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Attentional and Affective Processing of Sexual Stimuli in Women with Hypoactive Sexual Desire Disorder

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Abstract Hypoactive sexual desire disorder (HSDD) is the most common sexual problem in women. From an incentive motivation perspective, HSDD may be the result of a weak association between sexual stimuli and rewarding experiences. As a consequence, these stimuli may either lose or fail to acquire a positive meaning, resulting in a limited number of incentives that have the capacity to elicit a sexual response. According to current information processing models of sexual arousal, sexual stimuli automatically activate meanings and if these are not predominantly positive, processes relevant to the activation of sexual arousal and desire may be interrupted. Premenopausal U.S. and Dutch women with acquired HSDD ($n = 42$) and a control group of sexually functional women ($n = 42$) completed a single target Implicit Association Task and a Picture Association Task assessing automatic affective associations with sexual stimuli and a dot detection task measuring attentional capture by sexual stimuli. Results showed that women with acquired HSDD displayed less positive (but not more negative) automatic associations with sexual stimuli than sexually functional women. The same pattern was found for self-reported affective sex-related associations. Participants were slower to detect targets in the dot detection task that replaced sexual images, irrespective of sexual function status. As such, the findings point to the relevance of affective processing of sexual stimuli in women with HSDD, and imply that the treatment of HSDD might benefit from a stronger emphasis on the strengthening of the association between sexual stimuli and positive meaning and sexual reward.

Keywords Attention · Automatic affective associations · Implicit measure · Hypoactive sexual desire disorder

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Introduction

Low sexual desire is believed to be the most commonly experienced sexual problem among women, with prevalence rates varying between 20 and 30% (Laumann, Paik, & Rosen, 1999; Laumann et al., 2005; Mercer et al., 2003; Simons & Carey, 2001). When low (or absent) sexual desire is persistent or recurrent and leads to distress or interpersonal problems, it may be diagnosed as hypoactive sexual desire disorder (HSDD; American Psychiatric Association, 2000). Most clinicians make a distinction between two main subtypes of HSDD: Acquired and lifelong. Lifelong HSDD involves women who never have experienced sexual desire. Acquired HSDD involves those who once did experience sexual desire. The present investigation focuses on acquired HSDD. There are currently no empirically validated treatments for women suffering from HSDD (Ter Kuile, Both, & van Lankveld, in press). The lack of a generally accepted theoretical framework for how to best conceptualize sexual desire together with a complex, not well-understood, interplay of factors that may facilitate or disrupt women's desire for sexual activity is likely to have limited the development of more effective interventions for HSDD.

Incentive motivation models provide a useful framework for the conceptualization of sexual desire. According to such models, sexual arousal and desire result from the interaction between

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sexually meaningful stimuli (i.e., incentives) and a responsive sexual response system (e.g., Agmo, 1999; Both, Everaerd, & Laan, 2007; Singer & Toates, 1987; Toates, 2009, cf. Levine, 2003). Processing of an actual or imagined sexual stimulus is hypothesized to automatically result in changes in the brain and periphery (e.g., genital vasocongestion) that prepare the individual for sexual action, and this activation may be defined as sexual arousal. The awareness of motor preparation, possibly in conjunction with expectations about possible rewards, may be conceptualized as sexual desire (Both et al., 2007; Everaerd & Both, 2001; Laan & Both, 2008). In support of this view, studies have found high correlations between (problems of) desire and arousal (e.g., Rosen et al., 2000; Sanders, Graham, & Milhausen; 2008; Segraves & Segraves, 1991). Thus, in terms of incentive motivation models, there is no such thing as "spontaneous" desire—although one may not be consciously aware of the cues that resulted in sexual desire, and, therefore, experience it as coming about spontaneously (e.g., Both et al., 2007). Indeed, growing evidence suggest that sexual desire is primarily responsive (e.g., Both, Everaerd, & Laan, 2003; Bancroft, Loftus, & Long, 2003; Cain, Johannes, & Avis, 2003; Carvalheira, Brotto, & Leal, 2010; Everaerd & Laan, 1995; Laan & Everaerd, 1995; Laan, Everaerd, van der Velde & Geer, 1995; McCall & Meston, 2006).

Although some stimuli may generate sexual responses and sexual desire more reflexively—such as touching the genitals—it is hypothesized that most stimuli become incentives via learning: when a stimulus has once or repeatedly led to a rewarding sexual experience, such a stimulus is likely to acquire a positive sexual meaning, especially if the rewarding sexual experience involves orgasm (e.g., Both et al., 2008; Both, Laan, & Schultz, 2010; Everaerd & Both, 2001; Laan & Everaerd, 1995; Rosen & Beck, 1988; Toates, 2009). The quantity and quality of incentives that have the ability to activate the sexual system depend on an individual's sexual history (e.g., sexual experiences with partners or with masturbation, sexual memories), and can be expected to differ from one person to another. In incentive-motivation terms, hypoactive sexual desire might be caused by a weak association between stimuli and sexually rewarding experiences (e.g., due to absence of expected reward, through negative experiences or both). As a consequence, potentially sexually meaningful stimuli will fail to acquire a positive meaning, or will lose it, resulting in a limited or decreased number of incentives that have the capacity to elicit sexual responses (Both et al., 2007, 2008).

In support of this view, research has shown that women with HSDD, as compared to women without sexual problems, experience fewer cues for sexual desire (McCall & Meston, 2006, 2007), and experience—similar to women with other sexual dysfunctions—less sexual desire, arousal, and fewer positive feelings when presented with sexual stimuli (e.g., sexual images) (e.g., Arnow et al., 2009; Conaglen, 2004; Conaglen & Evans, 2006; Vardi et al., 2009). Other studies have found that in individuals with sexual dysfunctions, including women with HSDD, sexual (unsuccessful) situations and activities seem to trigger negative thoughts rather than lustful, erotic thoughts (e.g., Nobre & Pinto-Gouveia, 2009; cf. Barlow, 1986) and are associated with diminished pleasure (Trudel, Aubin, & Matte, 1995).

Together, these findings illustrate that women with HSDD seem to differ from women without sexual problems in the way they evaluate or appraise sexual stimuli, at least on a conscious, or explicit, level, and as established using self-reports. Because the meaning of sexual stimuli is considered crucial to the experience of sexual arousal and desire (e.g., Laan & Everaerd, 1995; Rosen & Beck, 1988), it is important to gain a better understanding of the cognitive-emotional processing of sexual stimuli in women suffering from this condition.

According to the information processing model of sexual arousal proposed by Janssen, Everaerd, Spiering, and Janssen (2000), both automatic, or unconscious, processes as well as more deliberate, or conscious, processes are involved in the activation of sexual arousal and desire.[1] That is, when a stimulus is encountered, it is first appraised as sexual or nonsexual and response generation (i.e., physiological changes in the brain and the body that prepare for sexual action, such as genital vasocongestion) takes place when it matches sexual meanings in memory. This process is thought to rely mainly on automatic or unconscious processes. In addition, the automatic activation of positive meanings will increase attentional focus to the sexual content of the stimulus or situation, which subsequently will result in higher arousal. It is hypothesized that when this activational process exceeds the perceptual threshold, sexual arousal is experienced consciously. Thus, the awareness of physiological responding to sexual stimuli, along with a positive appraisal of these stimuli, may eventually result in the occurrence of full-blown genital responses and the subjective experience of sexual arousal and desire. Sexually dysfunctional individuals, in contrast, are thought to appraise sexual cues less positively or even negatively and, subsequently, more likely to attend to contextual issues that are non-erotic, including possible reminders of previously experienced negative consequences of being engaged in a sexual activity. Fewer attentional resources will then be available for the processing of sexually arousing stimuli. This distraction from sexually arousing stimuli might subsequently result in lack of sexual arousal and feelings of sexual desire (Barlow, 1986; Janssen et al., 2000; Laan & Janssen, 2007; Sbrocco & Barlow, 1996). Thus, in sum, the information processing model claims that both attentional and affective processes are involved in the cognitive-emotional processing of sexual stimuli.

