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The Effects of False Physiological Feedback on Tumescence and Cognitive Domains in Sexually Functional and Dysfunctional Men

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Abstract A false feedback paradigm was used to produce a discrepancy between expected and "actual" tumescence among 57 sexually dysfunctional and 58 sexually functional men randomly assigned to one of four false tumescence feedback conditions: negative (NEG), neutral (NEU), positive (POS), or no (NO) feedback. Participants predicted an erection score before viewing an erotic film and then received false tumescence feedback based on this score. Tumescence and cognitive ratings were obtained before and after the feedback. It was predicted that discrepancies would differ between dysfunctional and functional participants such that functional participants would have the ability to overcome discrepancies, whereas dysfunctional participants would not. As expected, POS decreased tumescence for dysfunctional participants and NO did not influence tumescence for either group. Unexpectedly, NEU decreased tumescence for dysfunctional participants and NEG decreased tumescence for functional participants. Despite tumescence changes, cognitive ratings generally followed the feedback that was given. These results only partially support current models of sexual dysfunction and behavioral regulation. Anxiety, self-focused attention, cognitive interference, and unexpectedness of the feedback could not account for the partial support. However, most feedback that was outside of the realm of the status quo for both functional and dysfunctional participants did decrease tumescence, despite outcome expectancies. These results suggest that both functional and dysfunctional men may be at risk for erectile failure should feedback about their performance be discrepant from what they expect. Prevention and treatment should focus on preparing men for occasional erectile failure and on helping them overcome discrepant feedback.

Keywords Erectile dysfunction · False feedback · Self-focused attention

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Introduction

Men with and without psychogenic erectile dysfunction (ED) are known to differ in key cognitive and behavioral domains during exposure to sexual stimuli, including self-focused attention (SFA). These differences formed the basis of Barlow's (1986) model of male sexual dysfunction and a modification of this model incorporating self-regulation theory (Sbrocco & Barlow, 1996). A presupposition of these models is that sexual behavior, like all human behavior, is regulated in a system of feedback control (Carver & Scheier, 1981). The processes of self-focus and behavioral regulation involve individuals using reference points for ensuing behavior. As individuals engage in tasks, they self-attend and monitor their actions with regard to their standards and experiences (Carver & Scheier, 1988).

Processing of Sexual Stimuli

Sexual stimuli are processed both subconsciously and consciously. This processing determines how individuals attend and respond to sexual stimuli (Spiering, Everaerd, & Elzinga, 2002; Spiering, Everaerd, & Janssen, 2003; Spiering, Everaerd, & Laan, 2004). Subconscious processing occurs rapidly and is predominantly automatic, whereas conscious processing is slower and involves interactions among past experiences, memory, emotional responses, and attentional focus. It has been hypothesized that the strong emotional valence produced by conscious sexual stimuli causes a delay in attentional

processing and decision making, termed the sexual content-induced delay (SCID) (Spiering et al., 2002). Exposure to conscious sexual primes results in slower categorization of target pictures than exposure to conscious neutral primes. Furthermore, conscious threatening picture primes have been shown to further delay categorization of targets as compared to sexual primes (Spiering et al., 2002).

Such findings suggest that any type of cognitive processing, especially conscious emotional processing, that distracts individuals' attention away from a task may negatively impact attention and decision making. In the context of sexual responding, conscious emotional processing, particularly from SFA, may distract individuals away from sexual stimuli, resulting in dysfunctional performance. In addition, sexual responding may be further inhibited if sexual stimuli are perceived as threatening (e.g., performance demands).

Self-Focused Attention and Outcome Expectancies

Ingram (1990) defined SFA as "an awareness of self-referent, internally generated information" (p. 156). Depending on the context, SFA generally follows an inverted U pattern and may or may not impact performance (Yerkes & Dodson, 1908). For instance, too much SFA can impair athletic and public speaking performance and is often associated with negative emotional states (Raglin, 1992; Spurr & Stopa, 2002; Zou, Hudson, & Rapee, 2007). A moderate amount of SFA can improve test and athletic performance should expectancies be favorable (Carver, Peterson, Follansbee, & Scheier, 1983; Raglin, 1992; Rich & Woolever, 1988).

SFA in relation to sexual activity is thought of as attention to one's own internal physiological and emotional states rather than to sexual stimuli. Sbrocco and Barlow (1996) posited that a turning point from functional to dysfunctional sexual performance is whether one can overcome discrepancies between expected performance and actual performance. Such discrepancies can produce SFA and emotional processing in the form of anxiety and can act as a distracter and possibly a threat, producing a SCID-like effect. Based on this model, the difference between function and dysfunction depends not solely on the presence or absence of non-erotic focus per se, but on a difference in the processes taking place within the individual.

