THE MODIFICATION OF DYSFUNCTIONAL PATTERNS OF SEXUAL AROUSAL THROUGH FALSE PHYSIOLOGICAL FEEDBACK AND SYMPATHETIC ACTIVATION

by

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ABSTRACT

The effects of sympathetic activation, induced by an anxiety-eliciting film, and false positive vaginal blood volume (VBV) feedback were examined to identify the mechanisms by which cognitive and physiological response components mediate sexual arousal and may be modified to reverse the dysfunctional process. Sixty-four matched sexually dysfunctional women were randomly assigned to one of four conditions: (a) anxiety-evoking or neutral-control preexposure film stimulus paired with an erotic stimulus followed by, (b) false positive VBV feedback or no feedback. Sexual arousal was measured physiologically with a vaginal photoplethysmograph, and subjectively with a self-report rating scale. All subjects (1) viewed stimulus series 1 and rated their sexual arousal, (2) received the feedback condition and rated their expectations, and finally, (3) viewed stimulus series 2 and rated their subsequent arousal. Consistent with Palace and Gorzalka (1990), anxiety as compared to neutral preexposure significantly enhanced the rate and magnitude of genital arousal. Women who received false VBV feedback reported significantly greater subjective expectations of sexual arousal, and consequently demonstrated a significant increase in their actual vasocongestive responses. Women who received false feedback and neutral preexposure subsequently also reported significantly greater perceptions of sexual arousal. Comparison of women in the false feedback groups who significantly increased their expectation with those who

exhibited no change, revealed that within 30 seconds, positive expectancy caused significant increases in actual physiological response. Finally, comparison of the subjective and genital responses of the four groups revealed that women exposed to anxiety-eliciting stimuli and false VBV feedback demonstrated the greatest increases in cognitive expectations and subsequent genital response. At stimulus series 2, dysfunctional women in this group achieved levels of vasocongestion comparable to sexually functional women in the Palace and Gorzalka (1990) investigation. These results (1) reveal that cognitive and physiological processes are key components of sexual response, (2) identify interactive mechanisms by which these components mediate sexual arousal, (3) suggest a cognitive-physiological model of sexual dysfunction, and (4) provide evidence that interventions directed toward increasing physiological response and cognitive expectancy via sympathetic activation and feedback will reverse the dysfunctional process and initiate a positive cognitive-physiological feedback loop of sexual arousal.

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The Modification of Dysfunctional Patterns of Sexual Arousal through False Physiological Feedback and Sympathetic Activation

Three decades of research have been directed toward identifying the interrelationship between subjective and physiological response components in the determination of human emotion. Since Schachter and Singer's (1962) two-factor theory of emotion, and Valins' (1966) reformulated cognitive theory, extensive research has been devoted to clarifying these processes in the mediation of fear and anxiety. In contrast, psychophysiological research on the mechanisms mediating sexual arousal is still in its infancy (Rosen & Beck, 1988). Specifically, innovative and promising research to identify the relationship between cognitive and physiological processes in women has been initiated over the past two decades. However, research progress on women has lagged behind that of men. Controversy exists in the literature regarding how best to operationalize the construct of female sexual arousal, and which response components reliably discriminate clinical from nonclinical patterns of sexual response. Identification of key response components and their interactive processes in mediating sexual arousal has major implications for (a) defining the construct of sexual arousal, (b) determining valid and reliable assessment measures, (c) deriving an etiological theory of sexual dysfunction, and (d) developing effective treatment methods for the alleviation of sexual dysfunction in women.

Patterns of Sexual Arousal

Until recently (Palace & Gorzalka, 1992), contradictory findings in the literature on the relationship between subjective and physiological patterns of sexual arousal in women were unresolved. Wincze, Hoon, and Hoon (1976) compared the responses of six women seeking treatment for heterogeneous sexual dysfunctions and six nonclinical women during the presentation of a 7-minute erotic stimulus that consisted of a silent black and white videotape of a couple engaging in sexual foreplay. A battery of self-report measures included rating the degree of sexual arousal on a 7-point Likert scale. Physiological data were obtained using the direct current (d-c) signal from the vaginal photoplethysmograph which measures vaginal blood volume (VBV) and reflects location-specific changes in the pooling of blood in the tissue. Their results revealed that dysfunctional women exhibited significantly less physiological sexual arousal in response to erotic stimuli than functional women. Contrary to the authors' hypotheses, no significant group differences were found on subjective ratings of sexual arousal. Wincze et al. suggested that these ratings may reflect demand characteristics of the experimental setting, causing dysfunctional women to report higher levels of arousal than actually experienced. They concluded that these findings (a) provide evidence for the validity of VBV as a diagnostic indicator of sexual dysfunction, and (b) support a behavioral-physiological interpretation of sexual dysfunction which suggests that dysfunctional women possess a constrained or

narrowed repertoire of sexual behavior that may be gradually increased in variety and frequency in order to enhance physiological response.

Morokoff and Heiman (1980) reported several potential confounding factors in the Wincze et al. (1976) investigation including the use of unmarried sexually functional subjects as a comparison group for the married dysfunctional women, and a design where half of the functional but none of the dysfunctional women viewed a dysphoric film prior to the erotic stimulus. In an attempt to clarify and extend the findings of Wincze et al., Morokoff and Heiman used a 9-minute erotic stimulus that consisted of a silent color videotape of a couple engaging in foreplay and intercourse, a 6-minute erotic audiotape, and sexual fantasy to compare the responses of 11 women experiencing low arousal and inorgasmia to 11 nonclinical women. Subjective measures included rating the degree of sexual arousal on a 5-point Likert scale. Physiological data were obtained using the alternating current (a-c) signal from the vaginal photoplethysmograph which measures vaginal pulse amplitude (VPA) and reflects the strength of the cardiac pulse in the vaginal tissue. Contrary to the authors' hypotheses, no significant group differences were found on physiological response. However, dysfunctional women rated their sexual arousal as significantly lower than functional women. No significant correlations were found between VPA and ratings of sexual arousal during the film condition for either group. They concluded that these findings

(a) provide evidence for the validity of subjective measures as diagnostic indicators of sexual dysfunction, and (b) support a cognitive-affective interpretation of sexual dysfunction which suggests that women with low arousal do not attend to genital cues, and that cognitive techniques focusing on the experience of arousal may enhance subjective perceptions (Heiman, 1977; Morokoff & Heiman, 1980).

Comparison of the Wincze et al. (1976) and Morokoff and Heiman (1980) investigations reveals seemingly opposite results, conclusions, and implications. Whereas Wincze et al. found that sexually functional and dysfunctional women experience different physiological but similar subjective responses to erotic stimuli, Morokoff and Heiman found that these groups experience similar physiological but different subjective responses. To resolve the apparent discrepancy, Palace and Gorzalka (1992) conducted an investigation designed to (a) systematically replicate the contradictory findings using erotic stimulus videotapes adapted from the original investigations; (b) reconcile the discrepancy by providing data supporting an explanation for the seemingly contradictory findings; and (c) provide empirical evidence clarifying the structural patterns of physiological and subjective sexual response in sexually functional and dysfunctional women.

The Palace and Gorzalka (1992) investigation extended the methodology of previous research in several respects. First, in addition to the original erotic stimulus videotapes, a videotape was included that contained a wide range of sexual

stimuli (i.e., color, sound, sexual activities, and verbal interactions). This stimulus was found to reliably evoke sexual arousal in sexually functional women (Palace & Gorzalka, 1990; J. P. Wincze, personal communication, May 27, 1987). Second, the system of data collection and reduction was designed to provide more valid and reliable physiological data. Hand-calculated deviations from baseline polygraph recordings sampled at 4-second intervals (Wincze et al., 1976), or a single mean derived from the peak-to-peak amplitude of the two 10-second intervals with the greatest response magnitude (Morokoff & Heiman, 1980), were replaced by the direct analog-to-digital (A/D) transfer of 0.0001 mV changes in VBV at 0.20-second intervals across the duration of the stimulus presentations. Third, although an extensive battery of self-report measures were employed in previous studies (Morokoff and Heiman, 1980; Wincze et al., 1976), investigators measured subjective sexual arousal by a single item. To provide a broader definition, encompassing a range of perceptions that may be attributed as sexual arousal, sexual arousal was defined by five self-report items adapted from a more recent version of the Film Scale (Heiman and Rowland, 1983). Fourth, to control for preexisting levels of sexual experience, rather than matching functional and dysfunctional groups on the number of years married, groups were matched on (a) the duration of sexual experience calculated as the difference between age at first intercourse and current age, and (b) the range of experienced sexual behaviors, assessed by Experience subtest

scores from the Derogatis Sexual Functioning Inventory (DSFI; Derogatis, 1978). Finally, in accord with suggestions in the literature that the lack of group differences in subjective ratings may be related to experimental demand (Wincze et al., 1976) or social dictates which inhibit women from reporting sexual arousal (Palace & Gorzalka, 1990), scripts were specifically designed to minimize reactivity to assessment by promoting honesty and assuring anonymity and confidentiality.