Recently, Prause, Janssen, and Hetrick (2008) investigated to what extent attention to, and appraisal of, sexual stimuli predicted individuals' levels of sexual desire in a nonclinical sample of women, who varied in their levels of desire as assessed by the Sexual Desire Inventory (Spector, Carey, & Steinberg, 1996).

[1] Automatic cognitive processes refer to fast and unintentional responses, whereas deliberate (or controlled) cognitive processes refer to responses that are under intentional control (cf. Moors & De Houwer, 2006).

Women with high levels of sexual desire differed from women with low levels of desire in the amount of attention captured by sexual stimuli (as assessed with a dot detection task; Mathews & MacLeod, 2002), but did not differ in affective responses to sexual stimuli (as assessed with a startle eyeblink modulation task; Lang, Bradley, & Cuthbert, 1992). These findings suggest that, at least in nonclinical samples, attentional processes may be more relevant than affective processes to a person's desire level. However, as women with HSDD have been found to appraise sexual stimuli less positively than women without sexual complaints (e.g., Arnow et al., 2009; Conaglen, 2004; Conaglen & Evans, 2006; Vardi et al., 2009), the relative importance of attentional versus affective processes in women with sexual desire problems remains to be examined. Consistent with this, the aim of the present study was to assess initial affective responses along with attention capture in women with versus without HSDD.

So far, research into the affective processing of sexual information in women with and without HSDD has largely relied on the use of explicit measures, including questionnaires, which fail to tap into more automatic, or involuntary, affective responses to sexual stimuli. It has been argued that automatic affective associations may be best predicted by indirect, or implicit measures, whereas more conscious experiences may be best predicted by direct, self-report measures (e.g., Egloff & Schmuckle, 2002; Huijding & de Jong, 2006). That is, self-report measures provide the opportunity to reflect on one's response, while measures of automatic associations leave little opportunity for conscious reflection on a response (e.g., because participants are urged to respond as fast as possible to stimuli that are presented in rapid succession). Participants' responses on implicit measures will therefore primarily reflect automatically activated associations.[2]

In the present study, automatic affective associations with sexual stimuli were assessed using two implicit tasks: a single target Implicit Association Task (ST-IAT; Bluemke & Friese, 2008; De Liver, Wigboldus, & van der Pligt, 2007; Dotsch & Wigboldus, 2008; Karpinski, & Steinman, 2006; Wigboldus, Holland, & van Knippenberg, 2004) and a Picture Association Task (PAT; van Leeuwen & Macrae, 2004; van Leeuwen et al., 2009). Both the ST-IAT and the PAT are reaction time paradigms that have been used in other domains. The versions of the two tasks used here measure to what extent sexual stimuli (i.e., pictures of heterosexual sexual acts) are automatically associated with positive or negative stimuli (i.e., words with a positive or negative meaning) by instructing participants to categorize the stimuli as quickly as possible. The time to select the correct response to the stimuli is influenced by the match between the valence of the positive or negative stimuli and the valence of the sexual stimuli, thereby revealing indirectly the valence of the sexual stimulus for the participant. If reaction times (RTs) are shorter when positive stimuli are paired with sexual stimuli than when negative stimuli are paired with sexual stimuli, this can be interpreted to mean that there is a relatively strong automatic positive association with sex. Because of differences in methodology between the ST-IAT and the PAT, the combined use of these two measures may provide complementary data regarding automatic sex-related associations in women with acquired HSDD.

To investigate the level of attention to sexual stimuli in women with and without HSDD, we used a dot detection task similar to the one used by Prause et al. (2008). In a typical dot detection task, two stimuli are presented simultaneously, one from a category of stimuli of interest and another from an emotionally neutral category. Immediately after these stimuli disappear, a dot appears where one of the two stimuli was located. Participants are instructed to indicate as quickly as possible the location of the dot probe on each trial. Faster reaction times have usually been explained in terms of an attentional bias for, or failure to disengage from (Yiend & Mathews, 2001), threatening and/or unpleasant stimuli. However, attentional biases in the opposite direction (i.e., prolongation of RTs) have also been documented in cases where the target stimuli were pleasant (e.g., food stimuli) to participants (e.g., Johansson, Ghaderi, & Andersson, 2004). Thus, consistent with one of the interpretations offered by Prause et al. (2008), longer reaction times in the group of women with high levels of desire may have been the result of increased attentional engagement or absorption in this group (cf. Tellegen & Atkinson, 1974). The finding that women with high sexual desire levels seemed to pay more attention to sexual stimuli concurs with information processing models of sexual arousal (e.g., Barlow, 1986; Janssen et al., 2000), which propose that the more attention a person allocates to sexual stimuli, the more easily one will reach higher levels of sexual arousal.

Our hypotheses were as follows: With respect to attentional capture by sexual stimuli, we expected that, similar to Prause et al. (2008), women without HSDD would take longer than women with HSDD to locate dots that replace sexual images. With respect to affective responses to sexual stimuli, we hypothesized that women with acquired HSDD may previously been able to appraise sexual stimuli positively given that they once responded with sexual desire to sexual cues. However, along with a supposed decline in rewarding sexual experiences, the strength of positive automatic and deliberate sex-related associations might have been weakened. Based on this reasoning, women with HSDD were expected to respond slower to positive stimuli paired with sexual stimuli than women without sexual complaints in both implicit tasks. Further, we hypothesized that both groups of women would be slower to respond to negative stimuli paired with sexual stimuli than to positive stimuli paired with sexual stimuli. Consistent

[2] Note that the constructs measured by implicit measure are not necessarily unconscious constructs. Participants may be unaware what the test measures, but that does not imply that they are also unaware of their evaluations (Fazio & Olson, 2003). Hence, in the present context, the term automatic is not equivalent to the term unconscious, but rather means that an implicit measure leaves insufficient time for participants to purposefully control their response.

with prior research (e.g., Arnow et al., 2009; Conaglen, 2004; Conaglen & Evans, 2006; Vardi et al., 2009), self-report (or explicit) ratings of sexual stimuli were also hypothesized to be less positive in HSDD women, compared to sexually functional women.

Method

Participants

The study was conducted in two research centers, one in the United States (U.S.) and one in The Netherlands (NL). A total of 20 SF women and 20 HSDD women participated in the study at the U.S. site, whereas these numbers were 22 and 22, respectively, for the NL site. At both sites, women were recruited through newspaper advertisements, listservs, and university announcements. Readers were informed that the study's purpose was to compare different methods to assess sexual desire in women with and without complaints of lack of sexual desire. Potential participants were initially screened by telephone for diagnostic criteria of acquired HSDD, inclusion/exclusion study criteria, and relevant medical history. Study purposes and procedures were also explained. Apart from the implicit tasks presented here, questionnaires, psychophysiological measures, and behavioral indicators were used in this research project to study differences between women with acquired HSDD and sexually functional women. The outcomes on the other measures will be presented in separate reports.