For functional men, the content of the SFA includes positive expectancies and generally facilitates performance. However, among dysfunctional men, SFA often is associated with negative outcome expectancies and begins a cycle of focusing on non-erotic cues or attending to "task irrelevant" cues. These cues can be sexual performance demands (i.e., "Am I going to get an erection?") or non-sex related (i.e., "I really need to finish some work.").

In the sex literature, SFA has often been used as an "either-or" construct. Functional men are conceptualized as having a moderate amount of SFA and able to maintain an erotic focus on sexual cues whereas dysfunctional men are conceptualized as self-focused at the expense of erotic cues (i.e., a SCID-like effect). However, the context of the SFA is important for task engagement or task disengagement (Sbrocco & Barlow, 1996). While functional men appear better able to maintain task engagement (Abrahamson, Barlow, Sakheim, Beck, & Athanasiou, 1985; Beck, Barlow, Sakheim, & Abrahamson, 1987; Farkas et al., 1979; Geer & Fuhr, 1976), all men may be vulnerable to decreased tumescence from distracting cues (van Lankveld, van den Hout, & Schouten, 2004). The implication is that any non-erotic distraction away from sexual stimuli can negatively impact sexual responding for functional and dysfunctional men.

Self-Focused Attention and Discrepancy Induction

In order to induce SFA during sexual arousal, false feedback paradigms have been used to bring about discrepancies between expected and "actual" sexual performance for men (Bach, Brown, & Barlow, 1999) and for women (McCall & Meston, 2007; Palace, 1995). Bach et al. (1999) provided false negative tumescence feedback or no feedback to functional college males after viewing two erotic film clips. The negative feedback manipulation was associated with lowered expectancies and a decline in penile tumescence during a subsequent erotic film. Despite decreases in tumescence, the false feedback group did not report a significant decline in subjective arousal or an increase in negative affect.

Overall, distraction, including a non-erotic SFA and performance demand, can negatively impact sexual functioning of both functional and dysfunctional men. Functional men may demonstrate increases in tumescence when a moderate amount of SFA is induced, but decreases in tumescence when SFA and physiological arousal become too great. Dysfunctional men already are self-focusing upon entering sexual situations and, when exposed to sexual stimuli, their tumescence is limited. This difference highlights that functional and dysfunctional men may differ on two important steps in the cognitive-behavioral regulation of sexual function: discrepancy monitoring and outcome expectancies (Sbrocco & Barlow, 1996). Individuals should only seek to reduce a discrepancy when they feel challenged to achieve an erection. That is, when men feel that they need to perform (i.e., have an erection), they will feel challenged to increase their performance. For functional and dysfunctional men, the perception of challenge is expected to differ such that functional men can overcome the challenge whereas dysfunctional men cannot. The purpose of this study was to examine whether a discrepancy between expected and actual (i.e., false feedback) tumescence would affect tumescence and outcome expectancies differentially for functional and dysfunctional men.

Table 1 summarizes the expected influence of negative (NEG), neutral (NEU), positive (POS), and no (NO) feedback conditions on tumescence and cognitive variables. POS and

Table 1 Predicted effects of feedback condition on tumescence and cognitive domains

Feedback type	Group	
	Functional	Dysfunctional
POS		
Tumescence	↑	↓
Predicted erection score	↑	↑
Confidence	↑	↑
Subjective sexual arousal	↔	↑
Anxiety	↔	↓
Attention to body	↔	↓
NEG		
Tumescence	↑	↔
Predicted erection score	↔	↓
Confidence	↑	↓
Subjective sexual arousal	↑	↓
Anxiety	↓	↑
Attention to body	↓	↑
NEU	No changes	No changes
NO	N/A	N/A

NEG feedback were employed to prompt discrepancy adjustment and reduction as in Sbrocco and Barlow's (1996) model. Dysfunctional and functional participants were expected to respond differently to discrepancies because of their differing cognitive sets (outcome expectancies and confidence). The valence and change in outcome expectancies and confidence is believed to be crucial in understanding and predicting tumescence. The NEU and NO conditions were not expected to induce discrepancies for both groups and were conceptualized as control conditions.

When exposed to sexual stimuli, dysfunctional men were expected to self-focus on non-erotic cues and believe that their tumescence would be less than average. It was hypothesized that any type of discrepancy among dysfunctional men would make their negative outcome expectancies worse because they would not expect to overcome the discrepancy. Specifically, the POS condition was expected to induce a discrepancy (expect poor performance—performance exceeds prediction) and be associated with decreased tumescence. NEG was not expected to induce a discrepancy (expect poor performance—performance equals prediction) for dysfunctional men as it would mimic their typical performance. It was hypothesized that functional men would believe that their tumescence would be "average" (performance to meet the demand) during the sexual stimuli. Therefore, any feedback above (i.e., POS) or below (i.e., NEG) "average" was expected to induce a discrepancy and increase tumescence because functional men have the necessary cognitive set to compensate for the discrepancies.