Palace and Gorzalka (1992) compared the subjective and physiological responses (VBV) of sixteen women referred from therapists for treatment of heterogeneous sexual dysfunctions and sixteen nonclinical women during the presentation of the three erotic stimuli. Systematic replication of the original methodology employed by Wincze et al. (1976) and Morokoff and Heiman (1980) resulted in the replication of several seemingly contradictory findings. Analysis of subjective ratings for the single item "sexually aroused" revealed no significant differences between functional and dysfunctional groups on the Wincze et al. stimulus; and a significant difference on the Morokoff and Heiman stimulus. Since the Wincze et al. stimulus was marginally less subjectively arousing than the Morokoff and Heiman stimulus for functional subjects, a single subjective item was unable to statistically differentiate groups. Analyses of subjective ratings across a range of items designed to assess sexual arousal revealed that the dysfunctional group reported significantly less sexual arousal than the functional group in all three stimulus conditions. Consistent with the

findings of Wincze et al., analysis of the physiological data using 4-second time samples revealed a significant difference between groups on the Wincze et al. stimulus. Contrary to the findings of Morokoff and Heiman, a significant difference was also found on the Morokoff and Heiman stimulus using both their film stimulus and data reduction technique. Analysis of physiological response using 0.20-second time samples revealed that the dysfunctional group demonstrated significantly less genital arousal that the functional group in all three erotic stimulus conditions within 30 seconds. These findings, using VBV sampled and reduced by three different strategies (ranging from 4- to 0.20-second time samples and 1 to 45 time blocks) across three significantly different arousal-eliciting stimulus conditions, consistently revealed significant differences between functional and dysfunctional women. We suggested that VBV is a more sensitive indicator of sexual arousal than VPA since it reliably discriminates dysfunctional from functional patterns of sexual response.

The findings from the Palace and Gorzalka (1992) investigation are threefold: First, they replicated several seemingly contradictory findings in the literature (Morokoff & Heiman, 1980; Wincze et al., 1976). Second, they reconciled the discrepancy by providing evidence that contradictory findings may be explained and resolved by the use of improved methods of physiological data collection and reduction, broader assessment of subjective arousal, manipulation checks to assess the arousal-eliciting capacity of erotic stimuli, and scripts

designed to reduce social demand. Third, they provided strong evidence that sexually functional and dysfunctional women exhibit different patterns of physiological and subjective sexual response. These results reveal that subjective experience and genital vasocongestion are two primary components of sexual response that reliably discriminate dysfunctional from functional arousal patterns, where dysfunctional women exhibit significantly lower levels of physiological and subjective arousal within 30 seconds of responding to sexual stimuli.

These findings have major implications: First, they suggest that physiological response and cognitive experience are critical components in defining the construct of sexual arousal. Second, they reveal that VBV and subjective ratings reliably detect group differences and may provide valuable measures for the diagnosis and assessment of sexual dysfunction. Third, they support a cognitive-physiological etiology of sexual dysfunction where both components are integral to the facilitation or inhibition of sexual arousal. That is, sexual dysfunction may be the result of an interactive process whereby negative cognitions and decreased physiological responsivity form a negative feedback loop. Finally, these findings suggest that effective treatment methods may be directed toward modifying negative cognitions and enhancing physiological response in order to reverse the dysfunctional cycle and initiate a positive cognitive-physiological feedback loop of sexual arousal.

The key questions that remain concern the mechanisms by which cognitive and physiological components interact to mediate sexual arousal, and can be modified to reverse the dysfunctional process. That is, how do cognitive and physiological processes interact to produce arousal, or conversely, to prevent arousal and produce a dysfunctional pattern of sexual response? To investigate these questions, two areas of research will be reviewed. Physiological mechanisms will be explored by examining the effects of modifying sexual arousal through anxiety-induction. Cognitive mechanisms will be explored by examining the effects of modifying cognitions through false physiological feedback.

Anxiety and Sexual Arousal

Anxiety has been viewed as a major determinant of low sexual arousal and a leading cause of sexual dysfunction in men and women. Wolpe (1958, 1982) has claimed that anxiety reciprocally inhibits the parasympathetic response components that elicit sexual arousal. Masters and Johnson (1970) described anxiety as the greatest known deterrent to sexual arousal due to its effect of inhibiting physiological response by interfering with the reception of sexual stimuli. Similarly, Kaplan (1974, 1988) has identified anxiety as the critical mechanism that prevents physiological sexual arousal through the disruption of autonomic nervous system functioning. Based on these assumptions, researchers and clinicians have widely adopted anxiety-reduction techniques in their treatment of sexually dysfunctional men and women. However, programs

incorporating sensate focus for the alleviation of performance anxiety in women experiencing orgasmic dysfunction have revealed failure rates ranging from 26% to as high as 75% (e.g., Andersen, 1983; Cooper, 1981; Crown & D'Ardenne, 1982; Kuriansky & Sharpe, 1981). In addition, a review of controlled studies that employed systematic desensitization for the treatment of inorgasmia revealed no significant change in orgasmic frequency (Andersen, 1983).

One explanation for the questionable efficacy of anxiety-reduction techniques for the treatment of sexual dysfunction is the assumption that autonomic control of sexual arousal is predominantly parasympathetic. Despite general acceptance that parasympathetic activation is required for the arousal response, the autonomic pathways and processes by which sexual excitation is initiated and heightened remain a matter of conjecture (Schnieden & Rees, 1985). Barlow (1986) has argued that anxiety-reduction techniques, which are presumed to enhance sexual arousal by increasing parasympathetic response and/or decreasing sympathetic response, are derived from etiological hypotheses based on clinical inferences rather than empirical data. Techniques such as sensate focus therefore enjoy widespread clinical popularity despite their lack of a theoretical rationale supported by empirical knowledge of the initiating stimuli and autonomic processes that control female sexual arousal. Contrary to etiological assumptions of more than 30 years, a growing research literature indicates that heightened anxiety, characterized by sympathetic activation,

may enhance rather than inhibit sexual arousal.

P. W. Hoon, Wincze, and Hoon (1977b) demonstrated that sexual arousal is enhanced in sexually functional women when they are exposed to an anxiety-evoking rather that relaxation-inducing film stimulus prior to exposure to sexual stimuli. Investigations with sexually functional men have also demonstrated a facilitatory effect of anxiety on sexual arousal, in which anxiety has been operationally defined as crossing a fear-arousing suspension bridge (Dutton & Aron, 1974), viewing an anxiety-evoking film segment (Wolchik et al., 1980), receiving the threat of a shock contingent on the size of erection (Barlow, Sakheim, & Beck 1983), and receiving performance demand instructions to self-monitor and maintain an erection (Heiman & Rowland, 1983). These studies provide evidence against the role of anxiety as an inhibitory mechanism and demonstrate that in certain conditions, anxiety enhances sexual arousal in functional men and women.

To examine the effects of anxiety on sexually dysfunctional men, J. G. Beck, Barlow, Sakheim, and Abrahamson (1984, cited in Barlow, 1986) systematically replicated their shock threat paradigm (Barlow et al., 1983) using matched sexually dysfunctional and functional men. Penile tumescence was measured during each of three counterbalanced conditions in which subjects viewed an erotic film: (a) contingent threat (performance anxiety), (b) noncontingent threat (generalized anxiety), and (c) no shock. Similarly, Heiman and Rowland (1983) compared self-reported sexual arousal and penile

tumescence in two preexposure conditions paired with erotic tapes: a performance demand set, instructing the subjects in the importance of self-monitoring and maintaining an erection, and a non-demand sensate focus set, instructing the subjects to relax and enjoy any pleasurable sensations that might occur. The results of these investigations revealed that sexually functional and dysfunctional men respond differently to pairings of anxiety-evoking and erotic cues: Anxiety, defined as performance demands to maintain an erection either by verbal instruction or contingent on shock, increased physiological sexual arousal in functional men and decreased physiological sexual arousal in dysfunctional men.

An additional investigation provides insight to the interaction between response components in the mediation of sexual arousal in men. To examine the effect of visual genital feedback on subjective and physiological response, Sakheim, Barlow, Beck, and Abrahamson (1984) exposed sexually functional men to erotic films judged to be of varying intensity. Subjects were prevented from viewing their genital responding by covering the genital area with a sheet in one condition, and allowed visual attention to penile response in the second. The results revealed that when functional men are exposed to intense erotic stimuli, visual attention to penile tumescence elicits significantly greater levels of physiological arousal. This finding suggests that visuosensory awareness of genital arousal provides a significant cue for subjective appraisal of sexual arousal. Accordingly, the literature suggests a high

degree of concordance between physiological and subjective sexual response in men (Heiman & Rowland, 1983; Rosen & Beck, 1988; Steinman, Wincze, Sakheim, Barlow, & Mavissakalian, 1981). The finding that under certain conditions anxiety inhibits sexual arousal in dysfunctional men (e.g., Barlow, 1986, 1988; Heiman & Rowland, 1983) may therefore involve a complex interactive process between subjective expectancies and genital cues. Based on these and a related series of studies, Barlow (1986, 1988) has proposed an etiological model that delineates the process by which cognitive and physiological factors interact in a feedback loop to produce functional or dysfunctional patterns of sexual response. According to this model, anxiety (i.e., increased autonomic arousal) enhances sexual arousal for functional subjects by facilitating their ability to focus on and attend to erotic cues. For dysfunctional subjects however, anxiety inhibits sexual arousal by facilitating the efficiency with which they distract themselves from sexual stimuli by focusing on nonerotic cues. Barlow (1986) contends that the processes of cognitive interference and anxiety interact in a negative feedback loop to produce dysfunctional patterns of sexual response in men and women. Until recently however (Palace & Gorzalka, 1990), the effects of anxiety on sexual responding in dysfunctional subjects have been tested exclusively with men.