All participants were required to meet the following criteria: (1) aged 18–45 years; (2) premenopausal status; (3) self-identify as heterosexual or bisexual; (4) in a relationship for at least one year; (5) using a reliable form of contraception; (6) in good health; (7) native Dutch or English speaking, depending on site. Inclusion criteria for the women with HSDD were: (1) meeting the criteria for HSDD acquired subtype according to the DSM-IV-TR (American Psychiatric Association, 2000) as modified at the International Consensus Development Conference on Female Sexual Dysfunction (Basson et al., 2004[3]); (2) decreased sexual desire for at least 6 months; (3) HSDD being the primary sexual problem; (4) a score between 5 and 16 on the desire domain of the Abbreviated Sexual Function Questionnaire (ASFQ; Williams, Abraham, & Symonds, 2010); (5) personal sexually related distress as indicated by a score >11 on the Female Sexual Distress Scale-Revised (FSDS-R; Derogatis, Clayton, Lewis-D'Agostino, Wunderlich, & Fu, 2008). Sexually functional (SF) women were included if they met the following criteria: (1) not having sexual desire problems or any other sexual dysfunctions in the past year; (2) being sexually active.

Exclusion criteria for both groups of women were: (1) illness or disease interfering with sexual functioning, including diabetes, cancer in the last five years, active depression; (2) using medications that might affect sexual functioning, including antidepressants and cyproteroneacetate containing oral contraceptives; (3) having a partner with medical or sexual problems that make it impossible for the couple to be sexually active; (4) breastfeeding or being pregnant or the intent to become pregnant during the study; (5) a total score ≥20 on the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996); (6) having undergone a hysterectomy with oophorectomy; (7) a history of vaginal procedures, including colposuspension and TVT application (tension free vaginal tape), that might interfere with vaginal vascularization and/or innervation of vaginal tissue. Additional exclusion criteria for women with HSDD were: (1) sexual pain problems; (2) lifelong low sexual desire.

Following the telephone screening, participants underwent subsequent testing at the outpatient sexology clinic of the Academic Medical Center in the Netherlands or at the Bloomington or Indianapolis campuses of Indiana University in the U.S. where they were examined to determine further suitability for the study. Screening consisted of a semi-structured sexual function interview by a psychologist and a standard medical screening performed by a research nurse. During medical screening, pregnancy tests were taken and blood samples to estimate hormone levels. Blood pressure and heart rate levels were obtained and participants were asked about health problems, medical conditions, and medication use. Two HSDD participants at the NL site were excluded after screening for having a BDI score above 20. Participants received a compensatory fee of $85 USD/€110 for participation in the entire study and their travel expenses were also reimbursed. The study protocol of the U.S. and NL site were approved by the Indiana University's Human Subjects Committee and by the Medical Ethics Committee of the Academic Medical Center, respectively.

Sociodemographic data and other group characteristics are summarized in Table 1. The HSDD group and SF group were successfully matched on age and were comparable in race, educational level, and income level. Relative to SF women, women in the HSDD group had relationships of significantly longer duration and the percentage of HSDD women cohabiting with their partner was significantly higher. All women, except two, had a male partner. The two women who had a female partner identified themselves as bisexual and reported to value depictions of heterosexual sexual acts as positive. The incidence of unwanted or forced sexual activity in the past did not differ between groups. HSDD women had searched significantly less frequently for sexual materials (e.g., images, stories) than SF women, not only during the past month, but during their entire adult life. Compared to the

[3] In 1999 an international classification committee sponsored by the American Urological Association Foundation met to deliberate and propose alternative criteria to sexual dysfunctions experienced by women. With respect to sexual desire problems a Sexual Interest/Desire Disorder was proposed, emphasizing that lack of sexual desire prior to engaging in sexual activity was not symptomatic of a sexual dysfunction if the woman was able to become sexually excited and experience desire during the sexual encounter. Instead, this diagnosis was given if there was also a lack of responsive sexual desire during the sexual interaction or following sexual arousal.

Table 1 Demographic and sexual function characteristics

Characteristics	HSDD						SF						χ^2 or F-values Group	χ^2 or F-values Site
	U.S. ($n=20$)		NL ($n=22$)		Combined ($n=42$)		U.S. ($n=20$)		NL ($n=22$)		Combined ($n=42$)			
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
Age (in years)	33.5	7.5	30.8	8.4	32.1	8.0	27.6	6.2	31.2	8.0	29.5	7.4	2.78	0.09
Duration relation (in years)	8.8	7.4	7.6	7.0	8.1	7.1	3.2	3.2	5.9	7.5	4.6	5.9	6.54*	0.26
Sex partner, male *N* (%)	19 (95.0)		22 (100)		41 (97.5)		19 (95.0)		22 (100)		41 (97.5)		0.00	2.25
Co-habiting, *N* (%)	20 (100)		19 (86.4)		39 (92.9)		10 (50)		12 (54.5)		22 (52.4)		17.30***	0.22
Ethnicity Caucasian, *N* (%)	16 (80.0)		20 (90.9)		36 (85.7)		15 (75.0)		18 (81.8)		33 (78.6)		0.73	1.12
Education (%)														
College/technical school/university	19 (95.0)		12 (54.5)		31 (73.8)		20 (100)		14 (63.6)		34 (81.0)		.612	17.67***
Income level													3.88	8.45*
Poverty	2 (10.0)		0 (0.0)		2 (4.8)		3 (15.0)		1 (4.5)		4 (9.5)			
Lower/middle	9 (45.0)		2 (9.1)		11 (26.2)		8 (40.0)		9 (40.9)		17 (40.5)			
Middle	6 (30.0)		13 (59.1)		19 (45.2)		8 (40.0)		8 (36.4)		16 (38.1)			
Upper middle and upper	3 (15.0)		7 (31.8)		10 (23.8)		1 (5.0)		4 (18.2)		5 (11.9)			
Unwanted/forced sexual activity in the past	5 (25.0)		5 (22.7)		10 (23.8)		7 (35.0)		4 (18.2)		11 (26.2)		.064	1.04
Exposure to sexual images past month	1.9	0.8	2.1	0.8	2.0	0.8	2.5	0.8	2.6	0.9	2.6	0.9	10.65**	0.613
Exposure to sexual images/stories adult life	3.0	0.8	3.0	1.1	3.0	1.0	3.5	1.4	3.5	1.3	3.5	1.3	4.14*	0.012
FSDS-R	24.8	9.2	27.0	10.0	26.0	9.6	6.5	6.6	4.9	5.1	5.7	5.8	134.35***	0.041
ASFQ														
Desire	12.8	2.6	13.5	3.6	13.1	3.1	24.4	3.2	23.1	3.9	23.7	3.6	195.80***	0.12
Arousal-lubrication	4.8	2.3	5.6	1.3	5.2	1.9	8.3	1.8	8.2	1.1	8.2	1.5	64.80***	0.92
Arousal-cognitive	4.1	2.2	4.2	1.8	4.2	2.0	7.8	1.5	7.2	1.4	7.5	1.5	74.15***	0.36
Arousal-sensation	8.5	4.2	9.0	3.4	8.8	3.8	13.9	2.8	14.2	3.0	14.0	2.9	47.57***	0.28
Orgasm	8.0	4.1	8.2	3.6	8.1	3.8	11.6	1.7	11.9	1.6	11.7	1.6	30.76***	0.16
Pain	14.1	1.4	13.0	2.6	13.5	2.1	13.7	1.6	14.3	1.1	14.0	1.4	1.58	0.32

