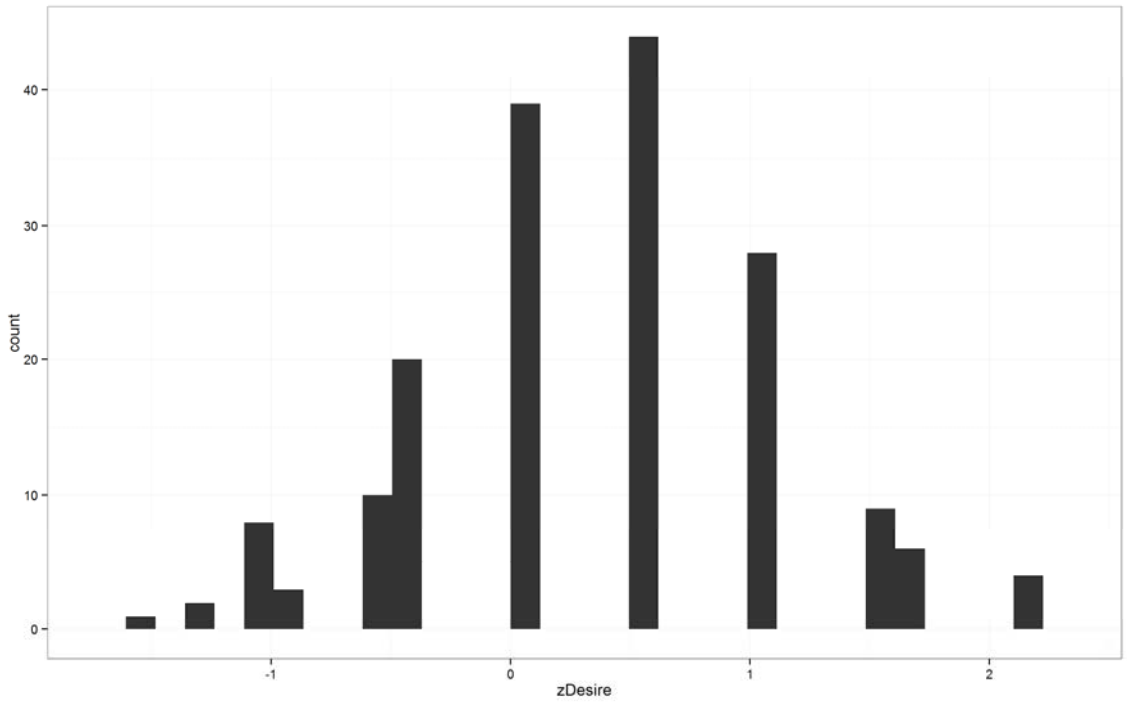

Figure 18. Distribution of FSFI/IIEF Desire (z-scored).

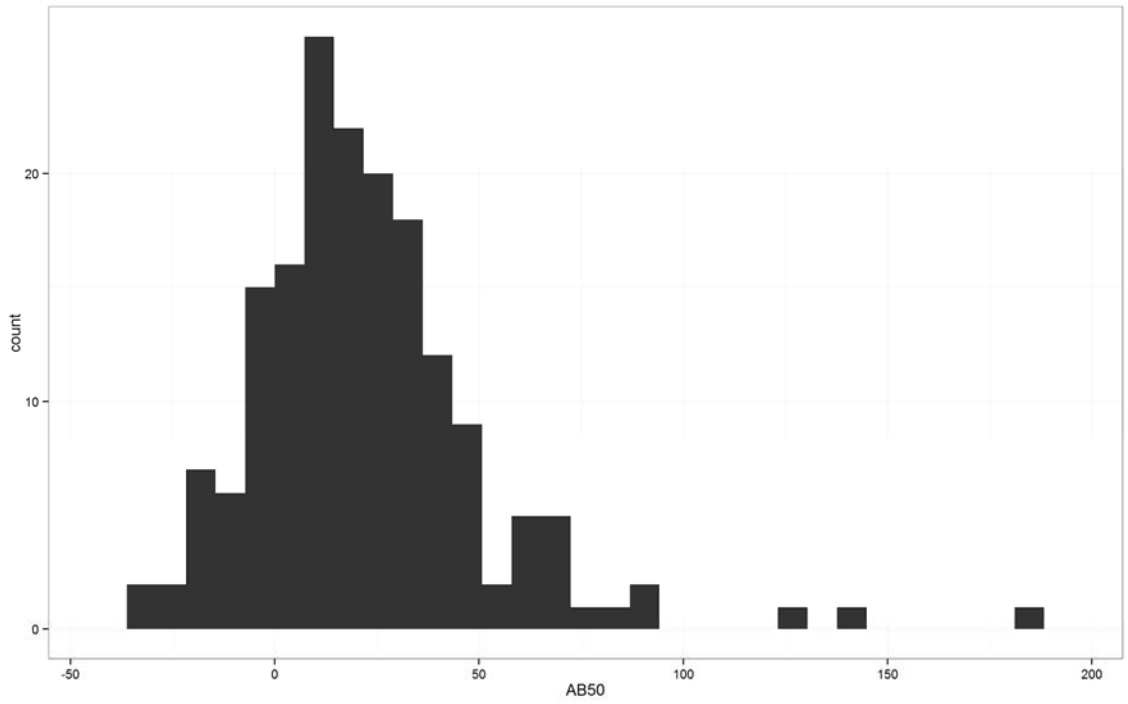

Figure 19. Distribution of attentional bias at 50ms (AB50).

