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Published in:
Sexual Medicine Review

DOI:
[10.1016/j.sxmr.2020.06.005](https://doi.org/10.1016/j.sxmr.2020.06.005)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2020

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Hinzmann, J., Borg, C., & de Jong, P. J. (2020). Implicit Measures in Clinical Sex Research: A Critical Evaluation. *Sexual Medicine Review*, 8(4), 531-541. <https://doi.org/10.1016/j.sxmr.2020.06.005>

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Implicit Measures in Clinical Sex Research: A Critical Evaluation



Jessica Hinzmann, MSc,¹ Charmaine Borg, PhD,² and Peter J. de Jong, PhD²

ABSTRACT

Introduction: Current information-processing models of sexual arousal imply that both controlled and automatic affective-motivational processes are critically involved in sexual responding and suggest that dysfunctional automatic processes may be involved in the development and persistence of sexual dysfunctions. Because (dysfunctional) automatic processes and responses cannot be adequately captured by common self-report measures, implicit performance-based measures have been developed to index these processes.

Objectives: This review provides an overview of studies that used implicit tasks in clinical sexual research, and critically evaluates the contribution and promise of these measures to improve our understanding of the mechanisms involved in sexual dysfunctions.

Methods: 6 electronic main databases (AMED, MEDLINE, PsycArticles, Psychology & Behavioral Sciences Collection, PsycINFO, and SocINDEX) were searched for studies involving implicit measurement techniques to measure automatic processes in clinical sex research.

Results: A series of studies examined if lowered (or heightened) attention for sex stimuli may be involved in low sexual arousal, low desire, and genital pain. Preliminary evidence showed that lowered attention is involved in low sexual arousal. The pattern with regard to desire and genital pain was mixed which may be due to heterogeneity in assessment instruments. A limited number of studies examined automatic memory associations with sexual cues. Preliminary evidence showed negative (sex-threat/sex-disgust) associations in women with genito-pelvic pain or penetration disorder, less positive associations in women with hypoactive sexual desire disorder, and sex-positive and sex-failure associations in men with sexual distress. Thus far, no studies have examined lowered (or heightened) automatic sexual approach tendencies related to sexual dysfunctions.

Conclusion: Implicit measures showed some promise as tools to index automatic sex-relevant cognitive mechanisms in sexual dysfunctions. Yet, more systematic research and the development of psychometrically sound measures are critical for a more comprehensive evaluation of the relevance of implicit measures in clinical sex research and their usefulness as indices of individual differences in clinical practice. **Hinzmann J, Borg C, de Jong PJ. Implicit Measures in Clinical Sex Research: A Critical Evaluation. Sex Med Rev 2020;8:531–541.**

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Key Words: Implicit Tasks; Automatic Processes; Sexual Dysfunctions; Clinical Sex Research

Over the past few decades, there has been a surge of interest in the use of implicit tasks in many scientific domains. Specifically, in the domain of psychopathology, the popularity of implicit tasks is likely to be related to their potential to extend measures of disorder-relevant psychological attributes beyond what direct self-reports can reveal. Traditionally, researchers in psychopathology almost exclusively relied on explicit measures such as

self-report questionnaires to assess patients' beliefs and feelings. However, such explicit measures are not suited to assess uncontrollable and reflexive symptoms that are considered to lie at the core of many psychopathological conditions. Implicit tasks in psychopathology research are particularly relevant because automatic processes are assumed to be important in understanding the development and maintenance of psychopathological problems. In psychopathology research, the 3 important targets for using implicit performance-based measures are dysfunctional automatic attentional processes, dysfunctional impulsive associations in memory, and dysfunctional reflexive approach-avoidance tendencies.¹ These same components are also part of the information-processing models of sexual behavior. For example, in their model, Janssen et al² theorize that both automatic and controlled processes are involved in the activation of sexual desire and arousal. In line with this, when a person is

Received March 22, 2020. Accepted June 14, 2020.

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<https://doi.org/10.1016/j.sxmr.2020.06.005>

presented with a stimulus, the stimulus is first appraised as sexual or non-sexual, and consequently response generation (ie, physiological changes in the brain and body that prepare for sexual action) takes place, when it fits the sexual meaning in memory. This process is assumed to be based mainly on automatic processes. Moreover, the automatic activation of positive meaning will enhance attentional focus to the sexual stimulus, which in turn results in higher sexual arousal. Accordingly, when this activation process surpasses the perceptual threshold, sexual arousal is experienced consciously. Therefore, the awareness of physiological responding to sexual cues, together with a positive appraisal of these cues, may eventually result in a full-blown genital response and the subjective experience of sexual desire and arousal. In men, this full-blown sexual arousal is associated with an erectile response of the penis, which is necessary for sexual behaviors such as penile-vaginal penetration. In women, this is associated with increased blood flow in the vaginal walls, which results in lubrication, and in turn facilitates penile-vaginal penetration.³

Individuals with sexual difficulties are assumed to appraise sexual stimuli less positively or even negatively and are thus more likely to attend to sex-irrelevant stimuli instead of the sexual cues. In fact, it is thought that people with sexual problems may attend to possible reminders of previously experienced negative consequences of being involved in sexual behaviors instead of the actual sexual cues. Fewer attentional resources are then available for the processing of sexual information. This distraction from sexual stimuli may then result in a lack of or insufficient sexual arousal.^{2,4,5} For example, in men, there will be no erectile response of the penis. Similarly, in women, the absence of enhanced blood flow in the vaginal walls and thus the lack of lubrication may result in the experience of pain. In sum, this model assumes that both attentional and affective processes are included in the cognitive-emotional processing of sexual information.

