

The Dual Control Model of Sexual Response: Relevance of Sexual Excitation and Sexual Inhibition for Sexual Function

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Abstract

Purpose of Review The dual control model of sexual response aims to explain sexual behavior and response through two factors, labeled sexual excitation and sexual inhibition. Sexual dysfunctions are common among women and men and pose a threat to the sexual health of both genders. The main objective of this paper was to review the latest findings concerning the predictive value of sexual excitation and sexual inhibition for sexual function and dysfunction in men and women.

Recent Findings Most relevant studies have been conducted in North America and Europe using non-clinical samples. Women and men with high sexual inhibition related to performance concerns and distractibility during sex report lower sexual function. In addition, high sexual excitation is associated with higher sexual function in both genders.

Summary Sexual excitation and sexual inhibition are predictors of sexual function in women and men. More prospective and clinical studies are needed to evaluate the usefulness of both propensities as predictors or moderators of treatment success.

Keywords Dual control model of sexual response · Sexual excitation · Sexual inhibition · Sexual dysfunction · Sexual function

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Introduction

Being satisfied with one's intimate relationships and sexual life is important for mental and physical health. Sexual satisfaction is associated with better self-perceived general health, greater psychological well-being and happiness [1–4], lower levels of depression and anxiety [5–7], as well as greater partnership satisfaction [8]. While experience of low desire for or interest in sexual activities, difficulties with sexual arousal or orgasm, and genito-pelvic pain are common sexual problems among women, men are most likely to be concerned about obtaining or maintaining an erection or early ejaculation [9]. The numerous associations between sexual, mental, and physical health underline the relevance of identifying predispositions and risk factors for the development of sexual difficulties.

Dual Control Model of Sexual Response

The dual control model of sexual response offers a theoretical framework to systematically assess factors that may predispose sexual difficulties [10]. According to this model, individuals differ in two propensities that facilitate or diminish sexual response in any given situation. Individuals are supposed vary across these two factors, called sexual excitation (SE) and sexual inhibition (SI), with a close to normal distribution [11–13]. This assumption has been confirmed in samples of men and women with different sexual orientations both inside and outside the United States [13–16]. While most levels of SE and SI are assumed to be related to adaptive sexual behavior or function, high levels of SI as well as low levels of SE are expected to be associated with increased vulnerability for sexual dysfunctions. High SE, especially when combined with low SI, has been shown to increase the likelihood of high-risk sexual behavior [17•].

This review provides an overview of the latest findings concerning SE and SI as predictors of sexual function and dysfunction in women and men. First, the different self-report questionnaires that have been developed to assess SE and SI in men and women, are presented. Describing the content and factor structure of these scales is helpful to evaluate the significance of specific aspects of SE and SI for sexual function. The following sections describe the relevance of SE and SI for sexual function in women and men, respectively. Finally, the findings are discussed with a focus on gaps in the literature as well as possible implications for future research and clinical practice. The latest, comprehensive review about the dual control model's relevance for different sexuality related outcomes was published in 2009 [17•]. The present paper will focus on studies that have investigated SE and SI with respect to sexual function and have been published afterwards.

Method

In February 2017, a literature search was conducted using Web of Science and PubMed. The following syntax was used: (“sexual excitation” OR “sexual inhibition” OR (“dual control model” AND “sexual”)) to find relevant studies that were published since 2008. Papers published earlier were identified by using the review by Bancroft et al. [17•]. In addition, authors of previous papers were contacted and asked to provide information about possible *in press* papers. A total of 134 papers were screened to assess their relevance for the present study. Twenty-eight papers that targeted SE, SI, and sexual function in humans were included in this review. These studies focused on validation or translation of different questionnaires to assess SE and SI or included data on the impact of SE and SI for women's or men's sexual function.

Measuring SE and SI

At least four different self-report questionnaires have been developed to assess SE and SI in male and female samples. An overview of these scales is presented in Table 1. The first questionnaire that was created to assess the two propensities in male samples was the Sexual Excitation Scale/Sexual Inhibition Scales (SIS/SES) [12]. This 45-item self-report instrument has three higher order factors, one reflecting SE (e.g., being easily aroused by sexual fantasies or other stimuli; SES), the other two relating to SI due to threat of performance failure (e.g., losing one's erection; SIS1), as well as inhibition due to threat of performance consequences (e.g., sexually transmitted infections; SIS2). The SIS/SES also includes ten lower order factors which tap into specific facets of SE and SI. Although the SIS/SES was originally developed to describe stimuli and behavior that were supposedly relevant for men's

sexual arousal, the scale also shows satisfactory convergent and discriminant validity in women [11]. In line with the model's assumptions, a significant gender difference was found with men consistently showing higher levels of SE, and lower levels of SI than women [11]. However, within-gender variability was much greater than differences between genders. In 2011, a 14-item short version of the SIS/SES was published [24]. Consisting only of the three higher order factors (SES, SIS1, and SIS2), this scale can be used when time or resources are limited. Items were selected to be fully measurement invariant for men and women. As the scale consists only of themes that are equally relevant for women and men, gender comparisons of SE and SI are feasible.