HSDD hypoactive sexual desire disorder, *SF* sexually functional, *U.S.* United States, *NL* The Netherlands, *ASFQ* abbreviated sexual function questionnaire, *FSDS-R* female sexual distress scale-revised

Note: Range for ASFQ subscales: Desire (5–31), Arousal-Lubrication (2–10), Arousal-Cognitive (2–10), Arousal-Sensation (4–20), Orgasm (1–15), and Pain (2–15). Lower scores indicate worse sexual function. Range for FSDS-R total score, 0–52. Higher scores indicate more sexually related personal distress

*** $p<.0001$, ** $p<.001$, * $p<.05$

SF group, the HSDD group displayed significantly higher levels of distress related to sexual function as indicated by the FSDS-R. On the ASFQ, the HSDD group reported significantly lower levels of Desire, Arousal-Lubrication, Arousal-Cognitive, Arousal-Sensation and Orgasm than the SF group. Scores on the Pain subscale indicated that neither the HSDD nor the SF group reported experiencing pain with intercourse, an exclusion criterion for participation in this study. Although characteristics related to sexual functioning did not differ for the two research sites, there were significant differences between the U.S. and NL with respect to education and income levels. In comparison to Dutch participants, U.S. participants were more highly educated, but their income levels were lower.

Measures

Implicit Measures

Single Target Implicit Association Task (ST-IAT). Following Wigboldus et al.'s (2005) methodology, our ST-IAT was designed to assess participants' affective associations with sexual stimuli. We selected the ST-IAT rather than the classic IAT (e.g., Greenwald, McGhee, & Schwartz, 1998), as the IAT is designed to assess the strength of affective associations of a target relative to a contrast category (e.g., black vs. white, ingroup vs. outgroup). However, in the case of target categories that have no meaningful contrast (such as the concept of sex), the ST-IAT is the only viable alternative version, and, if adapted correctly, has proven to be a valid alternative (e.g., Bluemke & Friese, 2008).

Participants were instructed to classify pictures portraying sexual acts (i.e., target stimuli) and words representing "positive" or "negative" meanings (i.e., attribute stimuli) to the appropriate superordinate category (i.e., "sex," "positive," "negative") as quickly as possible by pressing only a left or right response key on a keyboard. These labels used for these categories (sex, positive, negative) were continuously visible on the computer screen.

The ST-IAT consisted of a combination of practice and experimental blocks (for detailed methodology, see Greenwald et al., 1998). The experimental blocks consisted of one "incongruent" and one "congruent" block of trials. In the incongruent block, "sex" and "negative" were mapped on a single key and "positive" on the other, while in the congruent block, "sex" and "positive" were mapped on the same key and "negative" on the other.

The difference in reaction times between the two experimental blocks was assumed to reflect whether sex was associated more strongly with either positive or negative. Faster responses in the congruent block (compared to the other block) reflect stronger associations between positive and sex, and faster responses in the incongruent block reflect stronger associations between negative and sex.

The target-attribute combinations that shared response keys (i.e., block order) and left or right key response requirements were counterbalanced. Each critical block consisted of 40 trials, of which responses were divided equally over the two response keys.

The target category consisted of five exemplar stimuli of sexual images from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 1995), with the following numbers: 4800, 4652, 4658, 4659, and 4672. The attribute categories consisted of 20 generally positive and 20 generally negative words (Dotsch & Wigboldus, 2008; Dotsch, Wigboldus, Langner, & Van Knippenberg, 2008), thus reflecting more global affective associations with sex. These words were controlled for length and frequency (see Appendix Table 6).

With respect to validity, the ST-IAT's strength lies in high effect sizes due to double opposing categories, often leading to slower reaction times (the categorization decision requires effort as there are several possibilities to consider).

Picture Association Task (PAT). This valence task, developed by van Leeuwen and Macrae (2004), is based on the Affective Priming Task (e.g., Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 1994) where target words are preceded by another word or image that influences the categorisation speed of the target word. In the PAT, however, target words and images appear simultaneously.

In our PAT, participants were presented with positive or negative words superimposed on either sexual or neutral pictures. They were instructed to categorize the words as fast as possible as either positive or negative by pressing one of two computer keys. Participants were further instructed to focus on the words that appeared on the screen and not to attend to the background images as these were of no importance for the task (Jenkins, Lavie, & Driver, 2003) and the categories to which the pictorial stimuli belong (sex, neutral) were not explained. Thus, the PAT captures the unintentional influence of the affective value of the pictorial background stimuli on task performance. The time to select the correct response to the words (positive or negative) was influenced by the match between the valence of the word and the valence of the background image (sex or neutral), thereby revealing indirectly the valence of the picture for the participant.

The word categories consisted of 10 positive words and 10 negative words (see Appendix Table 7). Whereas for the ST-IAT general positive and negative words were selected (e.g., peace, respect, war, hate), the PAT consisted of positive and negative words that were applicable to a sexual situation, but that did not exclusively refer to sexual experiences (e.g., enjoyable, wonderful, dirty, disgusting) in order to create a conceptual overlap between the content of the words and the content triggered by the sexual pictures. These words were taken from a pilot study in the Netherlands in which female participants ($N = 20$) were asked to indicate on a 7-point Likert scale for each positive and negative word how well it described a positive or a negative sexual situation, respectively (Brauer & Laan, 2008). The selected words were translated into English and the English words were

matched on length with the Dutch words. The words appeared at one of four randomized locations on the picture to avoid expectation-related responses and to make sure participants would move their eyes over the image.

The sexual pictures were taken from another study on implicit associations with sexual stimuli in women with dyspareunia (Brauer, de Jong, Huijding, Laan, & ter Kuile, 2009). These pictures displayed a variety of sexual acts (e.g., kissing, cunnilingus, fellatio, coitus). Based on each sexual picture, a control picture was created by scrambling the sexual image, leaving a neutral stimulus. All pictures were standardized to 600 × 480 pixels and matched for brightness and contrast.

Each stimulus remained on the screen until participants made a decision or until 3,000 ms had elapsed. After 10 practice trials, 80 experimental trials were presented. Each word was paired randomly with a sexual picture and a neutral picture, resulting in four different combinations each presented 20 times: positive words and sexual images, negative words and sexual images, positive words and neutral images, negative words and neutral images. The order of presentation of the trials was counterbalanced within and response key mappings (i.e., positive/negative or negative/positive) were counterbalanced across participants. The computer recorded the accuracy and latency of each response.

With respect to validity, the strength of the PAT is that it is not sensitive to a possible interpretation bias due to the need to attend to the different stimulus categories at the same time, as is the case in the ST-IAT.

Dot Detection Task. To measure attention capture by sexual stimuli, we used a shortened version of the dot detection task used by Prause et al. (2008). Participants were presented with a simultaneous presentation of two pictures. The pictorial categories consisted of sexual and emotionally neutral pictures. The pictures appeared in the right and left positions on the computer screen for 500 ms. After 500 ms, a dot replaced one of the two pictures. The dot appeared randomly and equally often where the right and left images had been presented. Participants were instructed to indicate as quickly as possible the location of the dot probe on each trial by pressing one of two computer keys.