Therefore, in clinical sex research implicit measures provide a welcome addition to the available arsenal of self-report measures. Implicit measures are suggested to reflect uncontrollable, reflexive, and fast mechanisms and thus are capable of providing information that complements explicit measures. Implicit measures are commonly based on reaction times that cannot be controlled. This appears beneficial because sex and sexual dysfunctions represent sensitive domains and are sensitive to socially desirable answering tendencies and self-representational concerns that can be counteracted with implicit tasks.⁶ Additionally, individuals might discard automatic associations as irrelevant, though these automatic associations might drive dysfunctional reflexive behaviors.^{7,8} Importantly, individuals may not have access to the relevant mechanisms that underlie their behavior (eg, attentional bias).⁹

The major aim of this review is to critically evaluate the contribution and promise of implicit measures of automatic sex-relevant cognitive processes to improve our understanding of the mechanisms involved in the development and persistence of sexual dysfunctions. More specifically, we aim to evaluate the

strengths and weaknesses of these procedures and to discuss how the field can set a critical step further by using implicit measures and by bringing the processes under experimental control via cognitive bias modification procedures.¹⁰

6 electronic main databases (AMED—The Allied and Complementary Medicine Database, MEDLINE, PsycArticles, Psychology & Behavioral Sciences Collection, PsycINFO, and SocINDEX) were searched in February and March 2019. The string (implicit* OR indirect* OR automatic* OR reflex* OR unconscious* OR involuntar* OR uncontrol* OR instinct*) AND (inform* OR stimul* OR process*) AND (sex* OR erotic* OR intercourse) AND (attention* OR orient* OR allocat* OR engagement OR inhibit* OR disengagement OR apprais* OR evaluat* OR associat* OR motivat* OR behav* OR tendenc* OR approach* OR avoid*) AND (dysfunction* OR disorder OR clinic*) was used for the search. In line with common divisions of automatic processes¹ and relevant components of the information-processing models of sexual behavior,^{2,11} this literature review was restricted to original research using implicit measures of automatic attentional processes, sex associations, and approach-avoidance tendencies. The review was further restricted to studies conducted with patients with sexual dysfunctions or non-clinical samples with extreme scores (ie, analogue groups).

ATTENTIONAL BIAS

The (lack of) inclination to automatically direct attention to specific stimuli may be important in the development and persistence of sexual disorders, and the type of attentional bias may vary as a function of the disorder. For example, it has been argued that the absence of common attentional capture of erotic stimuli might play a role for sexual dysfunctions such as low sexual desire and arousal. According to information-processing models of sexual functioning,^{2,4} individuals with low sexual desire evaluate sexual cues less positively or even negatively and are in turn less likely to attend to sexual stimuli as compared to individuals with higher levels of sexual desire. It is of high clinical relevance to examine these automatic attentional processes because low sexual desire is thought to be the most commonly experienced sexual problem among women, with prevalence rates ranging from 20% to 30%.^{3,12} When low or absent sexual desire is persistent or recurrent and results in distress or interpersonal issues, it may be diagnosed as female sexual interest/arousal disorder,¹³ previously referred to as hypoactive sexual desire disorder (HSDD).¹⁴ There are no empirically validated interventions for individuals suffering from low sexual desire.¹⁵

A different type of attentional bias is theorized to be at play in the generation and persistence of genital pain. Genital pain is a common phenomenon in women, and a great proportion of women report regular pain experiences during sexual intercourse.¹⁶ Genital pain and fear of pain are also core symptoms of dyspareunia (ie, coital pain that includes recurrent or persistent discomfort associated with attempts at or during sex) and

vaginismus (ie, inability to have vaginal penetration), today combined and known as genito-pelvic pain or penetration disorder (GPPPD).¹³ Current information-processing models of sexual functioning suggest that attentional processes are critically involved in the impairment of sexual arousal and thus the persistence of genital pain.² Accordingly, if attention is preferentially allocated to the threatening aspects of the sexual cues, this may impede the generation of sexual arousal. In the absence of sexual arousal and lubrication, any attempt of penile-vaginal penetration may lead to genital pain. Repeated pain experiences may enhance both fear of pain and vigilance for pain stimuli, resulting in further weakening of sexual arousal.

In this way, different attentional biases are thought to be at play in different sexual dysfunctions and for each a particular implicit task may be most appropriate. For example, the visual probe task (VPT) has been used to investigate whether indeed individuals with low sexual desire attend less to sexual cues compared to healthy controls.