To investigate the effects of anxiety on sexual arousal in sexually dysfunctional women, Palace and Gorzalka (1990) compared the physiological and subjective responses of sixteen

dysfunctional and sixteen matched functional women to two videotape conditions: an anxiety-evoking and neutral-control preexposure stimulus, each paired with a sexual arousal-evoking experimental stimulus. Changes in sexual arousal were measured physiologically with a vaginal photoplethysmograph (VBV), and subjectively with a self-report rating scale. Consistent with the findings of P. W. Hoon et al. (1977b), the results revealed that anxiety preexposure elicited enhanced genital arousal in sexually functional women. Contrary to the findings with men, dysfunctional women also achieved a significantly enhanced rate and magnitude of genital arousal following exposure to the anxiety stimulus. Despite their increased physiological responses, both groups rated the anxiety-erotic condition as significantly less sexually arousing. These findings reveal the potential for a desynchronous relationship between cognitive and physiological sexual response in women.

The finding that the components of female sexual response are not necessarily concordant (Morokoff & Heiman, 1980; Palace & Gorzalka, 1990; Steinman et al., 1981; Wincze et al., 1976) suggests that women and men may differ in the physiological-subjective processes mediating sexual arousal to erotic stimuli. We have suggested (Palace & Gorzalka, 1990) that several factors may account for this discrepancy. First, social dictates and double standards of sexual etiquette may discourage women from attending to or verbally acknowledging genital cues. This interpretation is consistent with the finding that discordance for the functional women was as great

as for the dysfunctional women, and that no group differences were revealed in perceptions of physical sexual change, autonomic change, or affective response to erotic stimuli. In some instances, this lack of attentional focus may become a conditioned response, attenuating or extinguishing the arousal response to sexual cues. Second, because women possess a less obvious physiological feedback system (e.g., vaginal vasocongestion versus erection), some women may experience more difficulty attending to bodily cues (Heiman, 1977), yielding a lack of synchrony between physiological and subjectively experienced arousal. This is not to suggest that genital arousal is less intense in women than in men, but rather that the lack of a physically observable reminder may facilitate social demands for women to ignore or habituate to sexual arousal similar to the way that men and women often disregard other internal cues such as hunger or fatigue.

The findings of the Palace and Gorzalka (1990) investigation challenge several explanations for the effects of anxiety. The finding that both functional and dysfunctional women reported a significantly greater level of autonomic arousal (anxious, worried, faster breathing, faster heart beat, perspiration, feelings of warmth, and physical reaction) during the erotic stimuli following anxiety as compared with neutral preexposure suggests that anxiety arousal carried over to the erotic condition (i.e., was experienced simultaneously). It is important to note that these cognitions did not inhibit physiological arousal, but rather accompanied enhanced genital

response. This finding cannot be explained by anxiety relief (Wolpe, 1978) given that anxiety was reported throughout the erotic exposure and there were no significant differences in VBV between stimulus conditions at changeover. It is also not explained by misattribution (Beggs, Calhoun, & Wolchik, 1987; Dutton & Aron, 1974) given that subjective and physiological reports were opposite and not reciprocally influenced. Neither did anxiety serve to diminish genital arousal by facilitating distraction from erotic cues (Barlow, 1986, 1988), given that physiological arousal was significantly enhanced. Rather, these findings suggest an alternative explanation for the effects of anxiety on sexual arousal: Anxiety may enhance sexual arousal through the direct instigation and facilitation of sympathetic activation (i.e., increased blood pressure, heart rate, respiration, and muscle tension) which serves to prepare the individual for sexual arousal (vasocongestion). Cognitive expectancy may provide a secondary component that further increases or decreases the physiological effect elicited by activation of the sympathetic nervous system (SNS).

An additional finding from the Palace and Gorzalka (1990) study may be relevant to understanding the components mediating sexual response. Comparison of the physiological responses of functional and dysfunctional women revealed that the functional women experienced significant decreases in VBV during anxiety preexposure, whereas dysfunctional women experienced no change. Similarly, it was noted that a jagged line across preexposure and erotic stimuli reflected greater fluctuations in the

individual genital responses of functional women. A relatively smooth line for the dysfunctional women however, reflected a high degree of VBV consistency. Group differences in physiological response may therefore also be explained by individual differences in response lability, defined as the physiological capacity for autonomic arousal. It may be that the lability of the autonomic response system facilitates both heightened anxiety (sympathetic activity) as well as sexual arousal in functional women. Conversely, in sexually dysfunctional women, an underreactive autonomic response system may suppress both of these responses. Consistent with this finding, Jupp and McCabe (1989) revealed a curvilinear relationship between self-reported general arousability and sexual dysfunction, such that women reporting both extreme high and low levels of arousability were also more likely to experience low sexual desire. It may be that sexual arousal is enhanced with increasing sympathetic activity to an optimal point, at which time further increases in sympathetic activity cause a suppression of sexual arousal. Whereas some women with high autonomic lability may therefore experience an overstimulation of SNS and phobic anxiety of sexual stimuli, more frequently, women with low autonomic reactivity may experience inadequate stimulation of SNS and therefore the suppression of sexual arousal.

Based on the Palace and Gorzalka (1990, 1992) findings, it is proposed that the sexual arousal experienced by women consists of two components: (1) a biologically predetermined

or conditioned physiological capacity for autonomic arousal (response lability), and (2) a conditioned cognitive expectancy for sexual arousal. Physiologically, "anxiety" may enhance sexual arousal in both sexually functional and dysfunctional women because generalized sympathetic activation directly provides a "jump start" or preparedness for sexual arousal. When sexual cues are provided, this enhanced sympathetic responsivity may activate specific genital responses. Women with greater response lability may therefore experience proportionately more anxiety (sympathetic activity) as well as genital arousal. The conditioned cognitive expectancy for "failure" or responding "inadequately" to sexual stimuli may encourage women to ignore erotic cues and thereby facilitate the extinction of genital arousal. This interpretation of the Palace and Gorzalka (1990) findings suggests that anxiety enhances genital arousal for both functional and dysfunctional women through sympathetic activation, but that both conditions yield lower arousal for dysfunctional women as a result of the interaction of a physiological tendency toward low response lability and negative expectancy, which produces a negative feedback loop of dysfunctional sexual response.

The Palace and Gorzalka (1990) findings suggest that common components of treatment for sexually dysfunctional women, directed toward extinguishing anxiety and increasing parasympathetic response, may be counterproductive to the physiological elicitation of sexual arousal. Whereas this interpretation does not, of course, rule out a role in sexual

arousal for the parasympathetic nervous system, it suggests a more significant role for the sympathetic nervous system than previously assumed. Accordingly, anxiety-reduction techniques may serve to inhibit the sympathetic activation required for the instigation and enhancement of physiological arousal. Schwartz and Masters (1988) claim that sensate focus techniques are appropriate to all cases of inhibited sexual desire. However, results of the Palace and Gorzalka (1990) study revealed that of the dysfunctional sample experiencing low desire, 100% experienced enhanced genital arousal following exposure to the anxiety-eliciting stimulus. This effect was consistent across a heterogeneous population including women experiencing low desire, low arousal, primary and secondary inorgasmia, and dyspareunia. These findings suggest that treatment may instead be directed toward (a) providing sympathetic activation as a means of physiological preparedness for genital response, especially in those instances where response lability may be low, and (b) altering conditioned negative expectancy regarding sexual response when exposed to erotic stimuli. Although some women who experience phobic anxiety of sexual stimuli may not find this treatment effective, these findings suggest that for most women, sympathetic excitation may be the process whereby sexual arousal is elicited and enhanced.

We proposed that the interactional influences of physiological response lability and cognitive expectancy produce a positive feedback loop of sexual arousal, or

conversely, a negative feedback loop of dysfunctional sexual response. Accordingly, effective treatment may focus on strategies whereby women learn response synchrony such that physiological excitation, that occurs naturally through sympathetic activation, and cognitive expectation are directed toward a positive feedback loop of sexual arousal.