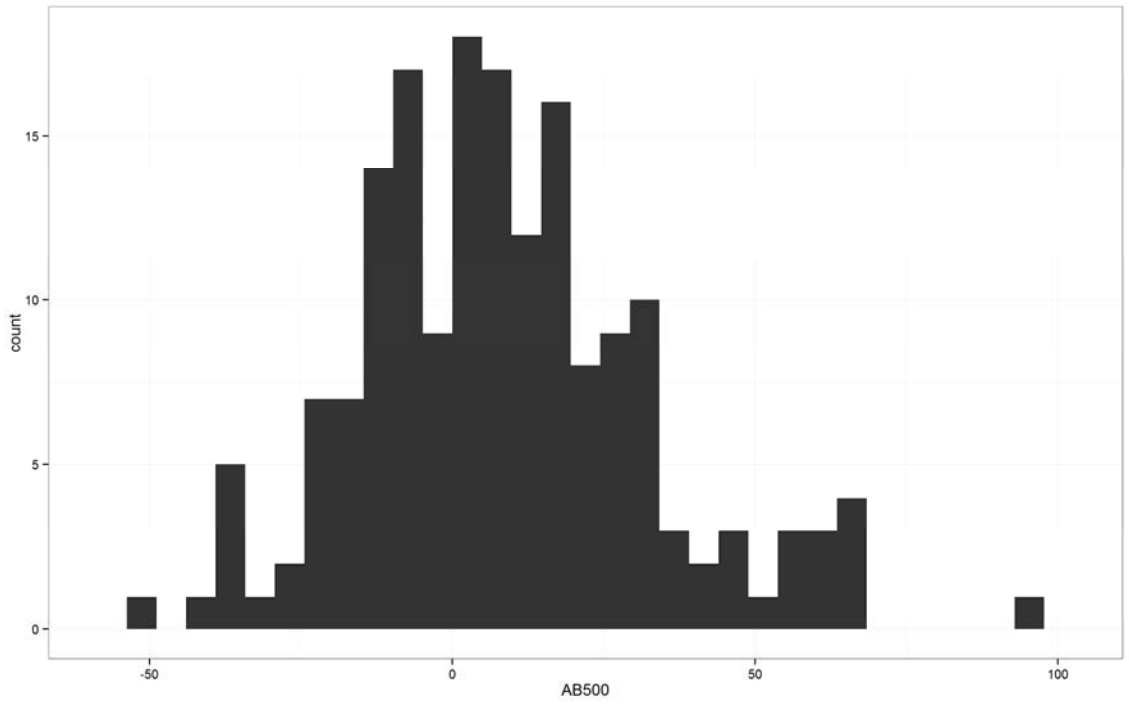

Figure 20. Distribution of attentional bias at 500ms (AB500).