VPT

A commonly used implicit experimental paradigm to assess attentional bias is the VPT, first described by MacLeod et al.¹⁷ In this task, 2 stimuli are presented simultaneously on the top and bottom of the screen for a brief period of time (eg, 500 ms). One of the stimuli is the target stimulus with emotional value (eg, sexual image) while the other represents a neutral control stimulus (eg, a chair). After the stimuli disappear, participants are asked to detect a probe that emerges on the location of either the target stimulus or the neutral stimulus. Participants are asked to respond with a button press to indicate whether the probe appeared on the top or bottom of the screen. Reaction times of trials in which the probe emerged on the target stimulus location (congruent trials) are compared to reaction times of trials in which a probe appeared on the neutral stimulus location (incongruent trials) and can provide information about attentional allocation. For example, if participants attend to the location of the emotional cue, they would be relatively fast on congruent trials. If they attend to the location of the neutral cue (and thus away from the sexual cue), they would be relatively fast on incongruent trials.

Prause et al¹⁸ used a VPT with sexual and neutral pictures that were presented for 500 ms before the probe appeared in order to examine if relatively low attention to sexual stimuli would be associated with relatively weak sexual desire. In apparent conflict with the hypothesis that sexual desire would show a positive relationship with visual attention to sexual stimuli, participants with high sexual desire were relatively slow on trials where the probe was presented on the location of the sexual stimuli. Thus, individuals with relatively low sexual desire were more inclined to allocate their attention to sexual stimuli than individuals with relatively high sexual desire. Although this finding is consistent with the view that attentional processes might be involved in sexual desire, it does not support the hypothesis that heightened

attention for sexual stimuli would contribute to sexual desire. Further experimental research is necessary to investigate how attention to sexual stimuli might be involved in sexual desire.

Brauer and colleagues¹⁹ used a similar VPT with 500-ms stimulus presentation time to examine whether women with HSDD would show lowered attentional capture by sexual stimuli than women without HSDD. Findings indicated that women were generally slower in detecting probes that replaced sexual images, independent of sexual functioning. Thus, participants in this study showed a general inclination to avoid looking at the sexual images, thereby questioning the proposed role of impaired attentional capture in HSDD. On the basis of these findings, it was proposed that perhaps different mechanisms are at play in clinical vs non-clinical groups with low sexual desire and that other factors such as affective processes may be more relevant in clinical samples.

The model of Barlow⁴ suggests that individuals with sexual problems are distracted by threat-relevant cues, and as alluded to earlier in this review, distraction may reduce sexual arousal. Consistent with the view that threat signals evoke increased vigilance and distraction, it has been argued that women with sexual dysfunctions will process sexual stimuli as threat-relevant. As a result, sexual stimuli will obtain processing priority and automatically capture their attention. To test if women with sexual dysfunction would indeed show an attentional bias for sexual stimuli, Beard and Amir²⁰ used a VPT with a stimulus presentation time of 500 ms. Using the Female Sexual Function Index, the authors classified undergraduates as experiencing sexual dysfunction or not. In line with predictions, participants in the sexual dysfunction group were faster to identify probes when they replaced sexual words than the no-dysfunction comparison group. Thus, indeed individuals with sexual dysfunction showed an attentional bias for sexual stimuli which may reflect their heightened current concerns with sex. Exploratory analyses additionally revealed that this relationship seemed to be particularly strong for women with sexual desire difficulties. However, due to the small sample size ($n = 25$ per group), this correlation should be regarded with caution.

Based on the results of the VPT we cannot conclude that individuals with low sexual desire attend less to sexual cues compared to healthy controls. It is important to keep in mind that attentional bias for sexual stimuli may arise from different sources. On the one hand, sexual stimuli may represent appetitive stimuli that elicit attentional capture and thus approach tendencies. On the other hand, sexual stimuli may also represent threat signals that elicit attentional vigilance to support fast escape and avoidance. Future research using varying presentation times (eg, 200, 500, 1,250 ms) may help to examine if the bias is restricted to initial orientation or whether it is also evident in maintained attention.²¹ This may in turn help to differentiate between sexual disorders such as individuals with low sexual desire or genital pain. In individuals with low sexual desire, we may expect low initial attention and similarly low attention for

longer presentation times. Because the stimuli are not motivationally salient there may be no bias at all. In contrast, when sexual stimuli are considered as threat stimuli as in individuals with genital pain, we may expect a vigilance avoidance pattern.

Another task that has been used to measure attentional bias is the so-called visual search task (VST). Instead of presenting 2 stimuli (a sex-relevant and a sex-irrelevant stimulus) as is done in the VPT, in the VST participants are presented with multiple stimuli at the time. This task allows to assess people's speed of detection of sexual stimuli as well as to what extent people are being distracted by sexual stimuli. Thus, it can differentiate between enhanced vigilance (faster detection of relevant cues) and distraction (heightened distraction by relevant stimuli).

VST

In the VST,²² each trial starts with a tone followed by a fixation cross in the middle of the screen. Then, participants are presented with a matrix of words or images. The participants' task is to indicate as fast as possible if the matrix contains words or images of the same category or contains 1 word or image from a different category (odd one out), by pressing a specified button of a response box. The VST is thought to measure attentional bias for stimuli of interest such as sex and pain.