Predicted erection score, confidence, subjective sexual arousal, anxiety, and attention to body were the cognitive variables of interest. Should men receive feedback about their sexual performance during real-life sexual encounters, these variables may influence future expectations of sexual encounters. That is, these variables could influence the feedback loop that individuals use to monitor and adjust their sexual behaviors. Cognitive interference and unexpectedness of feedback were chosen as exploratory variables to examine whether these variables influenced any significant results.

For dysfunctional participants, the discrepancy induced in the POS condition was expected to be associated with increased positive outcome expectancies, consequently increasing predicted erection score, confidence, and subjective sexual arousal. Anxiety and attention to body were expected to decrease as a result of POS. The opposite results were predicted for NEG, such that NEG would mimic the cognitive process they currently engage in and therefore have a negative effect on cognitive variables.

As described by Sbrocco and Barlow (1996), POS feedback was expected to mimic day-to-day experiences of functional men when they notice a discrepancy in sexual performance and successfully adjust responding. Therefore, POS was expected to result in an increase in predicted erection score and maintenance of positive outcome expectancies. Conversely, it was expected that NEG would serve as a challenge whereby functional participants would assess their future ability and respond with greater confidence in their ability to perform. They were not expected to alter their predicted erection score with NEG, but confidence and subjective sexual arousal were predicted to increase, whereas anxiety and attention to body were expected to decrease.

Method

Participants

Participants were heterosexual men, aged 18–60 years, from the Washington, DC metro area. They were without major medical problems known to impact sexual functioning or a current/partial remission Axis I psychiatric disorder (aside from Male Erectile Disorder for the dysfunctional participants). Heterosexual orientation was determined using the Kinsey scale and dysfunctional men met DSM-IV (American Psychiatric Association, 2000) criteria for Male Erectile Disorder-psychogenic origin. A total of 57 of 83 sexually dysfunctional participants referred by urologists met study criteria. Twenty-six dysfunctional participants were excluded from the study for primary diagnoses of premature ejaculation ($n = 11$), male orgasmic disorder ($n = 2$), anxiety disorder NOS ($n = 1$), major depressive disorder ($n = 5$), alcohol or substance dependence ($n = 2$), and presence of physical conditions (e.g.,

diabetes) or medication (e.g., anti-hypertensive) known to be associated with sexual difficulties ($n = 5$). Fifty-eight age- and race-matched sexually functional participants were recruited from newspaper advertisements.

Demographic characteristics are presented in Table 2. There were no significant differences in age across groups (functional, dysfunctional) or feedback conditions (POS, NEG, NEU, NO). There also were no significant ethnicity or marital status differences. Functional participants were more likely to have college and postgraduate degrees, $\chi^2(4) = 10.78$, $p < .05$.

Non-Responders

Kuban, Barbaree, and Blanchard (1999) found that penile circumference change less than a maximum of 2.5 mm does not reliably correlate with penile volume. Participants who did not meet this criterion were classified as non-responders. Consequently, responders were defined as participants who reached a maximum of 2.5 mm of tumescence change during *either* Film 1 or Film 2. Overall, 12.5% of functional (responders = 49, non-responders = 7) and 17.5% of dysfunctional (responders = 47, non-responders = 10) men were classified as non-responders. There was no significant difference between groups on the number of non-responders, $\chi^2(1) = .56$, *ns*. Preliminary analyses were performed with only responders and with all participants (responders and non-responders). There were few differences in the significant results when non-responders were included. Therefore, all participants were used in subsequent analyses.

Table 2 Demographic characteristics of functional and dysfunctional participants

	Group	
	Functional ($n = 58$)	Dysfunctional ($n = 57$)
Age (in years)		
M	42.0	43.5
SD	10.5	10.8
Range	21–60	21–60
Ethnicity (%)		
African American	39.3	33.3
Caucasian	55.4	54.4
Other	5.3	12.3
Education (%)		
High school degree or less	42.9	50.9
College degree	32.1	14.0
Graduate/Professional school degree	25.0	35.1
Marital status (%)		
Married	39.3	35.1
Single, never married	32.1	31.6
Separated, Divorced, or Widowed	28.6	33.3

Procedure

Participants were screened by phone to assess initial inclusion criteria (age, presence of ED, medical history). Participants meeting initial inclusion criteria were scheduled for a 2-½ to 3-h assessment. Upon arrival, participants were randomly assigned to one of four experimental groups (NEG, NEU, POS, NO) within their group (functional, dysfunctional). Participants were explained the nature of the study and informed consent was obtained. They completed a 1 to 1-½-h psychosocial interview and self-report measures. Additionally, medical histories, medical records, and a physician referral letters were reviewed by the project physician to rule out medical problems and medications that might impact sexual functioning or sexual desire. The Sexual Dysfunction Interview (SDI; Sbrocco, Weisberg, & Barlow, 1992) was used to assess sexual functioning and to determine study eligibility. The Structured Clinical Interview for the DSM-IV (SCID-IV; First, Spitzer, Gibbon, & Williams, 1994) was used to assess Axis I disorders, including sexual dysfunctions. The SDI and SCID-IV were used to make a DSM-IV diagnosis of Male Erectile Disorder of psychogenic origin. Following the diagnostic interview, participants were taken to a sound attenuated room where they were asked to disrobe from the waist down and be seated on a lined recliner. The participants placed a strain gauge 5–10 mm smaller than the circumference of their penises at mid-shaft and the experimenter ensured the strain gauges were properly attached. Participants' laps were covered so they could not see their genitalia during the experiment.