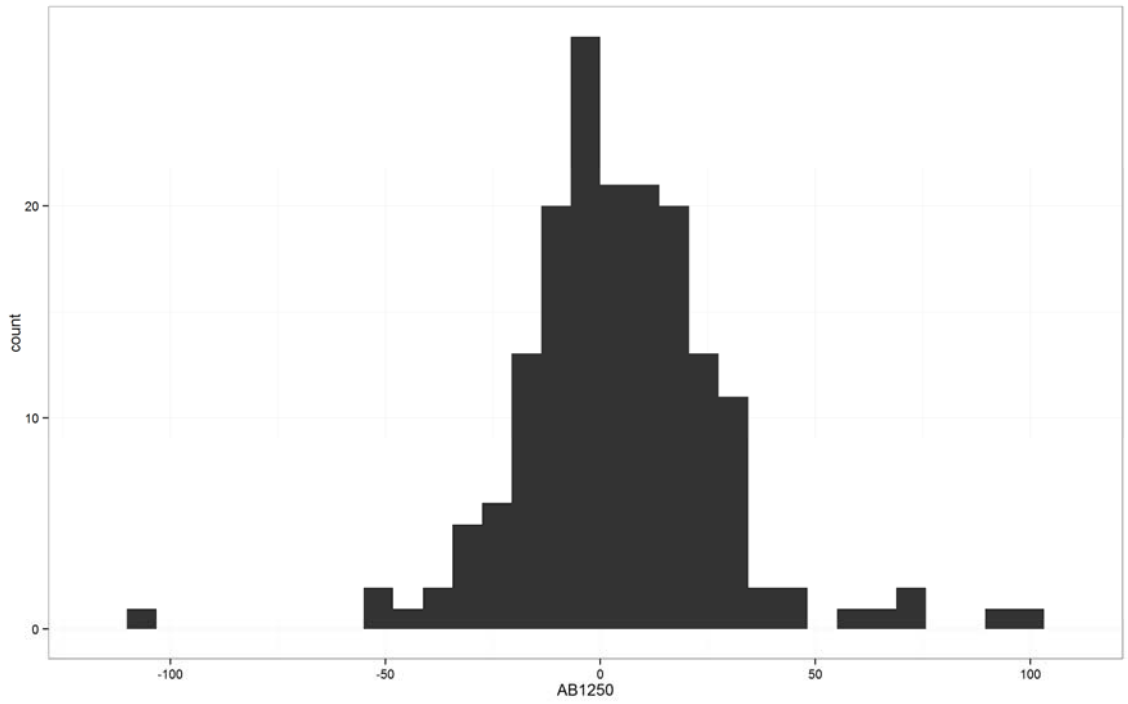

Figure 21. Distribution of attentional bias at 1,250ms (AB1250).

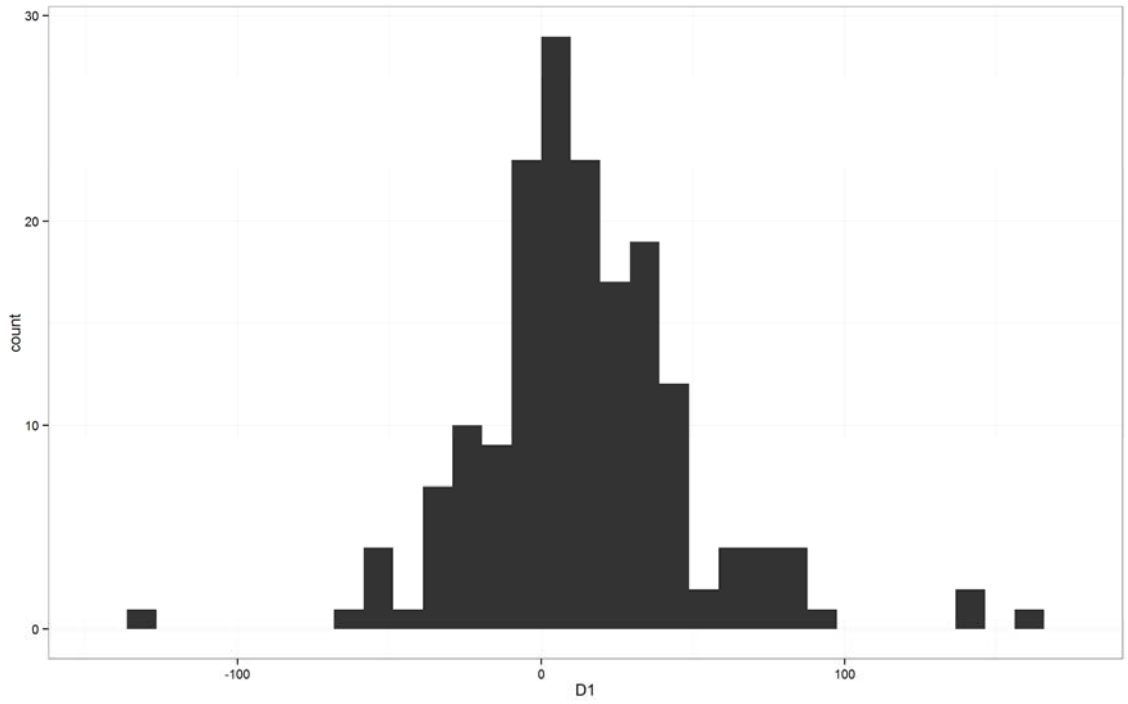

Figure 22. Distribution of the difference between AB50 and AB500 (D1).