Melles et al²³ investigated whether women with GPPPD show heightened attention for sex and pain in terms of faster detection and heightened distraction compared to non-symptomatic participants. For this, they used sexual words (eg, penetration), pain-related words (eg, irritating), and neutral words (eg, colors, nationalities) in a VST. No group differences in attentional bias were found. Yet, generally, across all groups, women were faster to detect sex and pain words than neutral stimuli. Additional analyses showed that slowed detection of sexual stimuli was related to lowered sexual arousal, which is consistent with the information-processing model.² Accordingly, impaired attention for sexual cues may impede the generation of sexual arousal. In this way, the VST provides support for the notion that the degree of sexual arousal is related to attentional processes when presented with sexual cues. To the extent that sexual desire is a cognitive component of sexual arousal,²⁴ this finding is in line with the work of Prause et al¹⁸ in which they used the VPT.

Both the VPT and VST make use of response times to infer conclusions about attentional processes. These response times may be influenced by factors such as motoric responses, which may add error or noise. As a more direct index of people's attention, some researchers measure eye movements to examine participants' natural or spontaneous viewing pattern.

Free-Viewing Task

Eye-tracker studies commonly use the free-viewing task to measure attentional processes including attentional biases. In this task, participants are instructed to look at sexual images or video material as they normally would do while their eye movements

are being recorded. The total dwell time for particular stimuli (eg, sexual vs non-sexual stimuli) and, similarly, the first fixation after the presentation of the stimuli are used to index people's viewing pattern. First fixation (latency) is suggested to be related to early attentional processes, which cannot be controlled.²⁵

Lykins et al²⁶ used the free-viewing task to test attention to and distraction from sexual stimuli in women reporting persistent pain with intercourse, women reporting low sexual desire, and women with no sexual complaints. They showed participants erotic images, each containing an object intended to distract from the erotic scene region. In each image of heterosexual couples engaging in sexual behaviors, a semantically inconsistent object (such as, a beach ball in an office) was digitally inserted. Research on general scene perception showed that scene regions that contained more information than others such as semantically inconsistent objects generally receive processing priority as also reflected in heightened visual attention.²⁷ Findings showed that women with sexual pain symptoms looked fewer times and for shorter periods at the sexual scene region as compared to women with low sexual desire and women without sexual complaints. They also looked more often and for longer periods at non-sexual scene regions compared to the control participants. These results support the cognitive distraction hypothesis, with cognitive avoidance in sexual pain patients. Actively avoiding the processing of sexual stimuli (eg, attention regulation) may interfere with the development of sexual arousal,²⁸ which in turn may contribute to the development or persistence of GPPPD.

The free-viewing task provides evidence that women with genital pain attend less to sexual cues than women with low sexual desire and non-symptomatic individuals. Certainly, more eye-tracking studies involving individuals with sexual dysfunction are needed. In fact, a systematic literature study from 2015 found 34 relevant studies that used video-based eye tracking in sex research but only one single study²⁶ involved a clinical sample.²⁹ Given that eye tracking is easily applicable and inexpensive compared to other physiological measures such as electroencephalography or fMRI, and preparation and measurement can be done fairly fast, there is a strong need for more research to shed light on attentional processes in sexual dysfunctions such as low sexual desire and genital pain. For example, the study of Lykins and colleagues²⁶ did not report participants' first fixation and it would therefore be critical for future research to investigate initial attention allocation together with total dwell time for particular stimuli in individuals with sexual complaints. If indeed individuals with genital pain are characterized by an attentional vigilance avoidance pattern, then they would first fixate on the sexual cues and then shift their attention away to non-sexual cues when being presented with erotic images. A more dynamic approach would be to present erotic video material while participants' eye movements are being assessed via the eye tracker.

Based on the results of the VPT, VST, and free-viewing task, automatic attentional processes are indeed involved in sexual

dysfunctions as demonstrated by studies that show differences in the corresponding groups; however, more research is needed to pinpoint which type of sexual disorder (eg, low desire, genital pain) relates to which type of attentional bias because different mechanisms seem to be at play. It would be necessary to systematically test responses to sexual cues of different types of sexual disorders. For example, initial attentional reactions could be measured with a viewing time of 200 ms in the VPT or the first fixation in the free-viewing task and maintained attention could be assessed with a viewing time of 1,000 ms in the VPT or the dwell time in the free-viewing task. When deciding which task to use, it needs to be considered that different from most free-viewing tasks, in the VPT the sexual stimuli are task-irrelevant and could thus be best ignored for optimal task performance. The VPT is therefore especially suited to test the ability to ignore sexual (or other target) stimuli and to focus on the task at hand. In this way, it assesses the more bottom-up automatic inclination to direct attention toward stimuli and/or the difficulty to redirect attention away from the task-irrelevant stimuli (eg, sexual cue). Thus, whereas the free-viewing task is best suited to index spontaneous attentional processes or preferences, the VPT is better suited to examine automatic attentional biases that interfere with their current task goal.