Film 1 was viewed without feedback by all participants. Following Film 1, the participants receiving false feedback were told they would view another 5-min erotic film, during which they would be shown a single erection score. They were informed that their "real time" scores would be based on a number of factors including erection size, rigidity, temperature, and blood flow and that the average score for other men was 12 (range, 0–24). They then were asked to predict the maximum score (predicted erection score) they would achieve during Film 2 and to predict how confident (confidence) they were that they would achieve that score. This score was used to create a single erection score for each participant such that (1) NEG received feedback 4 points less than predicted, (2) NEU received feedback equivalent to predicted, and (3) POS received feedback 4 points more than predicted. The NO group was told they would simply view another erotic videotape while their erections were measured. When maximum tumescence was reached (based on responding during Film 1), participants received the feedback score in the lower right corner of the video monitor for the entire 5-min erotic film clip. After Film 2, they were again asked to predict the scores they would

receive on a subsequent (bogus) Film 3 and to rate their confidence in these predictions. Participants then were informed there were no more films, they were asked to get dressed, and were debriefed.

During debriefing, participants were told the purpose of the study. Participants in the experimental groups were informed that they were given false feedback and the purpose of the feedback was explained. The explanations were designed to normalize the experience to ensure individuals had minimal lasting effects. All participants were provided with the experimenter's telephone number to call with further questions. Following debriefing, the experimenter thanked the participants, compensated functional participants $40 for their time, and dysfunctional participants were offered psychological treatment for their sexual dysfunction. No participants reported any problems/concerns after the experiment.

Penile Plethysmography

Changes in penile tumescence were measured using D. M. Davis, Inc., Stretchistor mercury-in-rubber strain gauges. Changes in penile circumference were detected using a Grass Instruments Dual Mercury Gauge Adapter (Model F-70DMG AC; pre-amplifier). The pre-amplifier output was channeled into a Grass Instruments 78G polysmonograph equipped with a 7P122H amplifier and a 7DAK driver amplifier. Tumescence was recorded on polygraph chart-paper moving at a speed of 50 mm/s. The polygraph was calibrated prior to each evaluation using a plexiglass calibrating cone. This calibration ensured that changes in erection, quantified as millimeters of penile circumference, corresponded to equivalent pen deflections on the polygraph chart-paper. The use of the mercury-in-rubber strain gauge to measure changes in penile tumescence has been shown to be a reliable and valid measure (Earls, Quinsey, & Castonguay, 1987; Farkas et al., 1979; Laws, 1977).

The psychophysiological assessment was conducted in a 7 × 10 foot sound attenuated chamber at the university with a 2 × 3 foot one-way mirror, through which the interviewer could observe the participants and the television monitor. The only objects in the room were a plastic upholstered recliner chair, a 27-inch television on a stand placed five feet in front of the recliner, and a table next to the recliner with a wireless intercom. Erection scores were displayed as a 5-inch white number in the lower right corner of the television screen. The experimenter in the control room generated and displayed the erection scores using a Sima Screenwriter Video Movie Character Generator, which received a signal from the VCR playing the erotic videotape.

Erotic Film Clips

Participants viewed two 5-min erotic film clips. Film clips were matched on content, depicting heterosexual couples engaged in consensual foreplay and consensual intercourse that did not contain any violence. A pilot study with 10 functional male participants indicated no difference between the two films in self-reported subjective arousal using a 100 cm visual analog scale (VAS) (Film 1 $M = 74.9$, $SE = 13.9$ vs. Film 2 $M = 76.3$, $SE = 13.8$) or self-reported size of erection (Film 1 $M = 60.0$, $SE = 14.1$ vs. Film 2 $M = 64.1$, $SE = 15.3$).

Self-Report Measures

Cognitive Variables

After Films 1 and 2, cognitive variables were assessed using a 100 mm VAS including subjective sexual arousal, anxiety, attention to body (i.e., SFA), confidence, cognitive interference, and attention to film. After Film 2, participants also were asked to rate the unexpectedness of the feedback score given during Film 2.

Predicted Erection Score and Confidence

Before Film 2 and the bogus Film 3, participants in the feedback conditions (NEG, POS, and NEU) predicted their erection score (from 0 to 24). Participants were told that the average score was 12. In reality, there were no actual erection scores and the average number was a bogus manipulation. They also rated how confident they were in their prediction (confidence). The VAS ratings were measured and transposed into ratings from 0 to 100.