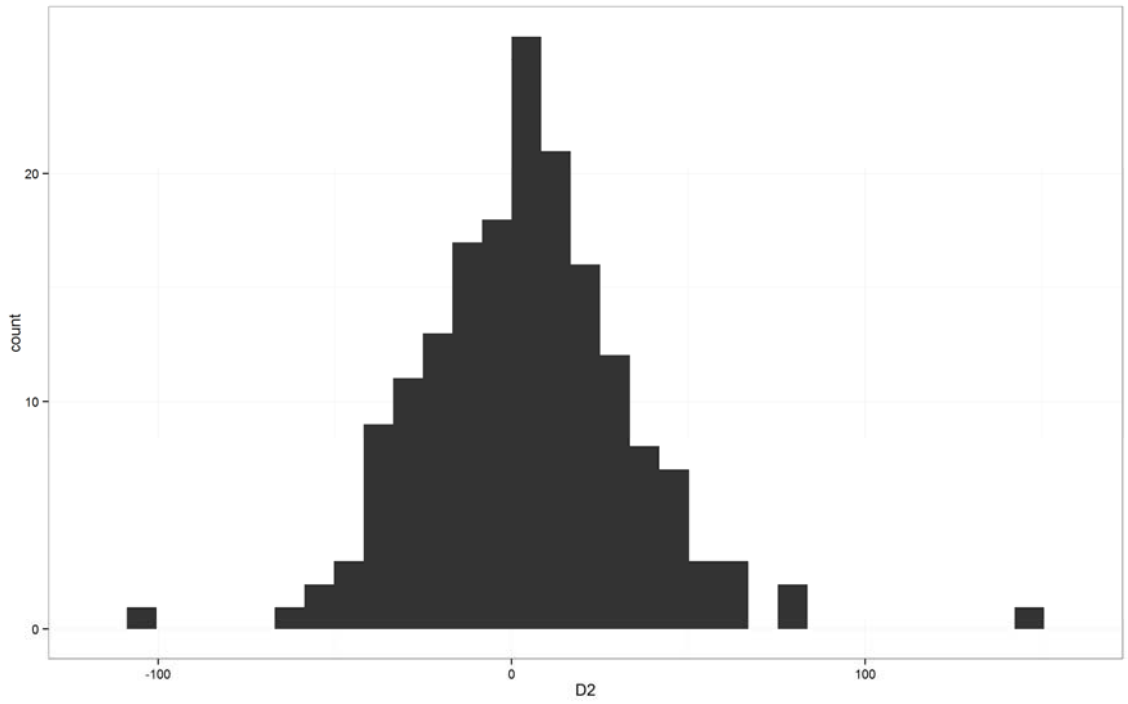

Figure 23. Distribution of the difference between AB500 and AB1250 (D2).

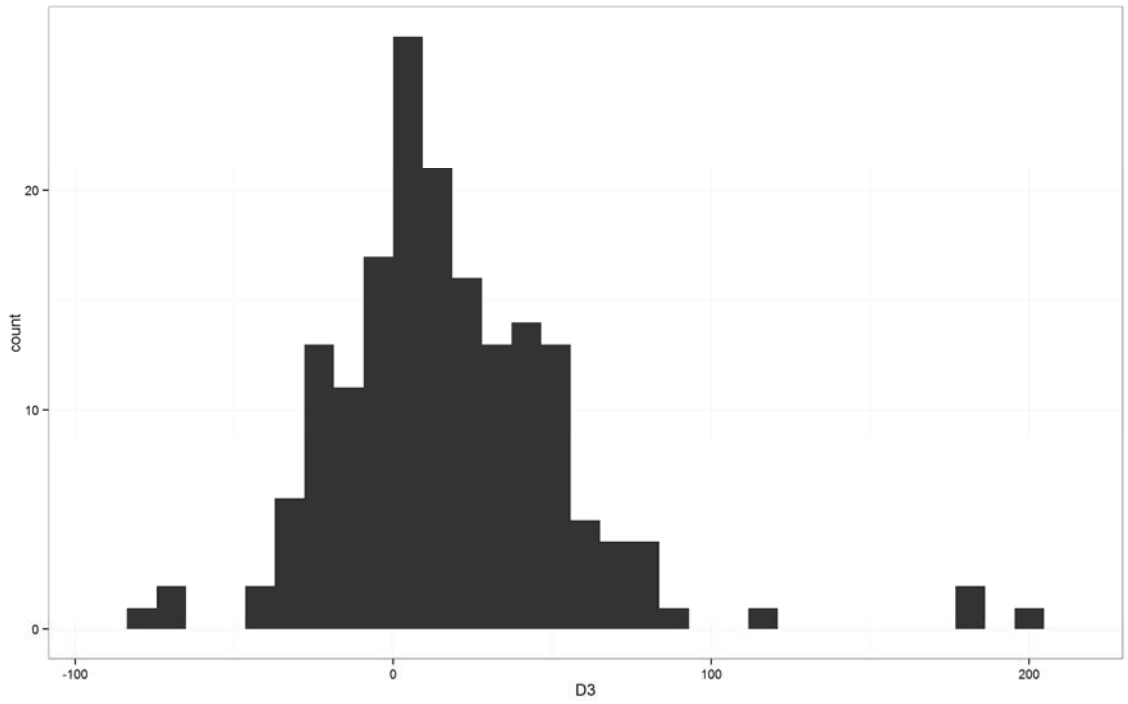

Figure 24. Distribution of the difference between AB50 and AB1250 (D3).