AUTOMATIC ASSOCIATIONS

According to information-processing models of sexual arousal,^{2,4} not only attentional processes but also affective processes play a role in sexual functioning. The absence of common positive automatic associations and/or the presence of negative automatic associations with sexual stimuli may play a role in sexual dysfunctions such as genital pain disorders. For example, it has been argued that disgust and threat may play a role in dyspareunia and vaginismus, or GPPPD.¹³ Particularly, disgust is assumed to be a defensive mechanism that protects the organism from contamination by pathogens. Disgust is related to avoidance tendencies and defensive reflexes that may help protect and avoid (anticipated) contamination.³⁰ This could be reflected in the involuntary contraction of pelvic floor muscles that are part of a general defense mechanism.^{31,32} Thus, GPPPD may at least partly be the result of a disgust-induced defensive response. In line with this view, women with vaginismus showed enhanced levels of self-reported trait disgust propensity.³³ However, no evidence was found to confirm that women also showed stronger disgust responsivity to sexual stimuli. Due to the explicit nature of this study, results may have been influenced by demand factors. Dual process models emphasize the importance to differentiate between more deliberate, reflective attitudes and more automatic, reflexive associations in memory.³⁴ Explicit cognitions tend to predict more deliberate behaviors, whereas automatic associations appear to play an important role in guiding relatively spontaneous behaviors, the kind of behaviors that seem also critically involved in disgust-and/or threat-induced defensive behavior. Therefore, the implicit association task (IAT) and the

affective Simon task (AST) were used to investigate whether indeed the presence of negative automatic associations with sexual stimuli may be involved in sexual dysfunctions.

IAT

Implicit evaluations or appraisals are commonly assessed using the IAT.³⁵ It involves a dual classification task and measures the strength of the association between concepts in memory. The basic notion is that participants respond faster to concepts that are strongly associated than concepts that are weakly associated in memory. Traditionally, there are 7 stages in the IAT with 2 targets (eg, male vs female) and 2 attributes (eg, positive vs negative). In the first stage, participants are asked to classify target words as quickly as possible as female or male. In the second stage, participants are asked to classify attribute words as quickly as possible as positive or negative. In the third stage, both targets and attributes are presented with “male/positive” sharing a response key and “female/negative” sharing a response key. Participants are then asked to classify words as quickly as possible using these combined categories. The fourth stage is similar to the third stage but with more repetitions of words. The fifth stage is a repetition of the first stage with the exception that the location of the 2 categories is reversed. The sixth stage is a repetition of the third stage with the exception that the categories would be in opposite pairings compared to previous trials. The last stage is similar to the sixth stage but with more repetitions of words.

Traditionally, the IAT uses 2 targets. However, the current studies all used a single-target version of the IAT task (ST-IAT).³⁶ An advantage of using only 1 target over 2 targets is that using a contrast category may influence the IAT score, which creates ambiguity with regard to the interpretation of this score. Similarly, in the traditional IAT, the attributes of positive and negative are used. However, modified versions of the IAT use attributes such as sexual vs non-sexual, sexually exciting vs sexually unexciting, and I like vs I don't like in order to avoid participants recoding the attributes into positive-negative and engaging in socially desirable answering.

Borg et al³⁷ used such modified versions of the IAT in order to examine if sexual stimuli elicit automatic disgust-related and/or threat-related memory associations in a group of women with vaginismus and dyspareunia compared to a group of sexually asymptomatic women. Specifically, they used 2 ST-IATs involving sexual penetration pictures (ie, target), 2 attribute categories for disgust: disgusting vs nice, and 2 attribute categories for threat: threatening vs safe. In line with results from explicit tasks,³³ results showed that the clinical groups showed stronger sex-disgust associations than the comparison group without sexual dysfunction. This is also in line with current information-processing models of sexual functioning² that assume that negative appraisal of sexual cues will lead to inhibition of sexual arousal and may thus result in genital pain. No difference between the clinical groups and the symptom-free

comparison group regarding sex-threat associations was found. However, the vaginismus group did show increased subjective threat (along with increased disgust) suggesting that in spite of the absence of automatic sex-threat associations, subjective threat appraisals of sexual stimuli seem nevertheless involved in genital pain symptoms.

To test the robustness of these findings, Melles and colleagues³⁸ examined whether sexual stimuli elicit relatively strong automatic and deliberate threat associations in women with vaginismus, compared with symptom-free women; and whether these automatic and more deliberate attitudes can be modified by therapist-aided exposure treatment. No difference in automatic threat associations between women with vaginismus and the comparison group was found; however, women with vaginismus (again) reported more deliberate threat associations compared to women without sexual dysfunctions. Concerning the exposure treatment, no change in automatic threat associations was observed; however, women with vaginismus reported a decrease in deliberate threat associations after treatment. The results are in line with the findings of Borg et al³⁷ and suggest that threat at a deliberate/reflective level of processing may play a role in genital pain symptoms and therefore seems a relevant target in exposure interventions.

In a related study, Melles and colleagues²³ again found no evidence for heightened automatic penetration-threat associations in women with GPPPD. However, strong automatic sex-threat associations were related to lower sexual arousal. Previous studies showed that self-reported threat appraisals may impede the development of sexual arousal.^{39,40} This is the first study to show that also more automatic sex-threat associations are related to low sexual arousal. In line with current information-processing models of sexual functioning,² strong threat values of sex may impede the person's readiness of having sex and interfere with the development of sexual arousal. To have interventions aimed at enhancing sexual arousal, it may therefore be critical to target both the more controlled/reflective and automatic threat appraisals.