Data Reduction

To facilitate data analysis, raw data, expressed in changes in mm of penile tumescence, were reduced to the mean mm of penile circumference change. For each 5-min film, penile response for each participant was divided into 50 epochs of 6 s. The first epoch of penile response was subtracted from subsequent epochs for each film. Epochs also were collapsed into an overall mean for each participant for Films 1 and 2.

Statistical Analyses

For each dependent variable, a 2 (Group: functional, dysfunctional) × 2 (Film: Film 1, Film 2) × 4 (Feedback: NEG, POS, NEU, NO) mixed model ANOVA was conducted with Group and Feedback as the between-subjects variables and Film as the within-subjects variable. For variables that were not repeated measures (i.e., unexpectedness of feedback), a 2 (Group) × 4 (Feedback) ANOVA was conducted, with Group and Feedback as the between-subjects variables. If an interaction was significant, simple effects were computed. Given the multiple statistical tests for the cognitive variables, a

Bonferroni correction was used setting α level at .01. For exploratory analyses, α level was set at .05.

Results

Baseline Tumescence Differences Between Groups

To evaluate potential baseline differences in tumescence between groups, a *t*-test on average tumescence for Film 1 was conducted. As expected, dysfunctional participants ($M = 6.1$ mm, $SE = 0.9$) had lower average tumescence during Film 1 than functional participants ($M = 9.7$ mm, $SE = 1.1$), $t(126) = 2.71$, $p < .01$.

Manipulation Check

To ensure participants' attention was affected by the false feedback, attention to film was examined. In agreement with the models of sexual functioning, there was a significant Feedback × Film interaction for attention to film such that NEG significantly decreased attention to film ($M = 104.0$, $SE = 6.8$ vs. $M = 88.6$, $SE = 6.3$), $F(3, 105) = 3.96$, $p < .05$, whereas POS, NEU, and NO produced no significantly change attention to film. There also was a Group × Feedback interaction for attention to film, $F(3, 105) = 3.21$, $p < .05$, such that within the dysfunctional group, NO ($M = 126.9$, $SE = 8.0$) participants had significantly better attention to film than NEG ($M = 97.8$, $SE = 8.3$), NEU ($M = 99.21$, $SE = 8.3$), and POS ($M = 89.4$, $SE = 8.3$) participants.

Effects of False Feedback on Tumescence

There was a significant Group × Feedback × Film interaction for tumescence, $F(3, 105) = 2.77$, $p < .05$; $\eta^2 = .07$. Changes in tumescence from Film 1 to Film 2 for each feedback condition by Group are displayed in Fig. 1. For the dysfunctional participants, NEU decreased tumescence from Film 1 ($M = 6.0$ mm, $SE = 1.7$) to Film 2 ($M = 3.5$ mm, $SE = 0.7$), $F(1, 105) = 4.22$, $p < .05$. Although not statistically significant, there was a trend for POS to decrease tumescence among the dysfunctional participants from Film 1 ($M = 6.1$ mm, $SE = 2.0$) to Film 2 ($M = 3.8$ mm, $SE = 1.5$), $F(1, 105) = 3.33$, $p = .07$. NEG and NO did not significantly affect tumescence for dysfunctional participants. For functional participants, NEG decreased tumescence from Film 1 ($M = 10.0$ mm, $SE = 1.9$) to Film 2 ($M = 7.0$ mm, $SE = 1.6$), $F(1, 105) = 5.58$, $p < .05$; however, POS, NEU, and NO did not affect tumescence.

Effects of False Feedback on Cognitive Domains

Table 3 summarizes the statistical tests for the group by feedback mixed model analyses on the seven cognitive variables. Table 4 presents the changes in VAS ratings of the cognitive variables from Film 1 to Film 2.