There were three types of image combinations: only neutral images (No sex, 66 pairs), combinations of one sexual image and one neutral image where the dot appeared under the neutral image (Sex not target, 34 pairs), and combinations with one sexual image and one neutral image where the dot appeared under the sexual image (Sex target, 34 pairs).

We used the same stimuli as Prause et al. (2008), with neutral stimuli selected from the IAPS and sexual stimuli selected from the IAPS and from a study conducted by Spiering, Everaerd, and Elzinga (2002).

The three tasks were programmed in Inquisit (2003). In all tasks, the accuracy and latency of each response were recorded and a 500 ms stimulus interval was used. Responses were made on a standard computer keyboard. The task order was counterbalanced.

Self-Reported Affective Responses

In order to compare implicit and explicit affective responses to erotic stimuli, participants were, after the completion of the two valence tasks (the ST-IAT and PAT) asked to rate the erotic stimuli on three dimensions. As a self-report equivalent of both implicit measures, participants were first asked to indicate their general affect experienced in response to each picture on a 7-point bidimensional Likert scale, ranging from 1 (very negative) to 7 (very positive).

To obtain a more complete impression of how the sexual stimuli were appraised, participants had also to assess the degree to which they were experiencing sexual desire and disgust when looking at each picture. The response options for the unidimensional item "sexual desire" ranged from 1 (no desire at all) to 7 (very strong sexual desire). The response options for the unidimensional item "disgusting" ranged from 1 (not at all disgusting) to 7 (extremely disgusting).

Questionnaires

Background Health and General Information Questionnaire. This questionnaire included questions about the participant's age, parity, relationship status, general health, and demographics. Past unwanted/forced sexual experiences were measured using five questions pertaining to different forms of unwanted/forced sexual activity. If a participant responded 'yes' to at least one of these questions, this was scored as meeting the criteria for an unwanted/forced sexual experience. Further, participants were asked to indicate the frequency with which they had searched for sexual materials (e.g., photos, erotic film fragments, erotic websites, erotic stories) during the past month and during their entire adult life, respectively.

Abbreviated Sexual Function Questionnaire (ASFQ). This abbreviated version of the Sexual Function Questionnaire (SFQ28; Quirk et al., 2002) is a 20-item self-report measure consisting of the following subscales: Desire (6 items; range, 5–31), Arousal-Lubrication (2 items; range, 2–10), Arousal-Cognitive (2 items; range, 2–10), Arousal-Sensation (4 items; range, 4–20), Orgasm (3 items; range, 1–15), and Pain (3 items; range, 2–15). Higher scores indicate better sexual functioning. Scores suggesting "normal" sexual function are as follows: Desire ≥23, Arousal-Lubrication ≥8, Arousal-Cognitive ≥8, Arousal-Sensation ≥14, Orgasm ≥12, and Pain ≥12 (Quirk, Haughie, & Symonds, 2005). In contrast to the full version, the abbreviated list does not contain the partner and enjoyment domains so as to focus exclusively on sexual function characteristics. The removal of the two domains did not impact the psychometric properties of the SFQ (Williams et al., 2010).

Female Sexual Distress Scale-Revised (FSDS-R). The FSDS (Derogatis, Rosen, Leiblum, Burnett, & Heiman, 2002) is a self-report instrument to assess sexually related personal distress. In the revised version of the FSDS-R (Derogatis et al., 2008), one additional question is included that asks women to rate distress related to low sexual desire, consistent with its use as part of the diagnostic criteria for HSDD. Response categories vary from 0 (never) to 4 (always). The range for the FSDS-R total score is 0–52. Higher scores indicate more sexual distress. The FSDS-R has demonstrated good discriminant validity, high test–retest reliability, and a high degree of internal consistency in measuring sexually related personal distress in women with HSDD. At a cut-off score of >11, the FSDS-R demonstrated sensitivity and specificity that was equivalent to that reported in the initial version (Derogatis et al., 2008). Results from a Dutch study sample supported its reliability and psychometric validity (Ter Kuile, Brauer, & Laan, 2006).

Procedure

After the study procedures were described in detail to participants and informed consent was obtained, the semi-structured interview regarding sexual function and the medical screening were conducted. Next, participants completed the three RT tasks, depending on the task order to which they had been assigned. These tasks were presented on a computer screen in a private lab room. Afterwards, participants were asked to rate the erotic images that were used in the ST-IAT and PAT.

Data Analysis

For all RT tasks, incorrect responses were excluded from analyses. In addition, RTs shorter than 300 ms or longer than 3000 ms were excluded from analyses. With respect to the ST-IAT data, we followed Wigboldus et al. (2005) in that we, for each participant, used the median response latency of the correct responses to the attribute items in congruent and incongruent blocks. Following this, median reaction times of the two experimental blocks were subtracted from one another to obtain a ST-IAT effect (i.e., ST-IAT effect = median (Sex/Negative) − median (Sex/Positive)). Negative ST-IAT effects indicate relatively stronger negative associations with sexual stimuli. The ST-IAT effects were submitted to a 2 (Group: HSDD, SF) × 2 (Site: U.S., NL) ANOVA.

For the PAT data, median response latencies of the correct responses were calculated, following Van Leeuwen and Macrae (2004). To correct for baseline reactions to positive and negative words, we calculated difference scores by subtracting RTs for positive words superimposed on sexual pictures from positive words superimposed on neutral pictures. The same was done for negative words superimposed on sexual and neutral pictures (i.e., Sex/+ = RT (sex/positive words) − RT (neutral/positive words) and Sex/− = RT (sex/negative words) − RT (neutral/negative words. Sex/+ < Sex/− = automatic positive associations with sex). These PAT difference scores were submitted to a 2 (Group: HSDD, SF) × 2 (Site: U.S., NL) × 2 (Sex Valence: Positive, Negative) repeated measures ANOVA.

For the dot detection task, median response latencies of the correct responses were calculated. Median reaction time data were subjected to a 2 (Group: HSDD, SF) × 2 (Site: U.S., NL) × 3 (Pair Type: No sex, Sex target, Sex not target) repeated measures ANOVA.

Self-reported affective responses (i.e., general valence, disgust, desire) to the erotic stimuli that were used in the ST-IAT and the PAT were submitted to 2 (Group: HSDD, SF) × 2 (Site: U.S., NL) MANOVAs, including all three variables.

For all analyses, two-tailed tests were used with α set at .05. For RT data and self-report responses, effect sizes (f) were calculated as a function of η^2 (see Cohen, 1988, p. 284). For the purpose of interpretation, Cohen considered $.10 < f < .25$ as small, $.25 < f < .40$ as medium and $f > .40$ as large.

Results

Implicit Tasks

One participant in the ST-IAT and two participants in the PAT were outliers and excluded from analyses (Tabachnick & Fidell, 2001). However, data analysis with inclusion of these participants yielded similar findings. In addition, one participant with 50 inaccurate responses (37%) on the dot detection task was excluded from analyses. Furthermore, because the order in which ST-IAT test blocks and key response assignments were presented did not influence the findings, we report the analyses using the pooled data. Similarly, the order in which key response assignments were presented in the PAT did not influence the findings. Finally, the order in which the three RT tasks were presented did not influence the main findings. Therefore, we did not include Order as another between subject factor in the analyses.