False Physiological Feedback

Traditionally, the strategy for experimental modification of subjects' cognitions has involved false feedback. False feedback techniques are directed toward inducing subjects to infer that they have responded physiologically in a manner contrary to their expectations. This paradigm has been used extensively in research examining the response components mediating emotions such as fear and anxiety. For example, Valins and Ray (1967) conducted a prototypical study where subjects fearful of snakes were presented with slides depicting snakes, and slides of the word "shock" followed by a finger shock. During the slide presentation, experimental subjects received auditory stimuli described as heart rate feedback, while control subjects heard the same sounds described as extraneous noise. For all subjects, the frequency of these sounds increased during the shock slides, but remained stable during the snake slides. They found that subjects who received false heart rate feedback, indicating that physiologically they did not react fearfully to the phobic stimuli, subsequently showed more snake-approach behavior than control subjects. In two additional studies, Valins (1966, 1967) presented male

subjects with slides of seminude females while listening to prerecorded sounds identified as heart rate feedback or extraneous noise. During the presentation of each slide, subjects heard these sounds increase, decrease, or remain constant. The results revealed that for false feedback groups, slides accompanied by a change in heart rate, whether increased or decreased, received greater subjective ratings of attractiveness than slides accompanied by stable heart rate. Further, slides paired with heart-rate increase feedback received the greatest ratings of attractiveness.

The findings of the Valins' series of investigations (Valins, 1966, 1967; Valins & Ray, 1967) challenge Schachter and Singer's (1962) theory which asserts that an emotional response is produced when cognitive labels are attached to ambiguous physiological states of arousal. Valins asserts that changes in an emotional state may be accomplished in the absence of physiological changes. Given his finding that bogus physiological feedback altered both subjective perceptions (Valins, 1966, 1967) and behavioral response (Valins & Ray, 1967), he suggests that cognitive factors alone are sufficient to elicit an emotional response. That is, when subjects believed they were less afraid, they were able to behave in a less fearful manner, regardless of alterations in physiological response. These findings have been used to support cognitive, as opposed to physiologically mediated techniques for the treatment of anxiety disorders.

Numerous investigators employing this paradigm have

replicated the finding that false physiological feedback (i.e., heart rate, electrodermal activity [EDA]) is effective in modifying subjective perceptions of fear and anxiety (e.g., Borkovec, Wall, & Stone, 1974; Gaupp, Stern, & Galbraith, 1972; Holmes & Frost, 1976; Kent, Wilson, & Nelson, 1972; Koenig, 1973; Lick, 1975; Rosen, Rosen, & Reid, 1972; Wilson, 1973), attractiveness (e.g., Barefoot & Straub, 1971; Bloemkolk, Defares, Van Enckevort, & Van Gelderen, 1971; Botto, Galbraith, & Stern, 1974; Goldstein, Fink, & Mettee, 1972; Hirschman, Clark, & Hawk, 1977; Kerber & Coles, 1978; Misovich & Charis, 1974; Stern, Botto, & Herrick, 1972), unpleasantness (Thornton & Hagan, 1976; Young, Hirschman, & Clark, 1982), persuasion (Hendrick, Giesen, & Borden, 1975), life stress (Stern, Miller, Ewy, & Grant, 1980), and depression (Stern, Berrenberg, Winn, & Dubois, 1978). In general, the literature reveals a positive linear relationship between the level of false physiological feedback and the modification of emotional experience (i.e., cognitions or subjective perceptions). One major criticism of these investigations has involved the frequent absence of measures to identify the effect of false feedback on actual physiological response. The finding that false feedback modifies actual autonomic arousal would challenge Valins' theory that emotion is an entirely cognitive phenomenon. Rather, it would provide evidence that both cognitive and physiological processes are involved in the mediation of emotion and the resultant behavioral response.

In an attempt to clarify the relationship between false

feedback, subjective experience, and physiological response, Woll and McFall (1979) systematically replicated and extended Valins (1966, 1967) investigation by adding the accurate measurement of heart rate during all conditions. This is the only investigation in the literature that has examined the effects of false feedback on subjective ratings of attractiveness and heart rate in women. Consistent with previous findings with men (e.g., Barefoot & Straub, 1971; Botto et al., 1974; Goldstein et al., 1972), false feedback was successful in modifying subjective perceptions. That is, slides of seminude men accompanied by bogus heart rate increases were rated as significantly more attractive and more arousing than slides accompanied by no change in heart rate. Further, slides paired with increased false heart rate showed significantly greater changes in actual heart rate. Despite the effect of false feedback in modifying both subjective ratings and cardiac activity, correlations between these response measures were generally nonsignificant.

The Woll and McFall (1979) finding that false feedback elicited changes in actual physiological activity has received mixed support in the literature. Some researchers have found that bogus feedback exerts an effect on actual physiological processes (i.e., heart rate, EDA, alpha activity) associated with fear and anxiety (e.g., Borkovec, 1973; Borkovec & Glasgow, 1973; Gaupp et al., 1972; Lick, 1975), attractiveness (e.g., Bloemkolk et al., 1971; Kerber & Coles, 1978), unpleasantness (Hirschman & Hawk, 1978; Young et al., 1982),

alpha experiences (Plotkin, 1980; Valle & Levine, 1975), discomfort (Hirschman, 1975), and attitude (Detweiler & Zanna, 1976), while other studies have revealed contradictory findings. For example, no actual physiological effects (i.e., heart rate, EDA, electromyograph response, alpha activity) have been found in response to false feedback associated with fear and anxiety (e.g., Borkovec et al., 1974; Gatchel, Hatch, Maynard, Turns, & Taunton-Blackwood, 1979; Gatchel, Hatch, Watson, Smith, & Gaas, 1977; Holmes & Frost, 1976; Rosen et al., 1972), attractiveness (Hirschman et al., 1977; Misovich & Charis, 1974; Stern et al., 1972), unpleasantness (Thornton & Hagan, 1976), alpha experiences (DeGood, Elkin, Lessin, & Valle, 1977; Pressner & Savitsky, 1977), and headaches (Kondo & Canter, 1977). Therefore, despite the modification of cognitive and/or behavioral processes, false physiological feedback has been found to be effective in modifying actual physiological processes for only some emotional responses and some investigations.

Explanation of these contradictory findings may involve the experimental confounds of subject demand and attention. Parkinson (1985) suggests that subject demand characteristics may have contributed to the subjective ratings obtained in some of these investigations. For example, subjects may report higher ratings of attractiveness based on the assumption that the experimenter expects those slides displaying the greatest heart rate to obtain the highest ratings, or based on a desire not to appear foolish by contradicting objective physiological

evidence. Changes in subjective ratings during the bogus feedback condition may therefore reflect experimental demand rather than the direct modification of cognitions. In situations where bogus feedback failed to influence actual autonomic responses, it is difficult to interpret whether the modification of cognitions had no effect on physiological response, or the cognitive ratings reflected subject demand as opposed to an actual modification of cognitive expectancy. The latter explanation may account for the finding that some investigations have not revealed a physiological change corresponding to the modification of subjective perceptions.

In regard to attentional factors, the majority of these investigations have employed an "extraneous noise" condition as a control for continuous auditory false feedback. Stern et al. (1972) revealed that attentional factors were as important as false feedback in modifying subjective ratings. That is, subjects in the extraneous noise condition who were instructed to attend to these stimuli while viewing slides of automobile accident victims, exhibited ratings similar to the false feedback group, i.e., slides accompanying increases in noise frequency were rated as significantly more unpleasant. Since changes in autonomic activity (e.g., heart rate deceleration) have been found to accompany attentional processes (Lacey, 1967; Lacey & Lacey, 1974), the attentional component alone may modify subjective and physiological arousal. This interpretation suggests that (a) attentional factors need to be adequately controlled in order to determine

the effects of bogus feedback on subjective response, and (b) the differential attention-eliciting nature of the feedback may explain contradictory findings regarding the ability of false feedback to modify actual physiological response. Investigations directed toward minimizing subject demand and providing equivalent attention-eliciting information to both control and experimental groups may rule out alternate hypotheses regarding the effects of feedback on subjective response, and provide less ambiguous information regarding its effects on physiological response.

Despite the influence of demand and attentional factors in obscuring the interpretability of the literature on the effects of false feedback, many researchers support Valins' contention to minimize the importance of physiological activity in emotional experience. In a review of the literature, Hirschman and Clark (1983) conclude that "to the extent that cognitive factors generally are prepotent, it may be necessary to reassess some of the assumptions underlying physiologically-based theories of emotion and physiologically-based treatments for anxiety" (p. 209). Similarly, in regard to sexual arousal, Rosen and Beck (1988) claim that "an individual's awareness or self-report of internally experienced arousal is primary in defining a response as sexual, irrespective of the nature or extent of his or her physiological reactions" (p. 28-29). The finding that these response components may be discordant for many women (Morokoff & Heiman, 1980; Palace & Gorzalka, 1990, 1992; Steinman et al., 1981; Wincze et al., 1976) but

concordant for men (Heiman & Rowland, 1983; Rosen & Beck, 1988; Steinman et al., 1981), and that dysfunctional women exhibit significantly less subjective and physiologically experienced sexual arousal than functional women (Palace & Gorzalka, 1992), suggests that understanding the influence of both these components is imperative for identifying the mechanisms that mediate sexual arousal. If false feedback is able to elicit changes in both subjective and physiological processes, it may elicit an alternate interactional pattern of sexual response. That is, for those women where false feedback concurrently modifies subjective perceptions of sexual arousal and genital arousal, there may be an increase in response synchrony similar to that generally experienced by men, and the initiation of a positive cognitive-physiological feedback loop.