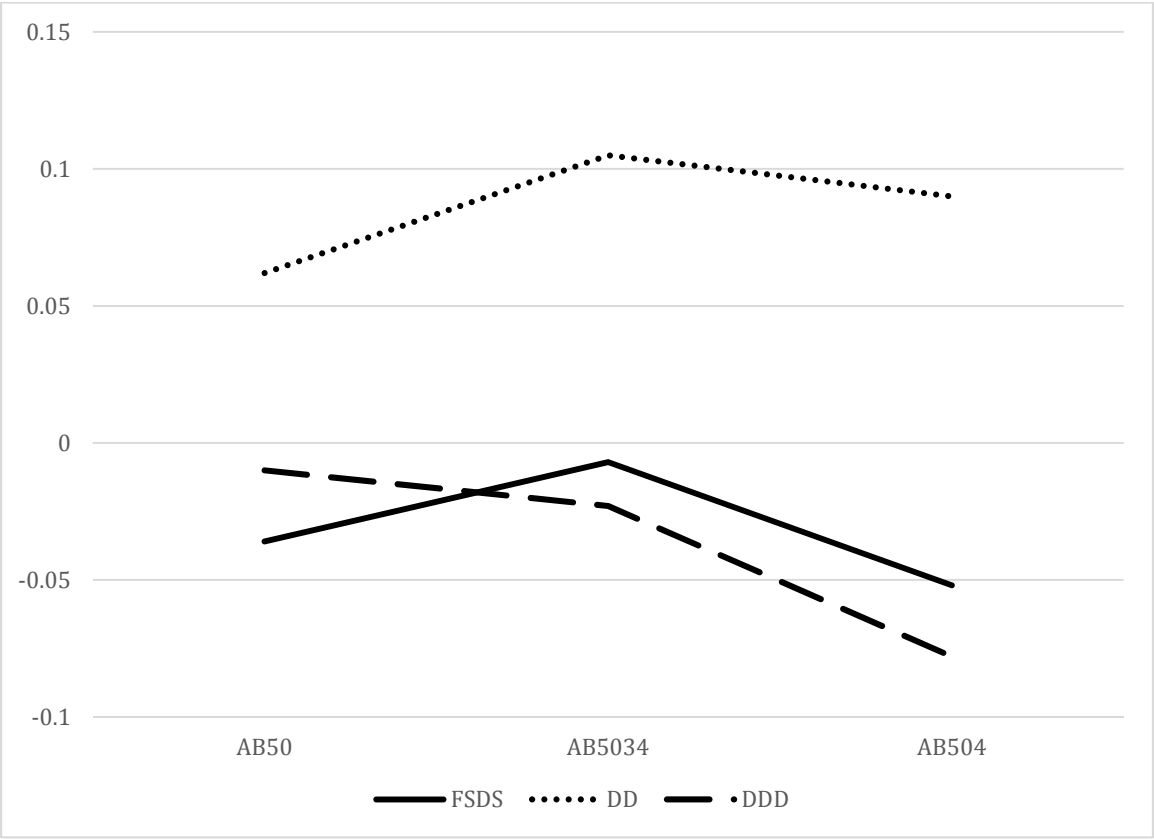

Figure 25. Differences in AB50 as calculated using all images (AB50), only images rated highly (AB5034), or very highly (AB504) erotic.

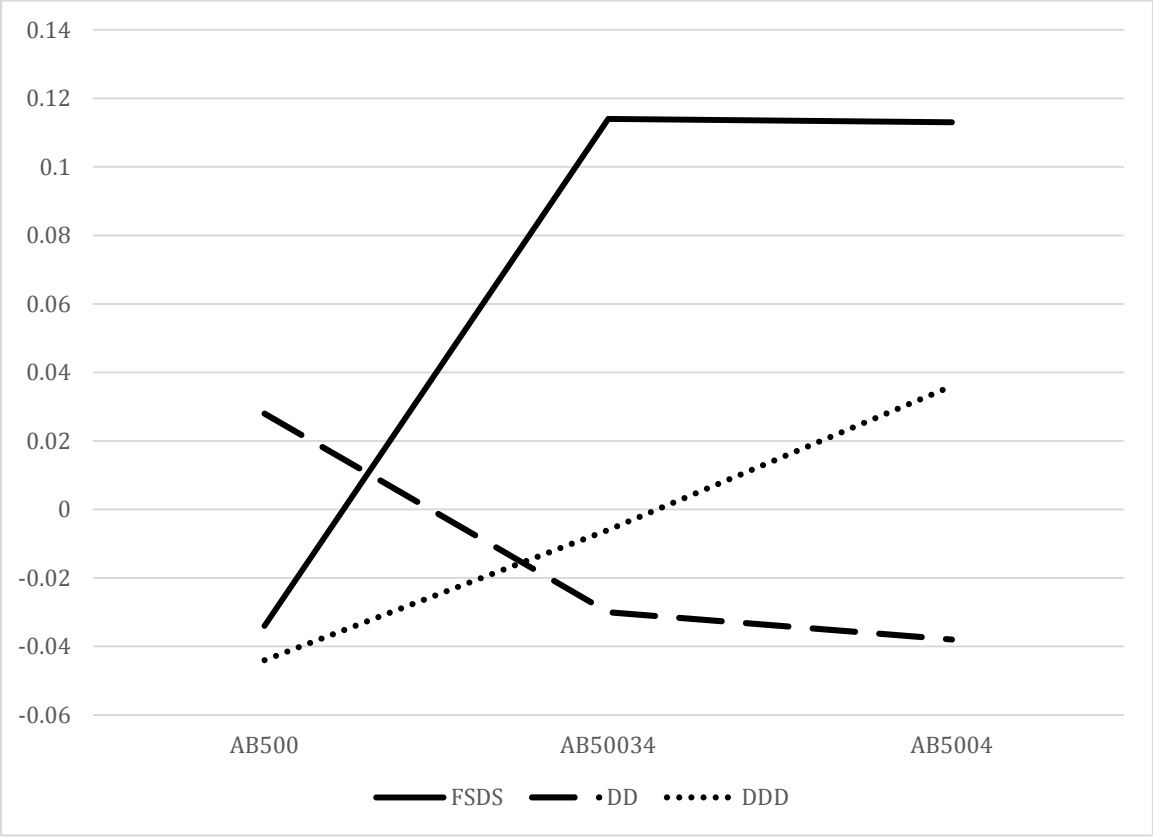

Figure 26. Differences in AB500 as calculated using all images (AB500), only images rated highly (AB50304), or very highly (AB5004) erotic.