Single Target Implicit Association Task (ST-IAT)

ST-IAT effects are shown in Table 2. A 2 (Group) × 2 (Site) ANOVA with ST-IAT effects as the dependent variable revealed a significant main effect of Group, $F(1, 79) = 4.75$, $p < .03$, $f = 0.25$. As predicted, ST-IAT effects were significantly less positive for HSDD women than for SF women, implying that HSDD women displayed weaker positive associations with sexual stimuli compared to SF women.

Picture Association Task (PAT)

RT data are shown in Table 3. A 2 (Group) × 2 (Site) × 2 (Sex Valence) repeated measures ANOVA with RT difference scores as the dependent variable, revealed a significant main effect for Sex Valence, $F(1, 78) = 30.00$, $p < .0001$, $f = 0.62$, as well as a significant Group × Sex Valence interaction, $F(1, 78) = 6.64$,

Table 2 Mean median response latencies (in milliseconds [ms]) to the attribute stimuli during the stIAT test phases as a function of sexual function status

	HSDD						SF					
	U.S. ($n = 20$)		NL ($n = 22$)		Combined ($n = 42$)		U.S. ($n = 20$)		NL ($n = 21$)		Combined ($n = 41$)	
	M	SEM	M	SEM	M	SEM	M	SEM	M	SEM	M	SEM
ST-IAT effect	−5.1	17.1	7.2	8.7	1.3	9.3	39.8	9.3	13.1	8.8	26.1	6.6

HSDD hypoactive sexual desire disorder, *SF* sexually functional, *U.S.* United States, *NL* The Netherlands

Note: ST-IAT effect = mean response latency (sex + negative) − (sex + positive). Higher ST-IAT effects indicate stronger positive associations with sex

Table 3 Difference scores for mean median response latencies (in milliseconds [ms]) to negative and positive word stimuli during the PAT test phase as a function of sexual function status

	HSDD						SF					
	U.S. ($n = 19$)		NL ($n = 22$)		Combined ($n = 41$)		U.S. ($n = 20$)		NL ($n = 21$)		Combined ($n = 41$)	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Negative	44.4	14.8	56.8	16.1	51.1	10.9	100.2	23.5	72.8	20.6	86.2	15.2
Positive	25.4	13.2	20.6	13.3	22.8	9.3	29.9	25.2	−10.1	15.6	9.4	14.8

HSDD hypoactive sexual desire disorder, *SF* sexually functional, *U.S.* United States, *NL* The Netherlands

$p < .015, f = 0.29$. Follow-up tests for this interaction effect indicated that both groups were slower when they had to respond to negative words superimposed on sex pictures than when positive words were superimposed on sex pictures; however, this effect was stronger in the SF group, $F(1, 78) = 32.50, p < .0001, f = 0.65$) than in the HSDD group $F(1, 78) = 4.20, p < .045, f = 0.23$). These findings imply that both groups of women associated sex more with positive than with negative, although the strength of positive sex-related associations was significantly weaker in the HSDD group.

Dot Detection Task

RT data are shown in Table 4. The Dot Detection data were subjected to a 2 (Group) × 2 (Site) × 3 (Pair Type) mixed-factor ANOVA. There was a significant main effect for Pair Type, $F(2, 158) = 39.97, p < .0001, f = 0.71$). Follow-up tests indicated that reaction times for all pair types differed significantly, meaning that participants were fastest to identify the target during No sex trials and slowest to identify the target during Sex target trials.

Self-Reported Affective Responses to Sexual Stimuli

Single Target Implicit Association Task (ST-IAT)

Table 5 shows the subjective ratings of the sexual stimuli used in the ST-IAT. A 2 (Group) × 2 (Site) MANOVA yielded a significant multivariate main effect for Group, $F(3, 77) = 10.18, p < .0001, f = 0.63$. Univariate follow-up tests indicated that the sexual pictures in the ST-IAT elicited significantly less positive feelings, $F(1, 77) = 20.39, p < .0001, f = 0.51$, more disgust, $F(1, 77) = 10.80, p < .0001, f = 0.43$, and less desire, $F(1, 77) = 52.67, p < .0001, f = 0.61$, in HSDD women than in SF women.

Table 4 Mean median response latencies (in milliseconds [ms]) to sexual and neutral stimuli during the dot detection task as a function of sexual function status

	HSDD						SF					
	U.S. ($n = 20$)		NL ($n = 22$)		Combined ($n = 42$)		U.S. ($n = 20$)		NL ($n = 21$)		Combined ($n = 41$)	
	M	SEM	M	SEM	M	SEM	M	SEM	M	SEM	M	SEM
Sex target	580.0	4.9	508.4	4.5	544.2	2.3	577.0	4.9	561.8	4.7	569.4	2.4
Sex not target	568.7	4.8	506.7	4.3	537.7	2.3	570.2	4.8	551.0	4.6	560.6	2.3
No sex	536.6	4.4	492.8	4.0	514.7	2.1	544.3	4.4	530.9	4.2	537.6	2.1

HSDD hypoactive sexual desire disorder, *SF* sexually functional, *U.S.* United States, *NL* The Netherlands

Note: Sex target = pairs with one sexual image and one neutral image in which a dot appeared under the sexual image; Sex not target = pairs with one sexual image and one neutral image in which a dot appeared under the neutral image; No sex = pairs with only neutral images

Table 5 Self-reported affective responses to erotic stimuli used in the ST-IAT and the PAT

Ratings	HSDD						SF					
	U.S. ($n=20$)		NL ($n=22$)		Combined ($n=42$)		U.S. ($n=20$)		NL ($n=22$)		Combined ($n=42$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
ST-IAT												
General affect	5.6	1.2	4.6	1.0	5.1[a]	1.2	6.2	1.1	6.2	0.9	6.2[b]	1.0
Desire	4.5	1.5	3.8	1.3	4.1[a]	1.5	5.8	1.3	5.6	1.0	5.7[b]	1.2
Disgust	1.7	1.0	2.6	0.9	2.2[a]	1.1	1.4	0.6	1.5	0.7	1.5[b]	0.7
PAT												
General affect	5.5[a]	1.2	4.4[b]	1.2	4.9	1.2	6.0[a]	1.1	6.0[a]	1.0	6.0	1.0
Desire	3.6	1.5	3.6	1.5	3.6[a]	1.4	5.3	1.6	5.4	1.2	5.3[b]	1.4
Disgust	2.1[a]	1.2	3.1[b]	1.2	2.6	1.3	1.6[a]	0.9	1.6[a]	0.9	1.6	0.8

HSDD hypoactive sexual desire disorder, *SF* sexually functional, U.S. United States, *NL* The Netherlands

Note: Range for general affect towards sex-related stimuli, 1 (very negative)—7 (very positive). Range for the item desire, 1 (no desire at all)—7 (very strong sexual desire). Range for the item disgust, 1 (not at all disgusting)—7 (extremely disgusting). Means with different superscripts are statistically significantly different at $p<.05$

Picture Association Task (PAT)