Next to genital pain disorders, automatic associations also seem to play a role in sexual desire and arousal disorders. Particularly, most stimuli become incentives through learning: when a stimulus has once or repeatedly led to a rewarding sexual experience, such a stimulus is more likely to acquire a positive sexual meaning, especially if the rewarding experience includes orgasm.^{41,42} From this perspective, low sexual desire and arousal may be the result of a weak association between stimuli and sexually rewarding experiences (eg, due to the absence of an expected reward, through negative experiences, or both). Consequently, potentially sexually meaningful stimuli may fail to acquire positive meaning, or will lose it, which results in a limited number of incentives that are able to evoke sexual responses.⁴¹

Brauer et al¹⁹ tested the hypothesis that women with HSDD will respond slower to positive stimuli paired with sexual stimuli

than women without HSDD. For this study, the authors used a ST-IAT involving sexual images (ie, target) and 2 attribute categories: positive vs negative words. As expected, participants with HSDD showed less positive automatic associations with sexual stimuli compared to the control group. This finding is in line with models of sexual functioning^{2,4} that suggest that individuals with low sexual desire will appraise sexual stimuli as less positive than individuals with high sexual desire.

According to Barlow,⁴ men with sexual problems are more preoccupied with thoughts about dysfunctional erectile performance, they pay less attention to sexual cues, and have low self-efficacy in getting sexually aroused. Dysfunctional sexual performance is in turn experienced as confirmation of the preceding expectations, consequently reinforcing the vicious circle, and potentially resulting in chronic sexual dysfunction. Ample evidence is found for the involvement of deliberate negative cognitions in men with erectile dysfunction.^{43,44} However, only 2 studies examined whether this is the case in automatic processing.

Van Lankveld et al⁴⁵ assessed whether men with sexual dysfunction showed automatic associations of visual erotic stimuli with attributes representing affective valence ("liking"). Unexpectedly, results showed that compared to men without sexual dysfunction, men with sexual dysfunction showed stronger automatic associations of sexual stimuli with positive valence than with negative valence. This may suggest that automatic associations of sexual stimuli in men with sexual dysfunctions are relatively unaffected compared to more deliberate associations as previously found.

To test the robustness of these findings, van Lankveld and colleagues⁴⁶ assessed whether male urological patients will show automatic associations of visual erotic stimuli with attributes representing affective valence (liking vs non-liking) and sexual success vs sexual failure. According to Barlow,⁴ men with sexual dysfunctions would expect low personal efficacy in becoming sexually aroused and have more negative sexual self-schemas. When men with sexual problems are repeatedly exposed to contexts of sexual failure, such negative expectations can also be assumed to lead to stronger automatic associations of sexual stimuli with failure, which in turn may contribute to the persistence of sexual problems. The findings showed that the lower the scores on sexual functioning, the stronger the automatic sex-positive associations. This is in line with previous findings⁴⁵ and seems to be a robust phenomenon. It is possible that these associations may reflect a strong positive appreciation of sexual stimuli that may not necessarily be experienced with their own partner as a sexual stimulus. The sexual cues that were used in the studies depicted anonymous professional pornographic actors. The positive relationship may thus be the result of a learning process after repeated exposure to explicit pornographic material and association of these cues with the rewarding experience of orgasm through masturbation. This stands in contrast to the negative

emotional experiences with their partners. It still remains to be tested whether different outcomes may be found if stimuli depicting one's own partner are used to test automatic affective associations with sexual stimuli.

Based on the results of the IAT, automatic associations with sexual cues indeed appear to be involved in the development and/or persistence of (some) sexual dysfunctions. Negative emotions such as disgust and threat were shown to be related to sexual cues in women with sexual complaints and may thus be important targets of interventions in order to weaken dysfunctional associations and in turn diminish experienced symptoms. Surprisingly, in men with sexual difficulties, relatively positive associations with general/non-personalized sexual stimuli were found, which may reflect a discrepancy between their strong desire for positive sexual experiences and their actual sexual experiences. More research is necessary to shed light on these differences and to investigate whether other emotions such as shame are involved on an automatic level in patients with sexual complaints.

The IAT demonstrated high validity and reliability in assessing both individual and group differences in automatic attitudes^{47–49} as well as predictive validity for relatively automatic behaviors.⁵⁰ However, the IAT cannot be used to examine associations involving subcomponents of the concept of interest within the same task (eg, erotic stimuli with or without penetration). The AST seems more suited to that aim as will be demonstrated in the next section.

AST

The AST⁵¹ assesses automatic global affective associations with sexual stimuli. It consists of 3 phases. The first priming phase aims to strengthen the bond between the required response and the affective valence of the stimulus. For example, participants are asked to say “positive” when the stimulus has a “positive” valence and “negative” when it has a “negative” valence. In the pictorial version of the AST, all pictures are presented twice in portrait and landscape format. During the second and third phase, participants are asked to respond as fast as possible by saying either “positive” or “negative” to indicate whether the picture is presented in a landscape or portrait format. Prior to the actual AST, participants are presented with practice trials using neutral stimuli to become familiar with the procedure. The voice key records reaction times. Each trial consists of a fixation cross (500 ms) followed by a stimulus. A modified version of the AST is the extrinsic AST.^{52–54} In the extrinsic AST, participants use 2 response keys to sort target stimuli based on their format (portrait/landscape) and to sort the attribute stimuli on the basis of their valence (positive/negative). Participants are instructed to respond as fast and as accurately as possible to minimize any effects of deliberate stimulus appraisal. Evaluation of whether individuals find it easier (here speed or accuracy) to respond to a target picture with the positive or negative key enables inference of the valence of that stimulus.