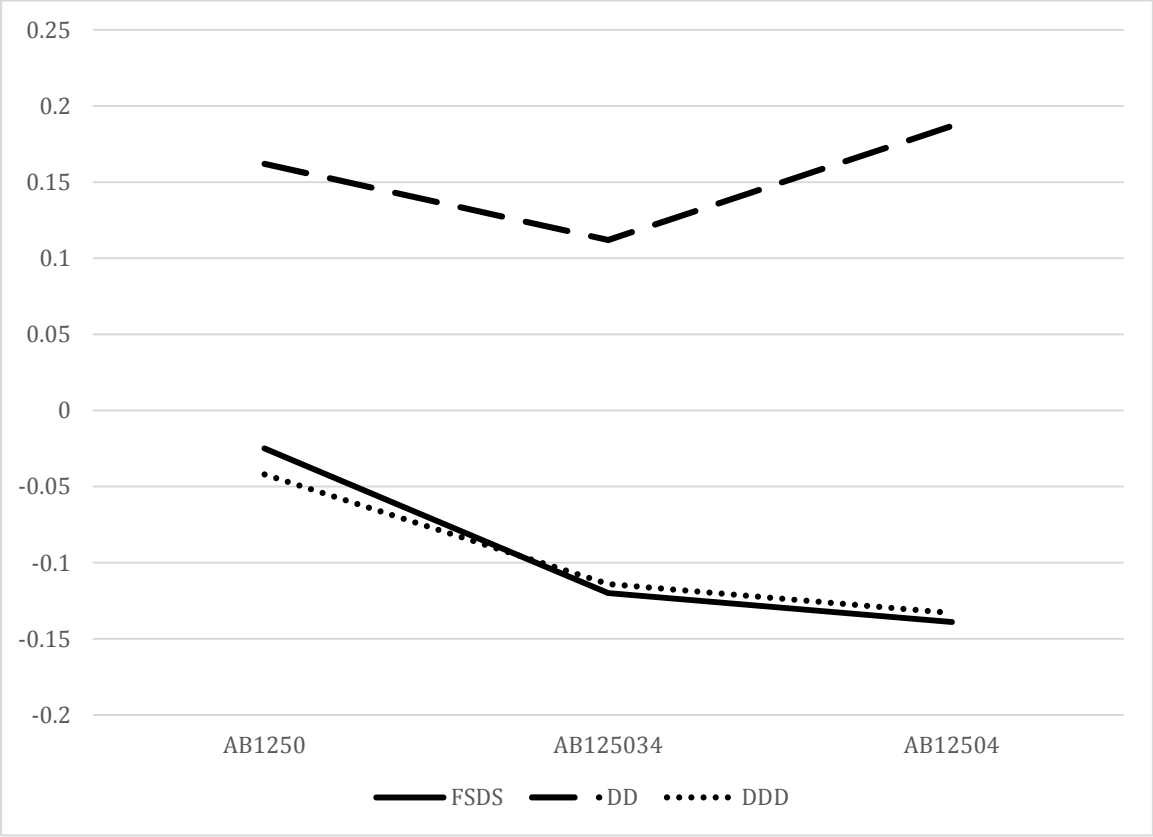

Figure 27. Differences in AB1250 as calculated using all images (AB1250), only images rated highly (AB125034), or very highly (AB12504) erotic.