Despite the satisfying psychometric properties of the SIS/SES in a female sample [11], it was questioned whether the scale was equally suited for use in women. Therefore, another 36-item self-report questionnaire was developed based on results of a focus group study to identify topics that are specifically relevant for female sexual arousal and desire [25]. The Sexual Excitation/Sexual Inhibition Inventory for Women (SESII-W) assesses SE and SI with five and three lower order factors, respectively [26]. Psychometric properties (i.e., construct validity, internal consistency and test-retest reliability) of the original version [26] as well as Dutch [16], Spanish [22], and German [15] translations were acceptable to good and comparable across versions. To assess the validity and reliability of all translated versions will be an important step to ensure comparability across languages [27].

Based on the same item-pool as the SESII-W, another questionnaire was developed for the use in women and men. The Sexual Excitation/Sexual Inhibition Inventory for Women and Men (SESII-WM) includes 30 items that are measurement invariant across genders [28]. While having substantial overlap with the SESII-W—19 items are used in both scales—factor structure and remaining items differ between the two instruments, which prevents researchers from directly comparing results from both questionnaires.

To sum up, several, well-validated questionnaires are available to assess SE and SI in men and women. The scales of the SIS/SES, SESII-W, and SESII-WM are, however, not directly comparable. More research is needed to determine which scale is most appropriate to assess the two propensities of the dual control model in male and female samples and to clarify which instrument can predict specific sexuality-related outcomes such as sexual function or sexual risk-taking most effectively.

Dual Control Model and Sexual Function in Women

In 2008, the first study investigating the relationship between SE, SI, and sexual problems in women was published using the SESII-W in a non-clinical sample of 540 women [29]. The

Table 1 Comparison of different self-report questionnaires for sexual excitation and sexual inhibition

	Sexual Excitation Scales/Sexual Inhibition Scales (SES/SES)	Sexual Excitation Scales/Sexual Inhibition Scales—short form (SES/SES-sf)	Sexual Excitation/Sexual Inhibition Inventory for Women (SESII-W)	Sexual Excitation/Sexual Inhibition Inventory for Women and Men (SESII-W/M)
No. of items	45	14	36	30
Versions	Male and female version	Male and female version	Female version	One version for men and women
Translated versions*	German [18], Hindi [19], Urdu [20], Panjabi [20], Tamil [20], Sinhalese [20]	Dutch, German [18], Spanish [21]	Dutch [16], German [15], Italian, Polish, Portuguese, Spanish [22]	German, Portuguese [23]
Factor structure	Sexual excitation (SES) - Social interactions - Visual stimuli - Fantasizing about sex - Non-specific stimuli Sexual inhibition due to the threat of performance failure (SIS1) - Losing arousal easily - Partner concerns - Performance concerns Sexual inhibition due to the threat of performance consequences (SIS2) - Risk of being caught - Negative consequence - Pain/norms and values	Sexual excitation (SES) Sexual inhibition due to the threat of performance failure (SIS1) Sexual inhibition due to the threat of performance consequences (SIS2)	Sexual excitation (SE) - Arousability - Partner characteristics - Power dynamics - Smell - Setting (unusual/unconcealed) Sexual inhibition (SI) - Concerns about sexual function - Arousal contingency - Relationship importance	Sexual excitation (SE) - Arousability - Partner characteristics and behaviors - Setting (unusual/unconcealed) Sexual inhibition (SI) - Inhibitory cognitions - Relationship importance - Dyadic elements of the sexual interaction

Note. * Published translations and validation studies are provided if available

two strongest associations with both current and lifetime sexual problems were the inhibitory factor arousal contingency, which describes how everything has to be “just right” for sexual arousal to occur, and concerns about sexual function, which describes the loss of arousal due to worries about being a good lover or taking too long to reach orgasm. These findings were in line with the theoretical assumption of the dual control model that high SI is linked to vulnerability to sexual problems. The generalizability of the findings, however, was limited by the use of a non-clinical convenience sample and exclusion of non-heterosexual women. In addition, single item questions instead of validated questionnaires were used to assess sexual function and only cross-sectional data was used. Since then, several studies have been conducted to overcome these limitations and to further explore which aspects of SE and SI are the most relevant for sexual function in women.