Vaginal Blood Volume Feedback and Sexual Arousal

To date, only four investigations have examined the effects of genital feedback (i.e., vaginal vasocongestion) on sexual arousal, and only one of these has employed false feedback. These investigations were directed toward examining voluntary control of the vaginal vasocongestive response, and the efficacy of biofeedback as a therapeutic technique for facilitating control of genital arousal. Cerny (1978) presented women with one of three conditions: continuous accurate feedback, continuous noncontingent (false) feedback, or no feedback while viewing a 3-minute erotic videotape. Subjects were instructed to increase their vasocongestive response (VBV and VPA) for half of the trials, and to suppress

it for the remaining trials. Although subjects were able to demonstrate voluntary control of genital vasocongestion, feedback was not found to facilitate enhancement of genital or subjective sexual response. That is, no differences were found between groups using VBV, while VPA data revealed that the false and accurate feedback groups achieved lower levels of physiological sexual arousal than the no feedback control group. No significant differences were found in the VPA responses of women in the false and accurate feedback groups. Similarly, P. W. Hoon, Wincze, and Hoon (1977a) provided women with continuous visual VBV feedback, instructions to fantasize, or VBV feedback in combination with instructions to fantasize. The results revealed that over repeated trials, biofeedback in combination with erotic fantasy produced significant increases in VBV whereas biofeedback alone was ineffective in facilitating genital arousal. E. F. Hoon (1980) further compared the effects of auditory and visual feedback modalities, and no feedback control conditions during instructions to increase or decrease genital response. Consistent with the Cerny (1978) findings, VBV, VPA, and subjective levels of sexual arousal were significantly higher under instructions to increase arousal, and correlations between subjective and physiological response were found only for VBV. Although compared to audio feedback, visual feedback was found to elicit significantly greater overall control of sexual arousal, consistent with previous findings (Cerny, 1978; P. W. Hoon et al., 1977a), biofeedback did not appreciably

improve voluntary control of genital arousal.

One explanation for the finding that continuous feedback is ineffective in the modification of genital arousal (Cerny, 1978; P. W. Hoon et al., 1977a) is distraction. Barlow (1986, 1988) has suggested that sexual arousal in functional men is decreased by tasks competing with the processing of erotic stimuli and performance-related sexual cues. Although visual attention to penile tumescence has been found to elicit significantly greater levels of physiological arousal (Sakheim et al., 1984), distraction (i.e., audiotape of nonsexual passages from a novel) while viewing erotic films has been found to significantly decrease sexual arousal (Abrahamson, Barlow, Sakheim, Beck, & Athanasiou, 1985). Similarly, attention to a continuous auditory or visual display (accurate or false) of one's physiological response may create a strong diversion from erotic stimuli. According to Barlow's model, continuous feedback may decrease sexual arousal by inhibiting the ability to focus on and attend to erotic stimuli. Continuous visual or auditory feedback of vaginal vasocongestion in the form of "beeps" or lines may not be equivalent to the continuous feedback inherent in visual attention to penile tumescence, and may divert attention from, rather than direct attention to, erotic stimuli. This distraction confound may explain the findings that (a) continuous biofeedback did not improve voluntary control of sexual arousal (Cerny, 1978; P. W. Hoon et al., 1977a), (b) no feedback was superior to accurate or false continuous feedback

in facilitating voluntary control of sexual arousal (Cerny, 1978), and (c) biofeedback combined with erotic fantasy was superior to feedback alone in facilitating genital arousal (P. W. Hoon et al., 1977a) (i.e., erotic fantasy may distract the individual from distracting feedback, thereby enhancing arousal). Also consistent with this interpretation is the finding by Zingheim and Sandman (1978) that significant increases in VPA were achieved in one experimental trial when a discriminative control procedure using operant techniques was employed, i.e., a feedback light was displayed contingent upon achievement of the desired response. Because these subjects were not presented with a continuous auditory or visual display of vasocongestive response patterns, they may have been less distracted from cognitive or physiological techniques employed to increase vasocongestion. Similarly, because they were not exposed to erotic film or slide stimuli, this feedback may have provided less distraction from exogenous erotic stimuli.

The results from investigations examining the effectiveness of biofeedback in modifying genital arousal suggest that sexually functional women can exert voluntary control of vaginal vasocongestion (Cerny, 1978; E. F. Hoon, 1980), that accurate feedback can facilitate modification of physiological responding (VPA) (Zingheim & Sandman, 1978), and that cognitions in the form of erotic fantasy can enhance physiological responding (VBV) (P. W. Hoon et al., 1977a). These investigations also contraindicate the use of continuous feedback in paradigms examining sexual arousal because

distraction may confound the effects of feedback on voluntary control of genital arousal.

Sympathetic Activation and False Positive VBV Feedback

We have proposed (Palace & Gorzalka, 1990, 1992) that the interactional influences of a physiological tendency toward low response lability and negative cognitive expectancy produce a negative feedback loop of dysfunctional sexual response. Accordingly, strategies directed toward enhancing physiological responsivity via sympathetic activation and modifying negative cognitions via false positive VBV feedback are hypothesized to reverse the negative dysfunctional cycle and initiate a positive cognitive-physiological feedback loop of sexual arousal.

To date, no one has investigated the effects of false feedback of vaginal vasocongestion in the modification of cognitions, or the extent to which cognitive expectations mediate actual genital response. In addition, this is the first investigation to examine the effects of feedback on sexual arousal in sexually dysfunctional women.

The purpose of the present study was to identify the mechanisms by which cognitive and physiological response components mediate sexual arousal, and may be modified to reverse the dysfunctional process. Five questions will be addressed:

1. Does sympathetic activation (increased autonomic arousal) enhance physiological (VBV) and subjective sexual arousal?

2. Does false positive feedback of genital vasocongestion (VBV) modify cognitive response (subjective expectations and the subsequent experience of sexual arousal)?
3. Does false positive VBV feedback modify actual physiological response?
4. Does the modification of cognitive expectations alter actual physiological response?
5. Do the combined effects of sympathetic activation and false positive VBV feedback elicit the greatest increases in physiological and subjective sexual arousal in sexually dysfunctional women?

Palace and Gorzalka (1990, 1992) found that sexually dysfunctional women report significantly lower levels of autonomic arousal and exhibit less autonomic lability than sexually functional women. A pilot study was therefore conducted with functional women to select videotape stimuli that, compared to neutral stimuli, elicited sympathetic activation (increased autonomic arousal) as defined by increased mean levels of heart rate and subjective ratings of anxiety and autonomic arousal. To investigate the above questions, sympathetic activation was induced in sexually dysfunctional women by exposure to these anxiety-eliciting videotapes (threatened amputation and impending danger), and autonomic activity was measured by heart rate and subjective ratings of anxiety and autonomic arousal. Positive expectancy was induced by providing subjects with false feedback of a

high vaginal vasocongestive response, and was measured by the comparison of subjective ratings of sexual arousal to erotic stimuli prior to and following the feedback condition. Sexually dysfunctional women were assigned to one of four conditions: (a) anxiety-evoking or neutral-control preexposure videotape stimulus paired with an erotic videotape stimulus followed by, (b) false positive VBV feedback or no feedback. All subjects (1) viewed stimulus series 1 and rated their sexual arousal, (2) received the feedback condition and rated their expectations, and finally, (3) viewed stimulus series 2 and rated their subsequent perceptions of sexual arousal. Physiological (VBV) and subjective measures of sexual arousal were assessed for all subjects in response to the two presentations of anxiety-erotic or neutral-erotic stimuli, prior to and following the feedback condition. In order to maximize attentional factors and minimize distraction, all subjects received a discrete analogue chart of VBV responses reported to be their own, following presentation of the first film series. The false feedback groups were provided with information regarding their vasocongestive responses to erotic stimuli, whereas the no feedback groups were provided only with information regarding their vasocongestive responses to orienting and neutral stimuli, and no feedback regarding their genital responses to erotic stimuli. Subject demand was minimized by having subjects seal their subjective ratings in an envelope. In addition, scripts were specifically designed to decrease subject demand and assure confidentiality. An

accurate feedback group was not employed because (a) feedback depicting a decrease in VBV in response to erotic stimuli might have validated negative expectations and reinforced dysfunctional response patterns, and (b) as evidenced by the Cerny (1978) study, feedback depicting an increase in VBV in response to erotic stimuli would mimic the false feedback manipulation. Finally, in accord with (a) suggestions by Palace and Gorzalka (1990) that low autonomic lability may be related to sexual dysfunction (inadequate stimulation of SNS), and (b) the finding by Jupp and McCabe (1989) that self-report measures reveal a curvilinear relationship between general arousability and sexual dysfunction, sexually dysfunctional women were matched on pretest self-report indices of state-dependent anxiety.