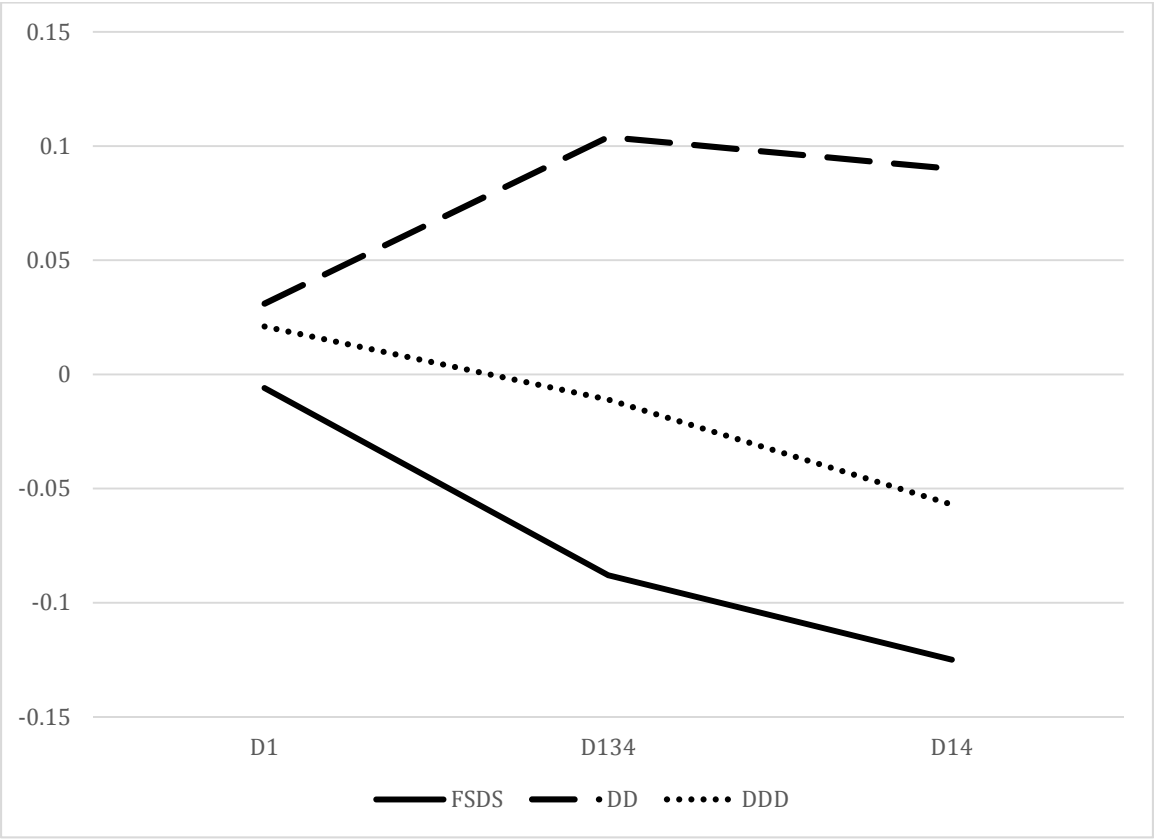

Figure 28. Differences in D1 (AB50 – AB500) as calculated using all images (D1), only images rated highly (D134), or very highly (D14) erotic.

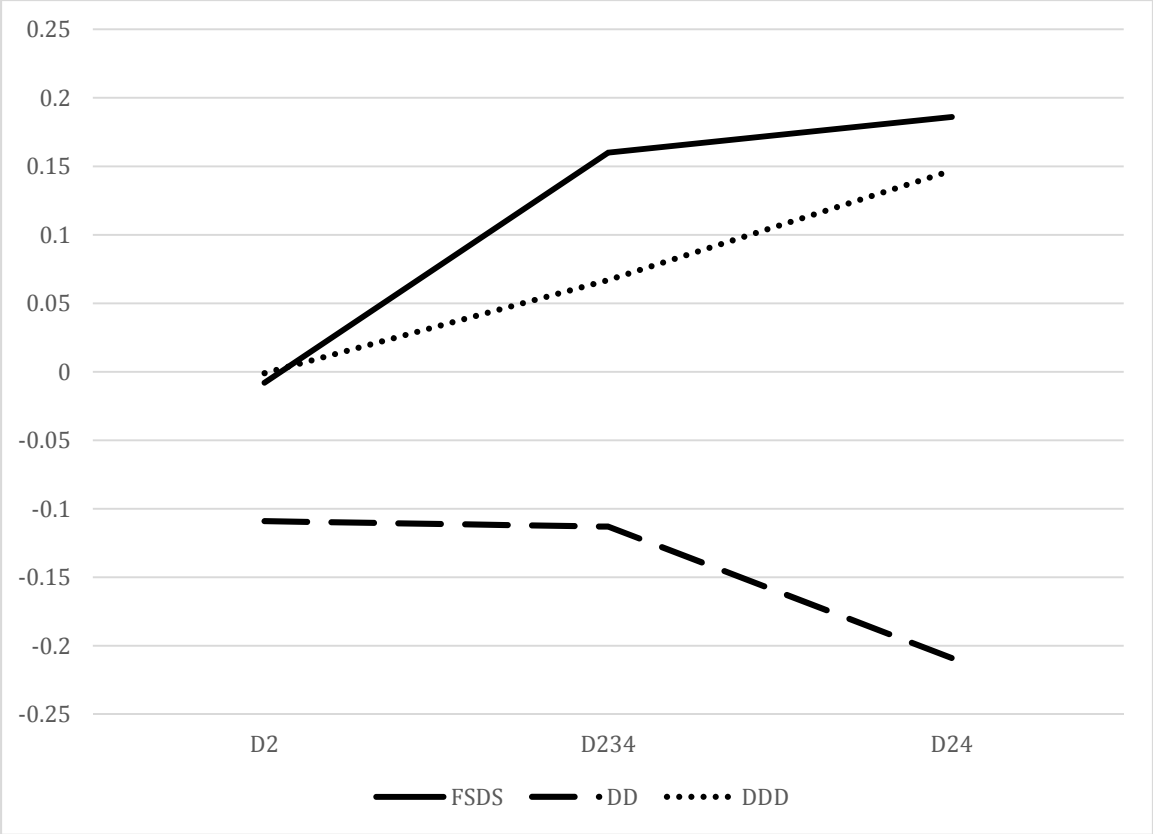

Figure 29. Differences in D2 (AB500 – AB1250) as calculated using all images (D2), only images rated highly (D234), or very highly (D24) erotic.