A Dutch study examined and confirmed the discriminative validity of the SESII-W for sexual problems in a sample of 259 women with and 186 women without sexual problems [16]. Again, the arousal contingency factor discriminated best between these two subsamples. A strength of this study was the use of a semi-structured diagnostic interview based on the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) [30] criteria of female sexual dysfunctions in a subsample of participants. This procedure allowed for conclusions about the relevance of the dual control model for clinical female sexual dysfunctions. Another study compared different sexuality-related variables between healthy controls and women with different sexual concerns, namely low sexual desire and/or arousal difficulties [31]. In line with previous findings, women with sexual difficulties reported lower SE and higher SI. Compared to women with one sexual dysfunction—either low desire or arousal difficulties—women with low desire and arousal problems reported even higher levels of SI [31].

Homosexual or bisexual women differ from heterosexual women with respect to sexuality-rated traits or attitudes such as sociosexual orientation and sexual interest [32, 33]. Therefore, one study aimed to replicate previous findings concerning women’s sexual function and the dual control model using the SESII-W in a sample of sexual minority women ($n = 733$ bisexual women, $n = 241$ lesbian/homosexual women). While controlling for age, relationship duration, and relationship status, four lower order factors of the questionnaire were predictive of sexual problems. As expected, arousal contingency and concerns about sexual function were positive predictors of sexual problems in homosexual and bisexual women. Interestingly, relationship importance was a negative predictor suggesting that women who emphasize the need for trust and commitment in order to get aroused report higher sexual function. Partner characteristics, a lower order factor of SE, was predictive of sexual problems, indicating that women who are easily aroused by certain

attributes of a sexual partner reported more sexual problems. A possible explanation of this finding is that women who rely on partner characteristics or behavior in order to get aroused might be prone to sexual difficulties if their current partner does not meet their standards or desired attributes [29]. The authors conclude that the SESII-W can be used to reliably and validly to assess the factors of the dual control model in sexual minority women and that the associations between SE, SI, and sexual function in these samples are comparable to the associations found in heterosexual women [14••].

Age-related changes have been found with respect to different aspects of women’s sexual well-being. Older and postmenopausal women often experience lower sexual function compared to younger and premenopausal women [34, 35]. To evaluate if the propositions of the dual control model also apply to older women, researchers examined the relationships between SE, SI, and different sexuality-related outcomes in a sample of 185 women 50 years and older ($M = 59.46$, $SD = 6.96$) [36]. The pattern of results was similar to studies with younger women [16, 37••]. Three aspects of SE (arousability, smell, and partner characteristics) were positive predictors, while two factors of SI (arousal contingency and concerns about sexual function) were negative predictors of sexual function. Compared to other factors of the SESII-W, arousal contingency was the strongest predictor of sexual function in older women [36].

Sexual traumatization, especially childhood sexual abuse, constitutes an important risk factor for sexual difficulties in adult women [9]. Women with a history of sexual abuse in childhood reported higher SI and—when controlling for body esteem—lower SE than women who had not experienced sexual abuse. More research is needed to examine whether the sexual concerns often experienced by survivors of sexual abuse are mediated by SE and/or SI [38].

High SE and low SI were also associated with sexual desire in a sample of 29 postpartum and 30 nulliparous women [39]. In addition, group comparisons showed that postpartum women had lower SE and higher SI related to performance anxiety than women who never had children [39]. The authors suggest that women who recently gave birth may be concerned about pleasing a partner after going through the physical changes that accompany parturition and the typical lack of sexual interactions in late pregnancy [39].

Compared to healthy controls, women with either a panic disorder or generalized anxiety disorder had not only lower sexual functioning but also higher levels of SIS1 and SIS2 [40]. Future studies should clarify the relevance of SI for the relationship of anxiety disorders and sexual concerns in women.

A shortcoming of the previously mentioned studies was the sole use of cross-sectional data. To assess predictor and outcome variables at the same time does not allow researchers to estimate the direction of effects. When relying solely on cross-sectional data, it remains unclear whether SE and SI influence

sexual function or vice versa. It is likely that women who experience a sexual difficulty such as low desire or problems with orgasm evaluate their SE and SI levels in the light of their sexual concern. The first and only published study that aimed to overcome this limitation [37••] included 2214 participants and assessed both outcome variables—sexual function using the Female Sexual Function Index and SE and SI using the SESII-W—at three time-points. On a cross-sectional level, findings from previous studies were replicated. While controlling for partnership status and depressive symptoms, two aspects of SI, namely arousal contingency and concerns about sexual function, were negative predictors, and three aspects of SE, arousability, sexual power dynamics, and setting (unusual/unconcealed), were positive predictors of sexual function. Most of these SESII-W subscales were also predictive of sexual function 1 or 2 years later. Arousability and partner characteristics were even predictive of future sexual function above and beyond baseline sexual function levels.