Brauer et al⁵⁵ tested whether automatic negative associations with sexual stimuli are involved in women with superficial dyspareunia compared to symptom-free women. They used the pictorial version of the AST that involved 2 categories: penetration vs non-penetration pictures, and 2 attribute categories: positive vs negative words. Findings showed that participants with dyspareunia, similar to women without dyspareunia, showed relatively positive automatic associations with sexual stimuli. However, the women with dyspareunia reported more negative deliberate appraisals of sexual pictures compared to the no-dyspareunia comparison group. These findings are in line with previous studies involving men with sexual dysfunctions.^{45,46}

The study of Brauer et al⁵⁵ involved a sample of women with superficial dyspareunia who experience relatively mild symptoms compared to other genital pain disorders such as vaginismus. In patients with vaginismus, the mere prospect of sexual penetration may evoke negative automatic appraisals, which could lead to reflexive contractions of the pelvic floor muscles that hinder sexual penetration. To examine if pictures of sexual penetration elicit negative automatic and deliberate affective appraisal in women with vaginismus and dyspareunia, Huijding et al⁵⁶ conducted a similar study and found that automatic appraisals of sexual penetration pictures tended to be positive, independent of sexual complaints. Women with vaginismus reported more negative global affective appraisals of vaginal penetration than women with dyspareunia, or controls but only in the explicit task.

To test the robustness of these findings, Melles et al³⁸ investigated whether sexual stimuli elicit negative automatic and deliberate global affective associations in women with vaginismus, compared with symptom-free women, and if these automatic and more deliberate attitudes can be modified by therapist-aided exposure treatment. They used the pictorial version of the AST with 2 target categories: penetration vs non-penetration pictures, and 2 attribute categories: positive vs negative. Findings showed that women with vaginismus, similar to symptom-free women, showed relatively positive automatic global associations with sexual stimuli. However, the explicit global associations with sexual stimuli were found to be less positive in women with vaginismus. These results are in line with the study of Huijding et al⁵⁶ who investigated automatic associations in women with superficial dyspareunia. Concerning the exposure treatment, no change in automatic global affective associations was observed; however, deliberate (explicit) global positive associations with sexual stimuli were strengthened. This suggests that global affective associations may at a reflective level of processing play a role in genital pain symptoms and it may be beneficial to target these in exposure interventions.

Based on the results of the AST, there is quite some evidence suggesting that women with genital pain disorders do not show less positive automatic global affect with sexual stimuli. However, women with genital pain disorders demonstrated less positive

deliberate global affect or more negative deliberate global affect with sexual cues. These findings indicate that it may be beneficial to strengthen positive global affect in the treatment of genital pain.

Advantages of the AST include that it appears to be sensitive to individual differences.^{53,54,57} It is a non-relative measure of automatic associations, allowing for a more straightforward assessment of concepts that have no meaningful contrast. Importantly, it seems more robust against non-associative explanations of the effects than IAT.

Due to the limited number of AST studies, and because these studies are all restricted to women with genital pain, it becomes clear that more research needs to be conducted in order to investigate how automatic global affect is involved in other sexual dysfunctions such as low desire and arousal in women. We may speculate that these individuals would demonstrate relatively negative global affect to sexual cues, given that IAT studies showed associations with automatic threat, but this is to be examined in future studies.

APPROACH-AVOIDANCE TENDENCIES

Sexual arousal is said to produce motivational action tendencies that are directed toward sexual approach behavior.⁵⁸ Yet, when sexual arousal is related to negative emotions, sexual stimuli may elicit avoidance responses in order to stop ongoing sexual stimulation.⁵⁹ These behavioral approach-avoidance tendencies are assumed to work automatically and may either translate into or interfere with overt behavioral reactions. Specifically, automatic behavioral tendencies may either be congruent with the more controlled intentional approach-avoidance behaviors or also deviate from each other. In order to assess these automatic behavioral tendencies to sexual stimuli, the approach-avoidance manikin and joystick versions can be used.

Approach-Avoidance Task (AAT)

Humans have a tendency to approach pleasant stimuli and to avoid unpleasant stimuli. Already in the sixties, Solarz⁶⁰ investigated these affect-action interplays and found that participants were faster in responding with pull movements (approach) toward positive words and with push movements (avoidance) toward negative words. To investigate these behavioral tendencies in the context of sex research, the AAT is commonly used. The AAT can involve actual approach-avoidance motor responses or more symbolic responses. The approach-avoidance joystick task⁶¹ is a measure of actual motor responses in which participants are asked to react to stimuli that appear on a screen by either pushing (avoidance) or pulling (approach) a joystick. Slightly different, the approach-avoidance manikin task⁵¹ is a measure of symbolic responses in which participants are asked to move a manikin figure either toward (approach) or away from (avoidance) stimuli presented on the screen. In these tasks,

participants are asked to approach or avoid pleasant and unpleasant stimuli depending on a certain task-irrelevant feature (eg, the frame) that is not related to the stimulus content. Therefore, participants do not actually need to attend to the stimuli of pleasant or unpleasant nature per se. The compatibility effect assumes that when the task instructions match the automatic behavioral tendency of the participant in reaction to the stimulus content (eg, avoid the spider), the reaction time will be fast, whereas the reaction will be slowed down when the task instructions do not match the automatic behavioral tendencies in reaction to the stimulus content (eg, approach the spider).