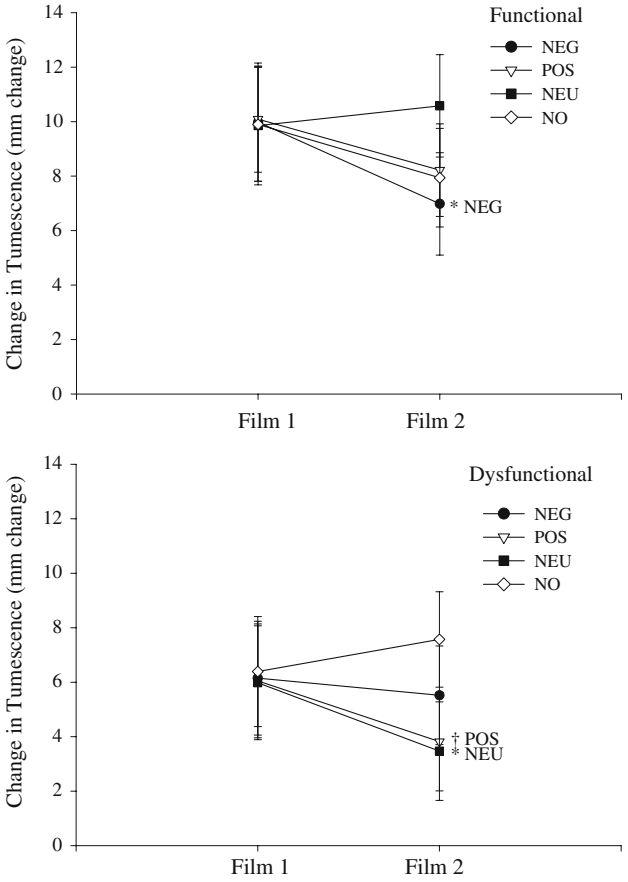

Fig. 1 Average tumescence by film and feedback condition (*$p < .05$; †$p < .10$)

Predicted Erection Score

As hypothesized, there was a significant Feedback × Film interaction for erection score. Regardless of Group, NEG decreased predicted erection score, $F(1, 78) = 90.11$, $p < .01$, and POS increased predicted erection score, $F(1, 78) = 37.73$, $p < .01$. There was also a significant main effect of Group such that functional participants ($M = 10.3$, $SE = .7$) predicted larger erection scores than dysfunctional participants ($M = 7.6$, $SE = .7$).

Subjective Sexual Arousal

There was a Feedback × Film interaction for subjective sexual arousal. POS significantly increased, $F(1, 105) = 12.32$, $p < .01$. NEG decreased, $F(1, 105) = 4.63$, $p < .05$, and NO increased, $F(1, 105) = 5.08$, $p < .05$, subjective sexual arousal, but not significantly.

Table 3 Results of mixed-effects model for cognitive variables for functional ($n = 58$) and dysfunctional ($n = 57$) participants

Variable	Group (G)		Feedback (F)		G × F		Film (Fi)		G × Fi		F × Fi		G × F × Fi	
	F	η^2	F	η^2	F	η^2	F	η^2	F	η^2	F	η^2	F	η^2
Predicted erection score	8.10*	.09	0.93	.02	2.16	.05	2.10	.03	0.68	.01	63.79*	.62	0.27	.01
Confidence	4.88*	.06	1.06	.03	1.16	.03	2.56	.03	0.01	.00	2.72	.07	0.01	.00
Subjective sexual arousal	1.38	.01	0.36	.01	0.24	.01	6.00	.05	1.52	.01	5.79*	.14	1.21	.03
Anxiety	1.91	.02	0.29	.01	0.25	.01	0.01	.00	0.30	.00	1.72	.05	1.33	.04
Attention to body	0.37	.00	0.77	.02	0.94	.03	7.95*	.07	1.42	.01	0.89	.02	2.05	.06
Cognitive interference	0.26	.00	3.70*	.10	0.35	.01	0.30	.00	0.60	.01	2.45	.07	1.10	.03
Unexpectedness of feedback	0.85	.01	5.50*	.13	4.71*	.11								

* $p < .01$

Table 4 Visual analogue scale of cognitive domains

	Film 1					Film 2				
	NEG M (SD)	NEU M (SD)	POS M (SD)	NO M (SD)	Total M (SD)	NEG M (SD)	NEU M (SD)	POS M (SD)	NO M (SD)	Total M (SD)
Predicted erection score	10.0 (0.9)*	8.9 (0.9)	8.5 (0.8)*	–	9.1 (0.5)	6.2 (0.9)*	9.3 (0.9)	10.8 (0.8)*	–	8.8 (0.5)
Confidence	74.3 (6.5)	80.2 (6.5)	60.9 (6.2)	–	71.8 (3.7)	72.0 (7.2)	82.5 (7.2)	77.5 (6.8)	–	77.3 (4.1)
Subjective sexual arousal	69.8 (7.7)	52.0 (7.7)	52.3 (7.3)*	62.0 (7.4)	59.5 (3.7)*	58.7 (7.8)	61.4 (7.8)	69.7 (7.4)*	73.3 (7.6)	65.8 (3.8)*
Anxiety	49.2 (7.2)	47.5 (7.2)	50.5 (6.8)	45.8 (6.9)	48.3 (3.5)	57.1 (6.9)	46.4 (6.9)	44.6 (6.6)	43.9 (6.7)	48.0 (3.4)
Attention to body	86.8 (7.4)	76.3 (7.4)	68.0 (7.0)	80.4 (7.1)	77.9 (3.6)*	91.9 (6.7)	85.0 (6.7)	84.8 (6.4)	84.8 (6.5)	86.6 (3.3)*
Cognitive interference	64.2 (8.1)	43.6 (8.1)	56.8 (7.7)	45.1 (8.2)	52.4 (4.0)	77.1 (7.4)	38.8 (7.4)	45.1 (7.0)	41.3 (7.6)	50.6 (3.7)

* Statistically significant difference between Films 1 and 2 at $p < .01$

Attention to Body, Confidence, and Anxiety

There was a main effect for Film such that attention to body increased from Film 1 to Film 2, but there were no significant interactions for attention to body. For confidence, there was a trend for a main effect of Group such that functional participants ($M = 82.2$, $SE = 4.9$) reported significantly more confidence than dysfunctional participants ($M = 66.8$, $SE = 4.9$). There were no main effects or interactions for anxiety.