To assess the impact of partner similarity in SE and SI on sexual function and sexual satisfaction in a sample of couples was the aim of another study. Using the SIS/SES questionnaire in a small sample of 35 newlyweds, greater similarity between partners for SIS1 and SIS2 was associated with fewer sexual problems in wives. In other words, a mismatch in SI between partners was related to more sexual problems in women [41].

There is substantial evidence for the predictive value of SE and SI for women's sexual function and dysfunction. With few exceptions, lower order factors of SE were positive, and lower order factors of SI were negative predictors of sexual function. Across all studies, the arousal contingency factor—which describes how everything has to be “just right” for sexual arousal to occur or how easily one is distracted from sexual arousal—was the strongest predictor. Evidence was consistent across women of different age groups, sexual orientations, as well as across European and American samples and using cross-sectional or longitudinal data.

Dual Control Model and Sexual Function in Men

During the late 1990s and early 2000s, Bancroft and colleagues applied the dual control model's assumptions and predictions to male sexuality and focused especially on explaining their relevance for men's sexual function [10, 12, 42•]. The importance of centrally acting inhibitory mechanisms as etiological and maintaining factors for erectile problems was proposed and confirmed [10]. Using the SIS/SES questionnaire, SIS1 and SIS2 were positive predictors of erectile problems (lifetime) in a sample of 313 heterosexual men [43, 44]. When current erectile problems were assessed, SIS1 was a positive and SES was a negative predictor. Similar associations for SIS1 and erectile problems were found in a

larger sample of homosexual men [45]. Neither SI nor SE was, however, predictive of early ejaculation [45]. Since then, research concerning the dual control model in male samples has been focusing more strongly on other aspects of men's sexuality such as sexual risk-behavior or hypersexuality [46–50]; few studies have investigated the relevance of SE and SI for different aspects of men's sexual function. One exception is the previously mentioned couples study that assessed how SE- and SI-similarity between partners is related to both sexual function and sexual satisfaction. In line with previous studies, higher SIS1 was associated with erectile problems in men. In addition, SES was associated with greater sexual satisfaction. Similarity of SE and SI between partners was not associated with men's sexual function.

In a sample of 71 men with and without sexual problems, men with erectile difficulties had lower SIS1 scores, while men with low sexual desire scored lower on SE compared to healthy controls [51]. The advantages of this study were the use of clinical sample and the inclusion of participants with other than erectile dysfunction.

In a small sample of 19 stroke patients, SES was positively associated with sexual desire, while SIS1 was negatively correlated with several aspects of sexual function such as erectile function, orgasmic function, sexual desire, as well as intercourse satisfaction [52]. This study underlines the significance of SE and SI beyond non-clinical, college-aged samples.

In a sample of 85 men with erectile dysfunction who were treated with PDE5 inhibitors, SE was significantly higher, and SIS1 was significantly lower in men with mild compared to men with moderate erectile problems. Interestingly, both SE and SI were not stable across the test-retest period of 3 months. While men with mild erectile problems experienced decreases in SIS1, men with more severe erectile problems reported decreases in SE and increases in SIS1 over the 3-month course of the study [53]. In some men, improvements in erectile function were related to higher SIS2, reflecting increases in SI related to fear of consequences of sexual activity. Men with improved erectile function may have more opportunities for sexual activity and may therefore experience more concerns related to the consequences of sexual encounters.

Discussion

The goal of this review was to provide an overview of the latest findings concerning the relationship between SE, SI, and sexual function in women and men. Low sexual arousal or desire are the most common sexual difficulties in women, while erectile dysfunction and early ejaculation are the most frequent sexual concerns among men [9]. If a sexual problem is frequent, enduring, and causes clinically significant distress, it can be diagnosed as a sexual dysfunction [54]. Sexual problems or dysfunctions—especially those related to low desire

and/or arousal difficulties—are related to low SE and high SI in both women and men. In women, two lower order factors of SI—arousal contingency and concerns about sexual function—are the most significant predictors of sexual problems across studies. Women who are easily distracted from their sexual arousal, who need everything to be “just right” for arousal to occur, and who are sexually inhibited by concerns about their sexual performance, are more likely to experience sexual problems. The arousal contingency factor has been described as an unconscious or automatic inhibitory mechanism, in contrast to a more conscious inhibition, which involves elaborate cognitive control (e.g., de-evaluation of a sexual partner or worries related to sexual performance or bodily appearance) [55]. The degree to which a woman perceives herself as distractible from sexual arousal is thereby significantly associated with her sexual experiences. In men, the strongest evidence was found for SIS1, which includes themes that are similar to the two before mentioned inhibitory factors relevant for women (e.g., having difficulties getting aroused, losing one’s arousal easily, having concerns about pleasing a partner).