Method

Subjects

Sixty-four women experiencing psychogenic sexual dysfunction participated in the investigation. Subjects were recruited from the community through local newspaper advertisements requesting women experiencing "current complaints of low or decreased sexual desire, decreased sexual arousal, or other sexual difficulties." Subjects included in the investigation were 22 years of age and above, were not taking medications of any kind, had an exclusive heterosexual orientation, and reported dissatisfaction with their current sexual functioning. Women did not participate if they were menstruating, pregnant, or had begun menopause. During an

initial interview, profile descriptions of each woman's sexual behavior were obtained using the Multiaxial Descriptive System for the Sexual Dysfunctions (Schover, Friedman, Weiler, Heiman, & LoPiccolo, 1982). All women included in the investigation experienced subjective, behavioral, or physiological problems associated with one or more of the desire, arousal, or orgasm phases of the sexual response cycle, or experienced coital pain. In addition, the Sexual Functioning Index (SFI) and Global Sexual Satisfaction Index (GSSI) subscales of the DSFI were used to corroborate verbal reports and clinical profiles. The DSFI scores of all women included in the investigation fulfilled at least one of two criteria: (a) scored at least 1 SD below the 50th percentile on both the SFI (i.e., the overall level of sexual functioning was less than the mean for the normative sample) and GSSI (i.e., their current level of sexual functioning rated poor to could not be worse), or (b) scored at least 1 SD below the 50th percentile on either the SFI or GSSI subscales (and below the 50th percentile on the other), and negatively endorsed the satisfaction subtest item, "Usually I have a satisfying orgasm with sex." These criteria were developed in order to prevent excluding women who were orgasmic but experienced low drive or arousal (Criterion a) and those who experienced normal levels of arousal but were unable to reach orgasm (Criterion b; Palace & Gorzalka, 1992). Finally, the Brief Symptom Inventory (BSI; Derogatis, 1975) subtest of the DSFI was used to screen all subjects for absence of general psychopathology using the 30th percentile as the

cutoff criterion (i.e., within 2 SD of the mean for the normative sample).

Subjects were matched on the following criteria: (a) age, (b) duration of sexual experience, (c) repertoire of sexual experience, (d) level of state-dependent anxiety, and (e) sexual dysfunction, and randomly assigned to one of the four groups (16 per group). The experience subtest of the DSFI was used to verify that all subjects experienced a similar repertoire of sexual behaviors, and reported a similar duration of sexual experience, calculated as the difference between age at first intercourse and current age. State-dependent anxiety was assessed by the state-anxiety scale of the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). Profile descriptions from the Multiaxial Descriptive System for the Sexual Dysfunctions were used to assess sexual dysfunction.

Participation in the study was voluntary, occurred prior to treatment, and did not affect the course of further treatment or medical care. All subjects were paid $20 for their participation and provided with a list of referrals to local therapists specializing in the treatment of sexual dysfunction.

Apparatus and Materials

Film stimuli. Preexposure stimuli consisted of four 3-minute videotapes: two neutral sequences that depicted nature in the Arctic and Antarctica, and two anxiety-eliciting sequences that depicted threatened amputation and impending danger. The experimental stimuli, or erotic sequences,

consisted of two 3-minute videotapes of a nude heterosexual couple engaging in foreplay and intercourse. The contents of the erotic scenes were matched on the number, order, type, and duration of sexual activities and contained the same actors and setting.

To assess the validity of the stimulus manipulations, a separate pilot study was conducted with five potential anxiety-eliciting and two potential neutral videotape segments. Ten sexually functional women viewed the randomly assigned anxiety and neutral segments. The two anxiety-evoking segments that elicited the greatest mean heart rate in beats per minute and subjective ratings of anxiety and autonomic arousal were selected. These segments elicited equivalent physiological (HR and VBV) and subjective ratings of anxiety, autonomic arousal, and sexual arousal. The neutral segments were also matched on these measures. The erotic videotapes have previously been found to evoke equivalent levels of genital (VBV) and subjective sexual arousal, and to reliably elicit sexual arousal in functional and dysfunctional women (Palace & Gorzalka, 1990, 1992).

False positive VBV and no feedback stimuli. A prerecorded polygraph chart from a vaginal photoplethysmograph that depicted the VBV responses of a sexually functional woman during the presentation of a 3-minute erotic stimulus was employed as false positive VBV feedback. This record displayed an analogue VBV response that originated at baseline and increased to ceiling levels of pen deflection (i.e., 5 mV or

35 millimeters pen deflection). This chart showed the greatest increase in blood volume deviation from baseline levels in response to erotic stimuli observed in the individual charts of 32 sexually functional women (Palace and Gorzalka, 1990, 1992).

A prerecorded polygraph chart from a vaginal photoplethysmograph that depicted the analogue VBV responses of a sexually functional woman during the presentation of a neutral stimulus was selected as the no feedback stimulus. This VBV response remained highly stable (i.e., 0 mV or 0 millimeters pen deflection from baseline).

Physiological measurement. A vaginal photoplethysmograph (Sintchak & Geer, 1975) was used to measure physiological sexual arousal by changes in VBV, and heart rate by changes in VPA. Direct measures of genital response are the only physiological indices capable of clearly and reliably discriminating sexual arousal from general autonomic arousal (Zuckerman, 1971), and the specificity of vaginal photoplethysmography to sexual stimulation is well established (P. W. Hoon, 1979). Vaginal blood volume was selected to measure sexual arousal in accordance with suggestions in the literature that, although there are two vasocongestive measures that can be obtained from the photoplethysmograph, VBV which is thought to reflect location-specific changes in the direction, rate, and magnitude of vaginal blood flow during engorgement may be the maximally sensitive measure of genital vasocongestion (J. G. Beck, Sakheim, & Barlow, 1983; P. W. Hoon, Wincze, & Hoon, 1976; Palace & Gorzalka, 1992; Rosen &

Beck, 1988). To minimize potential light history and temperature sensitivity effects, and to assess baseline stability, the photoplethysmograph was allowed a 45-minute warm-up period prior to insertion, followed by a 10-minute recorded adaptation period prior to the onset of videotape stimuli. The signal from the Geer gauge and module (Farrall Instruments) was channeled through an optical isolator-power supply and monitored on a Beckman Type R 611 dynagraph. The VBV signal for each subject was recorded at a sampling rate of 5 times/second using the Data Translation A/D converter and Labtech Notebook software (Laboratory Technologies Corporation, 1986) installed on a Compaq 386 microcomputer. The software program timed the administration of the videotape stimuli and employed a trigger signal to initiate recording and mark stimulus changeover.

Subjective measurement. A self-report rating scale comprised of 12 items was used to assess subjective perceptions of physical sexual change (5 items), sexual arousal (1 item), autonomic arousal (5 items), and anxiety (1 item) (see Appendix for complete item list). Subjective sexual arousal was defined by six items on this scale: Sexually aroused, breast sensations, warmth in genitals, genital wetness or lubrication, genital pulsing or throbbing, and any genital feelings. Subjects rated the degree to which they experienced these items on 7-point Likert scales from not at all (1) to intensely (7). The subjective reaction scale was adapted from Heiman and Rowland (1983) and has been determined to be a sensitive

indicator of emotional reactions to erotic stimuli (Heiman & Hatch, 1980; Morokoff & Heiman, 1980; Palace & Gorzalka, 1990, 1992). No significant differences have been found in results obtained by methods of discrete versus continuous subjective measurement (Steinman et al., 1981).

Multiaxial Descriptive System for the Sexual Dysfunctions. The Multiaxial Descriptive System for the Sexual Dysfunctions (Schover et al., 1982) provides a profile description of sexual behavior on six axes: (a) desire, (b) arousal, and (c) orgasm phases of the sexual response cycle; (d) types of coital pain; (e) dissatisfaction with the frequency of sexual activity; and (f) qualifying information including unusual sexual preferences that may affect compatibility with partners, and problems that may influence the prognosis of therapy, e.g., physical abuse, severe marital distress, substance abuse, and medication possibly affecting sex. Each axis includes physiological, subjective, and/or behavioral descriptions, and is modified according to whether the problem was the presenting complaint of the client and/or determined by the therapist. The first five axes are modified along two additional dimensions: lifelong versus not lifelong, and global versus situational. This system was selected because unlike the DSM-III-R and other current diagnostic systems for sexual dysfunctions, the Multiaxial Descriptive System provides specific operational descriptions of sexual behavior based on empirically-derived quantitative criteria. It simultaneously provides a comprehensive descriptive profile of sexual response by

accounting for problem areas along a continuum of as many as six equally important areas of sexual functioning.

Derogatis Sexual Functioning Inventory (DSFI). The DSFI is a standardized self-report multidimensional inventory comprised of eight distinct subtests designed to measure the current level of sexual functioning. The Experience subtest assesses the range of hierarchically scaled sexual behaviors experienced by the individual, progressing from fundamental ("clothed embrace") to relatively advanced ("mutual oral stimulation of genitals"). The subtest measuring psychological symptomology is a distinct psychometric diagnostic instrument, the BSI, empirically validated prior to the development of the DSFI as an independent measure of psychopathology. The DSFI provides a profile score derived from a summation of the subtest scores, the SFI, reflecting the overall quality of current sexual functioning; and a single item score, the GSSI, reflecting the respondent's self-perception of the quality of sexual functioning. This instrument has been determined to be a valid and reliable measure for differentiating sexually functional and dysfunctional women (Derogatis, 1980; Derogatis & Melisaratos, 1979; Derogatis & Meyer, 1979).