In non-symptomatic samples, studies showed that individuals are faster in responding to sexual, than to neutral stimuli, independent of the direction.^{11,62,63} Several studies also showed that individuals are faster in approaching sexual stimuli than neutral stimuli.^{62,63} To our knowledge, no study has been conducted that explores automatic approach-avoidance tendencies in individuals with sexual dysfunctions. However, based on models of sexual arousal,^{2,11} one may speculate that individuals with sexual dysfunctions will demonstrate weaker approach or stronger avoidance tendencies to sexual stimuli. Because they may not attend as much to sexual cues and may not evaluate them positively compared to individuals without sexual complaints, they may also be less likely to approach them. Alternatively, they may have stronger approach tendencies to sex cues because they have a greater appetite for good sex. These are hypotheses that future research needs to explore.

An advantage of the manikin version over the joystick version is that in the joystick version, pulling the arm toward the body may be interpreted in 2 ways: moving away from the stimulus and bringing the stimulus closer to the body. Thus, there is a danger to confound by interpretation issues. Besides, the manikin version may be more sensitive as a measure of approach-avoidance tendencies than the joystick version.^{64,65}

CONCLUSION AND FUTURE LEADS

It becomes clear that implicit tasks are helpful tools to assess automatic cognitions and can thus examine mechanisms underlying sexual dysfunctions. Yet, this does not mean that explicit tasks should be disregarded. Current dual process theories⁶⁶ emphasize the relevance of both automatic/reflexive and more deliberate/reflective processes. In fact, combining automatic and deliberate cognitive mechanisms increased the explanatory power of psychological models in various areas of psychopathology.⁴⁹

Additionally, it may be relevant for future studies to include several implicit tasks that measure different automatic components of sexual arousal. According to models of sexual arousal,^{2,11} not only do automatic attentional, affective, and behavioral factors play a role in sexual functioning but they are also related. To test these relationships, within-subjects studies may be beneficial. As a cautionary note, it needs to be acknowledged that implicit tasks have to deal with the issue of (un)reliability

especially as a measure of individual differences. It is thus important to verify the test-retest reliability when investigating individual trajectories instead of group comparisons.^{67,68}

Lastly, most of the studies using implicit measures in clinical sex research are correlational in nature and are thus silent with regard to the alleged causal impact of attention/affect/behavioral tendencies on the concerns. It is crucial to further examine the mechanisms of cognitive and emotional processing in sexual dysfunctions in order to target them in treatment interventions. Specifically, implicit tasks can be helpful in sex therapy, for instance, by increasing the reliability of the diagnosis, for the assessment of therapeutic outcomes, or for the development of cognitive trainings. As an example, the VPT was originally used for the assessment of attentional bias but has been adapted as a training task.⁶⁹ To the extent that individuals with low sexual desire do not attend to sex-relevant cues, the probe may replace each stimulus (sex-relevant vs sex-irrelevant cue) 50% of the time in the control condition, whereas in the active training condition, the probe may replace the sex-relevant stimulus 100% of the time, thereby training sexually symptomatic participants to automatically attend toward the sex-relevant stimulus/away from the sex-irrelevant stimulus. Similarly, the VST was utilized as a training task.⁷⁰ Again, in the context of low sexual desire, patients may be presented with a matrix of stimuli and instructed to identify a single sex-relevant cue amongst sex-irrelevant cues in the active training group. In the control group, participants may be asked to identify a specific sex-irrelevant stimulus amongst other sex-irrelevant stimuli. Additionally, the free-viewing task provides a platform for the development of novel eye-tracking-based bias modification. Such trainings that aim for attentional shifts based on eye-tracking results are already being examined with pedophile men in a virtual-reality context.⁷¹ Meta-analyses and reviews showed positive effects of comparable cognitive bias modifications on anxiety, depression, and substance-use disorders.⁷² To improve current cognitive (attentional) bias modification intervention strategies, in their review, Heitmann and colleagues⁷³ recommend, amongst others, reporting both baseline attentional bias and attentional bias changes between groups over time, using various paradigms for the assessment task and the intervention to be able to differentiate between direct learning effects and generalization of newly learned processes, and using several follow-up measures over a long time period. These suggestions may also be relevant for cognitive bias modification interventions in sex research in order to improve our understanding of automatic processes in sexual dysfunctions.

To conclude, this review aimed at evaluating the contribution and promise of implicit measures to improve our understanding of the mechanisms involved in sexual dysfunctions. It is evident that there are various implicit measurement techniques to assess different automatic processes. Yet, it is too early to use these instruments in individual assessments and there is no sufficient ground to recommend individually tailored treatment at this stage. More research is needed to be able to translate the

knowledge of the automatic processes in sexual dysfunctions to clinical practice. Professionals in sexual medicine may then at some point in the future apply these dual process models in order to provide the best possible diagnosis, assessment, and treatment.

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Conflict of Interest: The authors report no conflicts of interest.

Funding: None.

STATEMENT OF AUTHORSHIP

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