Appendix Table 6 shows the subjective ratings of the sexual stimuli used in the PAT. A 2 (Group) × 2 (Site) MANOVA revealed significant main effects for Group, $F(3, 76)=9.81$, $p<.0001$, $f=0.62$, and Site, $F(3,76)=4.32$, $p<.01$, $f=0.37$, and a significant Group × Site interaction, $F(3, 76)=3.60$, $p<.02$, $f=0.33$. Follow-up tests revealed a main effect for Group for desire ratings, $F(1, 78)=29.78$, $p<.0001$, $f=0.61$, indicating that HSDD participants experienced significantly less desire in response to the sexual stimuli than the SF participants. Group × Site interaction effects were found for general valence ratings, $F(1, 78)=4.86$, $p<.03$, $f=0.25$, and for disgust ratings, $F(1,78)=4.75$, $p<.035$, $f=0.25$. Subsequent univariate tests revealed that ratings of general affect did not differ between HSDD and SF participants in the U.S., $F(1,78)=1.98$, $f=0.16$, whereas these ratings were significantly different between HSDD and SF participants in the Netherlands, such that affect tended less toward positive in the HSDD participants than in the SF participants $F(1,78)=21.84$, $p<.0001$, $f=0.53$. The same pattern of findings was found for ratings of disgust, with HSDD participants in the Netherlands reporting more disgust than SF participants, $F(1,78)=20.12$, $p<.0001$, $f=0.51$, but with no group differences in the U.S., $F(1, 78)=1.59$, $f=0.14$. Furthermore, it was found that SF participants in the U.S. and NL did not differ in their ratings of general affect, $F(1, 78)<1$, $f=0.0$, and ratings of disgust, $F(1, 78)<1$, $f=0.0$, whereas for the Dutch HSDD participants ratings of general affect tended less toward positive, $F(1, 78)=9.41$, $p<.005$, $f=0.35$, and ratings of disgust were higher, $F(1, 78)=9.53$, $p<.005$, $f=0.35$, than for the HSDD participants in the U.S..

Discussion

This international two-site study was the first to assess attentional responses to and automatic affective associations with sexual stimuli in physically healthy premenopausal women with acquired HSDD. Consistent with previous research, our findings showed that affected women experienced less positive responses to sexual stimuli than women without sexual problems. However, as far as we know, our study is the first to show that these differences were not limited to evaluations at a more deliberate, conscious level. Both implicit measures successfully discriminated between women with and without acquired HSDD. The findings of the ST-IAT suggest that, in comparison with women without sexual problems, HSDD women had weaker positive automatic associations with sexual stimuli, as evidenced by a significantly less positive ST-IAT effect in women with HSDD relative to SF women. The PAT also differentiated between women with and without HSDD. Although the PAT data undeniably showed that both groups of women were faster when they had to respond to positive words superimposed on sexual images in relation to negative words superimposed on sexual images, the strength of positive associations—again, at an implicit level—was significantly weaker in the HSDD group. More specifically, the difference in RTs between positive/sex and negative/sex was small ($f=0.23$) in HSDD women, whereas it was large in SF women ($f=0.65$). As such, our findings point to weaker positive sex-related automatic associations in women with HSDD than in SF women.

In terms of incentive motivation models, it is assumed that when sexual stimuli are weakly associated with incentive prop-

erties, their ability to elicit sexual arousal and desire will decrease (Agmo, Turi, Ellingsen, & Kaspersen, 2004; Both et al., 2008, Toates, 2009). In relation to this, it is worth mentioning here that the findings of both affective tasks, as expected, did not demonstrate that (overtly) negative automatic sex-related associations were involved in symptomatic women. In that case, women with HSDD would have been significantly *slower* in their responding to positive words paired with sexual images than to negative words paired with sexual images in both tasks. Taken together, the present results indicate that women with HSDD are characterized by weaker positive (and not stronger negative) automatic sex-related associations than women without such problems. In support of the generalizability of our results, the same pattern of data emerged at two study sites.

The findings of the dot detection task did not support our hypothesis. We expected that women with HSDD would be faster than SF women in detecting dots replacing sexual images. However, both groups slowed down to a similar degree when dots replaced sexual images. Thus, the two groups demonstrated equal levels of attentional (dis)engagement with sexual stimuli. Combined, the findings of the attentional and affective tasks differed from those of Prause et al. (2008), who found, in a nonclinical sample, differences between low and high desire groups in attentional but not affective processes, whereas we found the opposite in a clinical versus a sexually functional group. This may suggest that different mechanisms are at play in clinical versus nonclinical groups of women with low desire. In the absence of distress, low sexual desire may be associated with a decreased capacity for sexual stimuli to attract attention, or induce attentional engagement, while those stimuli are not necessarily less positive (or more negative) than they are for other women. However, our findings suggest that in women with HSDD, attention for sexual stimuli is not different from that of sexually functional women; instead, it is the valence of sexual stimuli that appears to differ between these women.

Alternatively, methodological differences may have contributed to the diverging findings of the Prause et al. (2008) and our study. As sexual (dys)function information was not included in the former study, it is unclear to what extent the high desire group in that study is comparable to the sexually functional control group in our study. Given that only two participants out of 75 (of whom 36 were women) reported strong concerns about any sexual difficulty in Prause et al.'s (2008) study, it seems justified to infer that their sample of women with low sexual desire most likely did not meet the criteria for a diagnosis of HSDD. In addition, differences in measures to assess affective responses to sexual stimuli (acoustic startle task versus the ST-IAT and PAT) between the two studies could (also) account for the seemingly opposing patterns of results. These conflicting findings call for studies comparing women with increasing levels of sexual desire (from high through low to dysfunctional) in their attentional and affective responses to sexual stimuli.

In order to allow us to compare implicit and more conscious, or explicit, affective responses to erotic stimuli, participants were asked to rate the erotic stimuli used in the ST-IAT and the PAT. The findings on the subjective ratings showed that women with HSDD reported less desire and more disgust, and that their general affective appreciation of sexual stimuli used in the ST-IAT was less positive than that of women in the SF group. In comparison to SF women, sexual stimuli in the PAT evoked less desire in HSDD women in both the U.S. and NL, whereas for the Dutch HSDD women only, general affect tended to be less positive and ratings of disgust were higher. Interestingly, ratings of general affect in response to the PAT stimuli tended to be more positive and disgust was lower in U.S. than in Dutch women with HSDD. A possible explanation for this unanticipated finding relates to differences in complaint characteristics (i.e., sexual function, sexual distress, complaint duration etc.) between the HSDD groups at the two sites. However, given that the two groups had comparable scores on sexual function and sexual distress measures, this explanation seems unlikely. An alternative explanation is that the HSDD women at both sites differed in their familiarity with sexual materials, such as images and stories. However, our finding that HSDD women did not differ in how frequently they actively searched for sexual stimuli, renders this explanation doubtful. Thus, at present, it remains unclear what factors may account for these differences. Despite this unpredicted site difference in ratings of the PAT stimuli, the general pattern of self-report ratings implies that sexual stimuli elicited less positive meanings in women with HSDD at a more deliberate, conscious level. As such, these findings correspond with earlier research showing that women with HSDD (e.g., Arnow et al., 2009; Conaglen, 2004; Conaglen & Evans, 2006; Vardi et al., 2009) as well as women with other sexual complaints (e.g., Brauer, Laan, & ter Kuile, 2006; Brauer, ter Kuile, Janssen, & Laan, 2007; Brauer, de Jong, et al., 2009; Brauer, ter Kuile, & Laan, 2009; Laan, van Driel, & van Lunsen, 2008; Meston, 2006; Morokoff & Heiman, 1980) report less positive affect and lower sexual arousal and desire than sexually functional women.