Several studies with female samples have shown the relevance of SE for sexual function. In multivariate analyses, different facets of SE (i.e., partner characteristics, sexual power dynamics) were independently predictive of female sexual function [16, 29, 37••] above and beyond SI. Being easily aroused by a variety of stimuli may protect women from experiencing sexual problems, especially those related to low desire and arousal. The higher order factor of SE was also predictive of male sexual function in two studies [43, 51]. To the author’s knowledge, no published study has examined which specific aspects of SE are key for sexual problems in men. Sexually functional individuals perceive themselves as easily aroused by a multitude of stimuli, including sexual fantasies, partner behavior, visual stimuli, or the feeling of being desired sexually by a sexual partner, which in turn may prevent sexual difficulties.

Although these findings support the notion of both excitatory and inhibitory factors influencing sexual behavior, several empirical and conceptual issues remain. Both propensities combined explain approx. 15% of variance in women’s sexual functioning [37••]. However, it is still unclear how an individual with a low score of a hypothetical one factor of sexual arousability/excitability differs from an individual with low SE and high SI. In addition, preliminary evidence suggests that the simple equation “Greater SE leads to more or stronger sexual arousal” is an oversimplification, at least in female samples [56, 57••]. Sexual response patterns may be more complex than the dual control model suggests. Lastly, although various centrally acting excitatory and inhibitory pathways of sexual response have been identified [42•, 58], it remains unclear how these correspond to self-reports of SE and SI.

Implications for Future Research

The lack of longitudinal data precludes a causal interpretation of causes and effects [59]. One prospective study using a female sample has shown the predictive value of SI for future sexual function [37••]. Therefore, it remains questionable if low SE and high SI increase the vulnerability for developing sexual difficulties or are rather consequences of perceived sexual problems. Only few studies have included participants that have been diagnosed with a sexual dysfunction or are actively seeking treatment for sexual concerns [16]. As low sexual function is much more common than clinically relevant sexual dysfunctions [60], findings from non-clinical samples cannot be generalized to clinical populations. In addition, most studies have focused on general sexual function or have limited their study to certain sexual concerns such as erectile difficulties. More research is needed to evaluate the relevance of SE and SI for problems such as low sexual desire in men, orgasmic difficulties, or genital pain. To assess the value of SE and SI as predictors or mediators of treatment success might also be of further interest.

Clinical Implications

This review underscores the relevance of SE and SI for sexual dysfunctions in men and women. As both propensities are significantly associated with sexual function in both genders, psychosocial interventions that aim to reduce inhibitory factors (e.g., sexual concerns, distractibility) while also targeting SE, for example by improving sexual communication or identifying adequate sexual stimuli, may be promising.

Treatment research suggests that various psychological interventions can effectively improve sexual function in men and women [5, 61, 62]. Cognitive-behavioral treatment programs often include a number of different interventions such as sexual and psychological education, behavioral sex-therapy exercises, or cognitive restructuring of sexuality-related thought biases [62]. Self-exploration and sensate focus exercises may help individuals with low SE to familiarize themselves with their sexual responses and to identify which stimuli they find most arousing. In addition, these exercises may also reduce performance anxiety related to high SI.

Mindfulness-based interventions that aim to increase a non-judgmental acceptance towards bodily, and especially sexual, perceptions, and (negative) thoughts [63] have been found effective in improving sexual concerns in women with different sexual dysfunctions [19, 64, 65]. Mindfulness exercises might be effective to target problems related to high SI (e.g., promote acceptance of distracting thoughts or worries) and low SE (e.g., strengthen focus on the present moment and on bodily sensations). In addition, cognitive interventions can

be effective to identify automatic thoughts that are related to SE and SI [66].

Psychological interventions for sexual dysfunction in general and arousal difficulties in particular should address both low SE and high SI in order to improve sexual functioning. Thus far, psychosocial treatment programs for sexual concerns have mostly followed a “one size fits all” approach and have not specifically addressed issues related to low SE and high SI. It may be beneficial to explore which interventions are particularly effective for individuals with a medium-risk profile for sexual difficulties such as high SE/SI or low SE/SI.

Compliance with Ethical Standards

Conflict of Interest Julia Velten declares no potential conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by the author.

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