Unexpectedness of Feedback and Cognitive Interference

To understand what variables may have influenced the results, we examined cognitive interference and unexpectedness of the false feedback. For cognitive interference, there was a significant main effect for Feedback, $F(3, 102) = 3.70$, $p < .05$, $\eta^2 = .09$, such that cognitive interference decreased from Film 1 ($M = 52.4$, $SE = 4.0$) to Film 2 ($M = 50.6$, $SE = 3.7$).

There was a significant Group × Feedback interaction for unexpectedness of feedback. Dysfunctional participants that received POS ($M = 83.6$, $SE = 11.5$) reported significantly more unexpectedness of feedback than those that received NEG ($M = 51.3$, $SE = 11.1$). Functional participants that received POS ($M = 92.4$, $SE = 10.3$) and NEG ($M = 94.1$, $SE = 11.5$) reported similar levels of unexpectedness of feedback, and reported significantly more unexpectedness of feedback than those that received NEU ($M = 38.2$, $SE = 11.5$).

To examine whether unexpectedness of feedback could account for unexpected results, we performed an exploratory 2 (Group) × 2 (Film) × 4 (Feedback) mixed model ANCOVA with average tumescence as the dependent variable and unexpectedness of feedback as a covariate. With unexpectedness covaried, there was a significant Film × Group × Feedback interaction, $F(1, 76) = 3.56$, $p < .05$, $\eta^2 = .09$. For the dysfunctional participants, NEU decreased tumescence ($M = 6.09$ mm, $SE = 2.13$ vs. $M = 3.64$ mm, $SE = 1.77$), $F(1, 76) = 4.96$, $p < .05$. For the functional participants, NEG ($M = 9.6$ mm, $SE = 2.26$ vs. $M = 6.39$ mm, $SE = 1.89$), $F(1, 76) = 7.62$, $p < .01$, and POS ($M = 9.76$ mm, $SE = 2.04$ vs. $M = 7.68$ mm, $SE = 1.70$), $F(1, 76) = 3.89$, $p = .05$, decreased tumescence.

Table 5 provides a summary of the effects of the feedback conditions on the cognitive variables by group. Findings are summarized by group where different and for both groups where similar results were obtained.

Table 5 Summary of the effects of feedback condition on tumescence and cognitive domains

	Dysfunctional	Functional	Both groups
NEG		↓ Tumescence	↓ Attention to film
		More unexpected than NEU	↓ Predicted erection score
			↓ Subjective sexual arousal[a]
			↑ Cognitive interference
POS	↓ Tumescence[a]	More unexpected than NEU	↑ Predicted erection score
	More unexpected than NEG		↑ Subjective sexual arousal
NEU	↓ Tumescence		
NO	More attention to film than NEG and POS		↑ Subjective sexual arousal[a]

Note: Unexpectedness of feedback suggests that certain feedback was not expected or predicted by participants

[a] Although result was not statistically significant, there was a trend for a difference between Films 1 and 2

Discussion

This study was designed to further understand the role of behavioral self-regulation and self-focused attention (SFA) in Barlow's (1986) and Sbrocco and Barlow's (1996) models of sexual functioning. As predicted, tumescence decreased in dysfunctional participants in response to POS, suggesting that they could not take advantage of their increased outcome expectancies (subjective sexual arousal and predicted erection score). Surprisingly, tumescence decreased for functional participants in response to NEG, which was accompanied by decreases in outcome expectancies. These results are consistent with findings among women with sexual arousal disorder (McCall & Meston, 2007). Unexpectedly, NEU decreased tumescence in dysfunctional participants, but had no effect on cognitive domains.

These findings are in partial agreement with the current models of sexual functioning (Barlow, 1986; Sbrocco & Barlow, 1996) and self-regulation theory (Carver & Scheier, 1981, 1988). Consistent with the models was that NEG did not affect the tumescence of dysfunctional participants because they expected feedback to be negative. Also consistent with self-regulation theory is that cognitive domains generally followed the feedback provided. Specifically, for both groups, NEG decreased and POS increased subjective sexual arousal and predicted erection score. When no feedback was provided, both groups continued with their normal responding with increased subjective sexual arousal. Inconsistent with these models was that anxiety and SFA did not account for these findings.