Taken together, the findings from this study suggest that women with acquired HSDD do not differ from women without HSDD in their attentional responses to sexual stimuli. Instead, they seem to be better characterized as experiencing weaker positive associations with sexual stimuli than women without HSDD, both at an automatic and, though with less consistency by site, at a deliberate level. As such, these findings were consistent with information processing models of sexual arousal (e.g., Janssen et al., 2000) which emphasize that the initiation of responses to sexual stimuli, including their appraisal in terms of positive or negative valence, takes place at an automatic or implicit level. Following this perspective, individuals with sexual dysfunctions, including HSDD, appraise sexual cues less positively, which detracts from the processing of sexual meanings, or content, of relevant stimuli, and ultimately may result in reductions in or absence of

sexual arousal and feelings of desire (Barlow, 1986; Janssen, Everaerd, Spiering, & Janssen, 2000; Laan & Janssen, 2007; Sbrocco & Barlow, 1996). Although our findings for the dot detection task indicated that sexual stimuli did not capture less attention in women with HSDD, perhaps a less positive appraisal of sexual stimuli may still interfere with attentional processing at later stages of sexual arousal.

In terms of incentive motivation models (Agmo, 1999; Agmo et al., 2004; Both et al., 2007; Everaerd & Laan, 1995; Toates, 2009), the present findings suggest that, in physically healthy women with acquired HSDD, sexual stimuli have lost their associations with reward, and although this could be the result of a number of factors (including relationship concerns, lack of sexual skills; Laan & Both, 2008), this change might be associated with a reduction in positive affective responses to sexual stimuli. Since women's sexual feelings may especially depend on the meanings activated by stimulus and stimulus context (e.g., a woman's degree of intimacy and compatibility with her partner or the comfort of her physical environment; Laan & Janssen, 2007), our findings may have implications for clinical practice. The results underscore the possible relevance of developing interventions aimed at strengthening the association between sexually rewarding experiences and stimuli, such that the incentive value of sexual stimuli and the number of available sexual incentives may increase. Thus, pharmacological treatments for physically healthy premenopausal women with HSDD may not necessarily succeed in facilitating sexual desire as long as there is a lack of sexual incentives (e.g., Everaerd & Both, 2001; Everaerd & Laan, 2000; Laan & Both, 2008).

Our study sample of HSDD women consisted of physically healthy women. The decision to select generally healthy women for the control group was made as incentive motivation models assume that there must be an intact sexual system in order to become activated by adequate sexual stimuli. Therefore we excluded women with illnesses/diseases and/or medication use that have been found to negatively impact on sexual function. Nonetheless, this sample selection may limit the generalizability of the present findings. It would be informative to replicate this study within a more heterogeneous sample of women. Apart from the above suggestion for future research, there are other suggestions for further research into the appraisal of sexual stimuli in relation to (low) sexual desire. First, it would be valuable to investigate how strongly implicit measures, such as the ST-IAT and the PAT, correlate with change following psychosexual treatment of HSDD in order to establish the mechanisms of change.

Second, it would be interesting to explore how attentional and affective processes influence sexual desire and arousal beyond the initial processing of sexual stimuli. For this, continuous measures of attention (e.g., using eye-tracking) and affect (e.g., using startle eye-blink responses; Prause et al., 2008) could be used. This would allow for a more in-depth exploration of the interaction between affective and attentional processes over time. For example, it might be found that although initial attentional responses are not different in HSDD and SF women, a less positive appraisal of sexual stimuli may impact attention at later processing stages.

Third, longitudinal and experimental studies could help examine more directly the causal relationships between the appraisal of sexual stimuli, the quantity and quality (i.e., strength) of sexual incentives, and the level of sexual desire. At present, it is unclear whether the absence of or reduction in positive meanings is a cause or a result of acquired HSDD. As mentioned above, we assume, based on incentive motivation models of sexual response, that women with acquired HSDD once were able to appraise sexual stimuli positively (since they responded with sexual desire to relevant cues in the past). Perhaps the strength of positive sex-related associations has weakened in these women along with a decline in rewarding sexual experiences. However, it is also possible that a lower positive appreciation of sexual stimuli functions as a vulnerability factor for the development of HSDD. In relation to this, another suggestion for future research is to test the specificity of the present pattern of findings for symptomatic women in comparison to women who suffer from lifelong HSDD. In terms of incentive motivation models, perhaps in women with lifelong HSDD, a negative appreciation of sexual stimuli may have preceded a lack of sexual incentives as those women may never have had positive rewarding sexual experiences or have encountered negative sexual experiences. Finally, it might be useful to consider the inclusion of an additional clinical comparison group without sexual complaints (e.g., women with depression). This would allow for testing whether weaker positive automatic associations with sexual stimuli are relatively specific to women with HSDD rather than being common in other clinical groups of women.

In conclusion, the present study showed that although women with acquired HSDD hold weaker positive associations with sexual stimuli than sexually functional women, these associations were not overtly negative. As such, treatment approaches may benefit more from the strengthening of positive sex-related associations than from attempts to reduce possible negative associations.

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Appendix

See Tables 6 and 7.

Table 6 ST-IAT stimuli in the "positive" and "negative" attribute categories for the U.S. and NL site

	Positive U.S.	Positive NL	Negative U.S.	Negative NL
1	LOVE	LIEFDE	CANCER	KANKER
2	PEACE	VREDE	WAR	OORLOG

Table 6 continued

	Positive U.S.	Positive NL	Negative U.S.	Negative NL
3	SAFE	VEILIG	ACCIDENT	ONGELUK
4	HEALTHY	GEZOND	DEATH	DOOD
5	NICE	LEUK	TORTURE	MARTELING
6	KIND	AARDIG	AGGRESSION	AGRESSIE
7	FUNNY	GRAPPIG	SADNESS	VERDRIET
8	HAPPINESS	GELUK	ANGRY	KWAAD
9	HAPPY	BLIJ	LOSS	VERLIES
10	CHEERFUL	VROLIJK	PAIN	PIJN
11	SUCCESSFUL	GESLAAGD	EMERGENCY	NOOD
12	COSY	GEZELLIG	DISGUST	WALGING
13	WINNING	WINNEN	HATE	HAAT
14	ENTERTAINMENT	VERMAAK	POVERTY	ARMOEDE
15	FRIEND	VRIEND	DISEASE	ZIEKTE
16	VACATION	VAKANTIE	UNPLEASANT	VERVELEND
17	RESPECT	RESPECT	MEAN	GEMEEN
18	BEAUTIFUL	MOOI	DANGER	GEVAAR
19	PLEASANT	PRETTIG	BITTER	BITTER
20	PARTY	FEEST	TYRANT	TIRAN

Table 7 PAT stimuli in the positive and negative attribute categories for the U.S. and NL site

	Positive U.S.	Positive NL	Negative U.S.	Negative NL
1	NICE	FIJN	GRIM	NAAR
2	ENJOYABLE	PLEZIERIG	MISERABLE	ELLENDIG
3	KIND	LIEF	BAD	SLECHT
4	FAMILIAR	VERTROUWD	PAINFUL	PIJNLIJK
5	WARM	WARM	THREATENING	DREIGEND
6	PLEASANT	PRETTIG	UNPLEASANT	VERVELEND
7	SAFE	VEILIG	UNSAFE	ONVEILIG
8	PROTECTED	BESCHERMD	DISGUSTING	WALGELIJK
9	LOVED	GELIEFD	DIRTY	VIES
10	WONDERFUL	HEERLIJK	GRUESOME	AKELIG

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