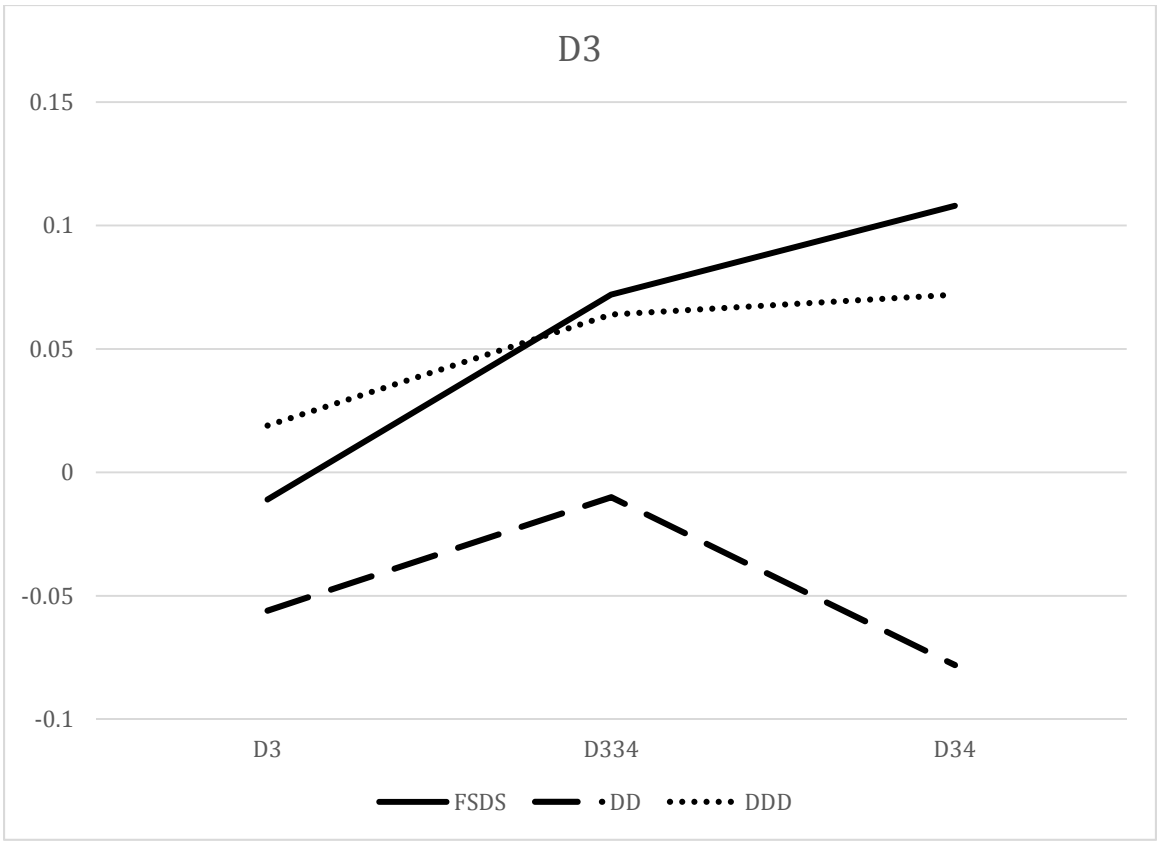

Figure 30. Differences in D3 (AB50 – AB1250) as calculated using all images (D3), only images rated highly (D334), or very highly (D34) erotic.

Endnotes

[i] Of particular note is that E. Janssen, et al (2000) found that penile engorgement actually decreased after a sexually explicit prime, but that, consistent with other research (Earls & Marshall, 1982; Kuban, 1997), penile circumference decreases while length increases during the first moments of erection.

[ii] Note that the system requirements of Inquisit Web are such that this criteria likely excluded less than one out of a thousand potential participants.

[iii] Cis, in this context, refers to people who were born with a physiology that is consistent with their current gender identification.

[iv] Which is consistent with findings about the relationship between age and fundamentalism and fundamentalism and erotophilia, although less intuitively sensible.

[v] Which is surely the subject for further research.

[vi] D3 is correlated with its component parts and with other difference scores that contain its component parts, but that reflects a mathematical relationship and not a theoretical one.

[vii] The IRAP is more commonly used to test implicit belief that a member of a category (e.g., adults or children) is consistent with a category (e.g., sexual or non-sexual) in the assessment of implicit sexual attraction to children (Dawson, Barnes-Holmes, Gresswell, Hart, & Gore, 2009), but it has more recently been used to test propositional statements, as in Lindgren, Neighbors, Westgate and Salemink (2014).

[viii] Results of Google Scholar search with search terms “Inquisit” and “Mechanical Turk” limiting search results to January, 2014 through April, 2015 and visually inspected to remove duplicates and obvious non-articles.