The basis of the models of sexual functioning (Barlow, 1986; Sbrocco & Barlow, 1996) and false feedback paradigms (Bach et al., 1999; Palace, 1995) is that outcome expectancies will change depending on feedback, which, in turn, will impact physiological sexual responding. In this study and a study by McCall and Meston (2007), physiological sexual responding was not always influenced by changes in outcome expectancies. Although outcome expectancies generally followed the feedback given in this study, they changed the tumescence of functional and dysfunctional men differently. For example, POS improved and NEU did not affect outcome expectancies, but POS expectedly decreased tumescence and NEU unexpectedly decreased tumescence in dysfunctional participants. Additionally, POS increased outcome expectancies but did not affect the tumescence, whereas NEG decreased outcome expectancies and decreased the tumescence of functional participants. Therefore, there may be other variables that can account for these findings.

It does not appear that cognitive interference or unexpectedness of feedback could fully account for these results. Cognitive interference decreased from Film 1 to Film 2, but did not produce differential changes across groups or feedback conditions. Although some feedback was perceived as unexpected, the unexpectedness was not consistent. As expected, dysfunctional participants found POS more unexpected than NEG, and demonstrated decreases in tumescence to POS. Functional participants found NEG and POS more unexpected than NEU, but only demonstrated decreases in tumescence when receiving NEG. When the unexpectedness of the feedback was accounted for, most types of discrepancy induction seemed to produce tumescence decreases such that dysfunctional participants receiving NEU and functional participants receiving POS and NEG had decreases in tumescence. Therefore, although the unexpectedness of the feedback did not directly alter tumescence, most discrepancy inductions did produce changes in tumescence.

Overall, NEG increased negative outcome expectancies and decreased the tumescence of functional participants, whereas feedback outside of the realm of perceived usual performance (POS and NEU) for dysfunctional participants decreased tumescence. In terms of prevention, it may be that all men are at risk of dysfunctional performance because of discrepant feedback. Men may only expect status quo performance and feedback during sexual performance, and may be unprepared when something out of the ordinary, either

positive or negative, occurs. Being unprepared sets them up for possibly attributing permanent explanations for what may have been a temporary condition. Men need to be educated by health professionals (i.e., urologists, psychologists, general practitioners) that many men experience temporary sexual performance discrepancies during their lives and that these experiences may have no bearing on future performance. This effort at widespread discrepancy inoculation could reduce the chance of being surprised when discrepancies occur during sexual activity. The idea is that if men are given the chance to process unexpected information prior to a sexual encounter, they will spend less cognitive energy processing discrepancies at a time when they need to focus their attention on sexual stimuli.

The findings of the present study must be taken in context with a number of limitations. The most obvious limitation is the fact that trying to get sexually aroused in a laboratory setting may not generalize to sexual arousal outside of the laboratory; however, most of the participants managed to achieve a certain level of arousal and tumescence with only a few "non-responders." In addition, many of the men, particularly dysfunctional participants, reported that the pressure they felt to perform in the laboratory felt similar to the pressure they feel to perform with partners. Another limitation is that the sexual functioning of functional men was based on self-reported interview. In future research, all functional participants should receive a comprehensive physical exam to rule out any potential influences of erectile failure.

Both functional and dysfunctional participants demonstrated equal subjective sexual arousal to both films in the pilot study as well as the experiment; however, tumescence was not equal between groups during the experiment, especially during baseline. Although this result is expected given that dysfunctional participants should have lower levels of tumescence, it calls into question the quality of the films to induce sexual arousal equally across all participants. Specifically, the choice of equally arousing stimuli often is a concern in studies of this type when the same stimulus is shown to all participants. The length of the segment and assessment period also may have influenced results. Future research is needed to determine an appropriate length of films to allow for the collection of as much important information as possible. Additionally, in future studies it may be more important for each subject to be maximally aroused than it is to ensure standardization of erotic material by allowing participants to choose their own type of film to watch. The two films were not counterbalanced and order effects could not be determined. Lastly, outcome expectancies generally followed the feedback (i.e., subjective sexual arousal and predicted erection score increased and decreased to POS and NEG, respectively), lending support that the feedback was believed; however, there was no direct measurement of how the participants perceived the feedback and whether they believed it.

In conclusion, the present study found that positive expectations may be necessary but not sufficient factors for successful tumescence. These results suggest that even positive outcome expectancies may not be useful if the feedback is discrepant. It is possible that functional men are not prepared to receive anything other than "status quo" information about their sexual functioning and have difficulty staying on task when they receive discrepant feedback. Dysfunctional men are used to negative feedback and may be further impaired by any other feedback. These results suggest that all men may be at risk for developing erectile dysfunction. Treatment should involve getting dysfunctional participants to stop seeking feedback until they are open to changing their expectations and can learn how to seek and receive accurate feedback. Inoculation or preventative education for functional participants could involve having them understand that decreased tumescence may occasionally occur and to not to lose confidence in their future performance.

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