State-Trait Anxiety Inventory (STAI). The State-anxiety scale of the revised STAI (Form Y-1; Spielberger, 1983) is composed of 20 self-report items designed to measure transitory feelings of fear or worry. The scale provides a single score ranging from 20 to 80, with higher scores indicating greater situational anxiety, and presents data on the relative

magnitude of perceived anxiety relative to normative and psychiatric patient samples.

Procedure

The procedure consisted of two sessions each lasting 2 hours. All subjects were requested to abstain from psychoactive drugs (including caffeine and alcohol) for 24 hours prior to each session.

Session 1. Following an initial telephone interview, subjects were scheduled for a first session with a female experimenter. During this session, subjects viewed the laboratory facilities and equipment, received verbal instructions on the use of the photoplethysmograph, and were allowed to discuss any questions related to the experiment. They were told that the purpose of the investigation was to learn about emotional and physiological reactions to brief visual stimuli, some of which may include erotic content. Subjects choosing to participate signed the standard consent form and completed the following questionnaires and procedures:

1. Semi-structured interview regarding the presenting complaint (Multiaxial Descriptive System for the Sexual Dysfunctions)
2. Derogatis Sexual Functioning Inventory
3. State-anxiety scale of the STAI
4. Baseline assessment of VBV and heart rate

To minimize experimental demand, subjects were instructed as follows:

It is very important to remember that there are no right or wrong answers to any of the information you will give us today. Each person is unique and only you know about your sexual history and behavior. The way that you can be most helpful to us is to try to be as honest as you can be. Also remember that all information is completely confidential. All of your forms are assigned a code, so that we will have no record of who gave us this information. It is important to us that that you feel comfortable telling us about your background and how you are feeling during the study, and knowing that this information is private.

The DSFI and State-anxiety scale were completed in a separate subject room. When these were completed, resting baselines of VBV and heart rate were obtained. With the aid of diagrammed instructions, subjects were instructed to insert the photoplethysmograph with the incandescent light source facing the anterior aspect of the vaginal wall. Subjects inserted the photoplethysmograph in a private, internally-locked subject room maintained at a constant 21.7° C. The instrument was sterilized in Cidex (long-life activated dialdehyde solution) between uses. A color television monitor was positioned where subjects could sit comfortably in a recliner with a full view of the screen. Subjects remained fully clothed and were covered with a light blanket. They were instructed through an intercom to sit quietly for at least 10 minutes prior to the onset of the film for purposes of adaptation, and to remain as

still as possible throughout the session. All subjects were presented a 1-minute segment displaying the word "relax," followed by a 1-minute neutral orientation stimulus, and a 3-minute neutral stimulus. VBV and heart rate were recorded during the last 80 seconds of the neutral stimulus. Subjects fulfilling the inclusion criteria were contacted by telephone to schedule a second session for the experimental procedure.

Session 2. To minimize experimental demand, during the second session, subjects were reminded of the previous instructions:

> As you know, we are interested in learning about emotional and physiological reactions to brief visual stimuli, some of which may include erotic content. Although I will be explaining the details of the experiment and giving you instructions as we go along, today you will be asked to sit back and watch a series of short films while I monitor your heart rate and vaginal blood volume on this machine. Following some of the films, I will ask you to fill out a short questionnaire regarding your feelings and reactions. At one point, I will also ask you to lay back and relax for about 10-15 minutes to assure that your responses look like the resting levels we charted last time. While you are waiting, I should be able to show you part of your physiological record. Since it is important to get a large sample of information, once your responses are at baseline levels, we will show you a second group of films. Once again, it is very important to remember that there

are no right or wrong answers to any of the information you will give us. Every person is unique and only you will know how you feel about the different films we will show you. The way that you can be most helpful to us is to be as honest as you can be, and while you are watching the films, to be the best monitor of your own responses that you can be. Please don't try to feel anything in particular, just lay back and watch the movies just like at home! Also remember that all information is completely confidential. All of your forms are assigned a code, so that we will have no record of who gave us this information. To assure this confidentiality, following each of the forms that you will fill out today, I will ask you to seal it in an envelope so that neither I nor my assistant will see your responses. In this way, we hope that you will feel comfortable telling us how you are feeling and knowing that this information is private.

Following these instructions, subjects inserted the photoplethysmograph in accordance with the previous procedure. All subjects underwent the following experimental sequence:

1. Stimulus Series 1 (A-E or N-E condition)
2. Rating 1 (subjective rating scale)
3. Feedback (false feedback or no feedback condition)
4. Rating 2
5. Stimulus Series 2
6. Rating 3

Each stimulus series began with a 1-minute segment displaying the word "relax," followed by a 1-minute neutral orientation stimulus, the 3-minute anxiety or neutral preexposure stimulus, and finally the 3-minute erotic experimental stimulus. Changeover from preexposure to experimental stimuli was immediate. Stimulus series 1 and 2 contained the same type of preexposure stimuli, for example, subjects viewing A-E stimuli for the first series viewed the matched A-E stimuli during the second series. Stimulus series were counterbalanced within condition. Immediately following the conclusion of each erotic stimulus presentation, subjects completed the subjective rating scale for the preceding series. Following the completion of rating 1, the experimenter informed subjects by intercom that she would enter the subject room to show them their physiological record. The false positive feedback group was given the standard false feedback stimulus and information regarding their genital responses to erotic stimuli:

> This is a preliminary record of your physiological responses to the films. I thought you might be interested in seeing what it looks like so far. We have recorded your heart rate and vaginal blood volume. The little bumps you see here are your heart beats. When you become sexually aroused, there is an increase in blood flow to the vagina. This is called "vasocongestion." Remember I showed you that the vaginal photoplethysmograph has a small light on the inside. It is very sensitive to changes in light and dark on the vaginal wall and converts

these changes to an electrical impulse which drives the pens on the polygraph. When you become sexually aroused and blood flows into the area, that is, more vasocongestion, the light can't reflect off the vaginal wall as well and the pen line on this chart goes up. When you become unaroused and the blood flows out of the area, that is, less vasocongestion, the light can reflect off the vaginal wall better, and the line on the chart goes down. To summarize, remember, more sexual arousal -> line goes up; less sexual arousal -> line goes down. During the 10-minutes you were resting at the beginning, during the time the screen said "relax," and during the National Geographic film [orienting stimulus], you can see that your heart rate and vaginal blood volume were very stable, as we would expect. The bumps (heart beats) are the same size and the line (vaginal blood volume) is relatively flat. In contrast, as you can see, once the erotic film started there is a very large change in your physiological response. Your heart beats are much larger, and there is a steady increase in your sexual arousal. This chart displays very clearly an enormous increase in your physiological arousal all the way to the end of the film. In fact, at the end of the film, you reached the highest level of sexual arousal that the pens are set to record for this study. Since the computer also recorded this information and can pick up a wider range of responses, I can tell you that it goes even a bit higher. I will

let you look at this for a few moments… it may take awhile for your physiological responses to return to resting levels, so I would like you to lay back and relax for another five minutes or so before we begin the next group of films.

The no feedback group was given the standard no feedback stimulus and no information regarding their genital responses to erotic stimuli. They were told that this was a record of their baseline VBV recorded during the first session.

This is a preliminary record of your physiological responses to the nature films you saw last time. I thought you might be interested in seeing what it looks like. We have recorded your heart rate and vaginal blood volume. The little bumps you see here are your heart beats. When you become sexually aroused, there is an increase in blood flow to the vagina. This is called "vasocongestion." Remember I showed you that the vaginal photoplethysmograph has a small light on the inside. It is very sensitive to changes in light and dark on the vaginal wall and converts these changes to an electrical impulse which drives the pens on the polygraph. When you become sexually aroused and blood flows into the area, that is, more vasocongestion, the light can't reflect off the vaginal wall as well and the pen line on this chart goes up. When you become unaroused and the blood flows out of the area, that is, less vasocongestion, the light can reflect off the vaginal wall better, and the line on

the chart goes down. To summarize, remember, more sexual arousal -> line goes up; less sexual arousal -> line goes down. During the 10-minutes you were resting at the beginning, during the time the screen said "relax," and during the National Geographic film [orienting stimulus], you can see that your heart rate and vaginal blood volume were very stable, as we would expect. The bumps (heart beats) are the same size and the line (vaginal blood volume) is relatively flat. Also as you can see, when the Nova film [neutral stimulus] started, there are relatively no changes in your physiological response. Your heart beats are about the same, and your level of sexual arousal remains steady. This chart displays very clearly a stable physiological responses all the way to the end of the film. As we would expect, at the end of the film, the pen line is in about the same level as when the films began. Since the computer also recorded this information, I can tell you that it also shows a stable resting baseline. I will let you look at this for a few moments… we want to assure that all your physiological responses are at these resting levels now, so I would like you to lay back and relax for another five minutes or so before we begin the next group of films.

Five minutes after the experimenter left the room, all subjects were instructed as follows:

We are ready to begin the next group of films. This group of films will be similar to the last ones you saw. Before

we show them to you, I would like you to complete the form on your left marked "number 2" just as you did before, only this time I would like you to indicate how aroused you "expect" to feel during the next film. After you have completed it, please seal it in the envelope marked "number 2," and let me know when you are finished.

Five minutes after the completion of rating 2, if VBV readings had not returned to baseline level, subjects were asked to count aloud backwards by serial numbers from 100 to facilitate decreased arousal. When VBV readings returned to baseline level, stimulus series 2 was presented. At the conclusion of the experimental session, a semi-structured interview was conducted with each subject in order to (a) assure their comfort with the procedure and understanding of the instructions, (b) assess their belief in the feedback manipulation, and (c) acquire further information regarding their interpretations and cognitions accompanying feedback. Finally, all subjects were thoroughly debriefed regarding the deception, shown their actual VBV record, and informed about the additional purposes and goals of the study.

Data Sampling and Reduction

Vaginal blood volume. The level of sexual arousal for each subject was measured in 0.0001 mV units of VBV deviation from a baseline reference level recorded at the point of changeover from the preexposure to experimental stimulus. VBV data were collected 5 times/second during the last 80 seconds of preexposure and the entire 180 seconds of experimental

stimuli for both stimulus series 1 and 2 (1,300 data points/subject/series). For graphic representation of continuous VBV across subjects, each time sample was averaged across all subjects in each group (i.e., 2 stimulus conditions X 2 feedback conditions X 2 stimulus series X 1,300 0.20 second means). For the statistical analyses, 0.20 second time samples for each subject and stimulus series were averaged across 10-second time blocks to yield 26 means.

Heart rate. Heart rate data were calculated from VPA recordings in beats per minute during the last 60 seconds of preexposure and the entire 180 seconds of experimental stimuli for both stimulus series 1 and 2.

Results

Analyses were conducted for two between-group factors, (a) stimulus condition (anxiety-erotic vs. neutral-erotic), and (b) feedback condition (false feedback vs. no feedback), and two within-subject factors (c) stimulus series (1 vs. 2) or subjective rating (1 vs. 2 vs. 3), and (d) time block mean (18 ten-second VBV time block means). Since multiple repeated measurements are likely to violate the traditional ANOVA assumptions of independence and sphericity, multivariate tests based on the Pillai-Bartlett trace statistic were used for all data analyses involving more than two repeated measurements (O'Brien & Kaiser, 1985; Olson, 1976). Multivariate F tests were followed up with univariate analyses and Newman-Keuls contrasts. An alpha level of .01 was set as criterion for all experimental results.

Characteristics of Matched Groups

Psychometric and demographic characteristics of the four matched groups of sexually dysfunctional women are shown in Table 1. A 2 X 2 X 6 (Stimulus X Feedback X Measure) multivariate analysis of variance (MANOVA) yielded no significant main or interaction effects. These analyses revealed that there were no significant differences in the matched groups of sexually dysfunctional women on the variables of age, duration of sexual experience, repertoire of sexual experience (DSFI experience score), level of state-dependent anxiety (STAI state-anxiety score), overall quality of sexual functioning (SFI), or self-perception of the quality of sexual functioning (GSSI).

Adequacy of the False and No Feedback Manipulations

To be effective, subjects must have perceived and accepted the false positive feedback of vaginal vasocongestion as an accurate depiction of their own genital responses to erotic stimuli. Semi-structured interviews at the conclusion of the experimental session revealed that all 32 subjects in the false feedback conditions accepted the bogus VBV feedback as veridical. In addition, all 32 of the subjects in the no feedback conditions believed that the standardized chart depicting stable VBV responses to neutral and orienting stimuli was their own.

Internal Validity of VBV Measures

Changeover. To verify that no differences in VBV occurred between groups or stimulus series at changeover from

Table 1.

Demographic and Psychometric Characteristics of Matched Groups of Sexually Dysfunctional Women

Measure	Anxiety-erotic False feedback			Anxiety-erotic No feedback			Neutral-erotic False feedback			Neutral-erotic No feedback		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
Age	35.75	8.64	22-50	32.44	9.34	22-48	31.56	6.71	22-43	31.94	6.78	22-48
Duration of sexual experience	18.25	7.36	4-29	14.56	9.03	2-27	15.31	6.65	4-26	14.87	7.09	3-31
Derogatis Sexual Functioning Inventory												
Experience subtest	49.00	9.34	31-63	50.69	7.38	40-63	49.37	8.02	32-63	47.94	7.30	32-63
Sexual Functioning Index	38.03	9.08	20-49	37.84	7.42	20-48	33.87	7.81	20-45	34.75	8.80	20-48
Global Sexual Satisfaction Index	39.25	3.57	35-47	36.37	4.10	30-47	38.87	2.68	35-45	37.37	3.93	30-45
State-Trait Anxiety Inventory												
State Anxiety	50.87	6.99	41-64	49.19	6.87	36-63	51.69	7.44	38-64	52.19	7.32	42-66

Note. Duration of Sexual Experience is calculated as the difference between age at first intercourse and current age. Means for the Derogatis Sexual Functioning Inventory and the State-Trait Anxiety Inventory are based on raw scores that were converted to established percentile rankings (*T* scores).

preexposure to experimental stimuli, VBV baseline levels across the last 10 seconds of preexposure stimuli for series 1 and 2 were averaged separately and compared prior to reference level adjustment. A 2 X 2 X 2 (Stimulus X Feedback X Series) analysis of variance (ANOVA) revealed no significant stimulus, feedback, series, or interaction effects.

Preexposure stimuli. A 2 X 2 X 2 X 8 (Stimulus X Feedback X Series X 10-second Time Block Mean) MANOVA was computed to verify that no significant differences in VBV occurred across the last 80 seconds of neutral or anxiety stimulus preexposure in relation to baseline levels at changeover within or between stimulus series 1 and 2. The results revealed no significant main or interaction effects. These findings validate the assumption that subjects in each group and stimulus series demonstrated similar levels of genital arousal before the onset of the experimental stimuli.

Internal Validity of Sympathetic Activation-Eliciting Stimuli

Pilot investigation. A 7 X 6 (Anxiety and Neutral Stimuli X Subjective Items) MANOVA was performed on the pilot data to determine if any of the five anxiety-eliciting stimuli evoked significantly greater autonomic arousal than the neutral stimuli for sexually functional women. The two anxiety stimuli that produced the greatest mean levels of heart rate and the highest mean subjective ratings of anxiety and autonomic arousal were also found to elicit increased heart rate as compared to neutral stimuli. Simple effects analyses to compare these anxiety-eliciting and neutral stimuli revealed

that sexually functional women reported significantly greater perceptions of sympathetic activity during the anxiety stimuli, $F(1, 9) = 58.30$, $p = .00012$. These reports of enhanced autonomic arousal included "anxious," "faster breathing," "faster heart beat," "perspiration," "feelings of warmth" and "any physical reaction at all." These findings support the assumption that for sexually functional women, the preexposure stimuli depicting threatened amputation and impending danger elicited moderate levels of sympathetic activation, as defined by increased mean levels of heart rate, and subjective ratings of anxiety and autonomic arousal.

Physiological autonomic arousal (heart rate). To investigate if, for sexually dysfunctional women, (a) the anxiety manipulation elicited greater heart rate than the neutral preexposure stimuli for series 1 and 2, and (b) this level of autonomic arousal was equivalent for series 1 and 2, a 2 X 2 (Stimulus X Series) ANOVA was calculated on the heart rate data during preexposure conditions. These analyses yielded no significant main or interaction effects and reveal that for sexually dysfunctional women, (a) heart rate was not significantly changed by anxiety induction and, (b) heart rate during anxiety preexposure stimuli remained relatively stable between series 1 and 2.

Subjective autonomic arousal. A 2 X 2 (Stimulus X Rating) ANOVA on subjective ratings of autonomic arousal at ratings 1 and 3 yielded no significant main or interaction effects. Consistent with the heart rate data, this analysis revealed

that dysfunctional women in the anxiety-erotic as compared to neutral-erotic conditions did not report significantly greater subjective perceptions of anxiety or autonomic arousal. These findings differ from the significantly enhanced autonomic arousal and anxiety reported by sexually functional women in the pilot study.

Effects of Sympathetic Activation

Physiological sexual arousal. Mean VBV data for sexually dysfunctional women during anxiety-erotic and neutral-erotic conditions in stimulus series 1 are presented in Figure 1. A 2 X 2 X 18 (Stimulus X Feedback X 10-Second Time Block Mean) MANOVA was computed to investigate if exposure to an anxiety-eliciting stimulus enhances genital arousal. No significant feedback effect was found which verifies the assumption that prior to implementing the feedback conditions, false and no feedback groups demonstrated similar levels of arousal. The multivariate F for stimulus, $F(1, 60) = 11.84$, $p = .0014$, and time, $F(17, 44) = 7.84$, $p < .00001$, effects were significant. These analyses reveal that whereas both groups demonstrated significant increases in arousal as a function of time, women exposed to anxiety-eliciting as compared to neutral stimuli subsequently demonstrated significantly greater genital arousal. Specifically, post hoc comparisons between stimulus conditions at each time block revealed that women exposed to anxiety as compared to neutral preexposure demonstrated significantly greater genital arousal within 10 seconds of the onset of the erotic film. This arousal-enhancing effect of

Figure 1. Mean vaginal blood volume (millivolts deviation from baseline) sampled 5 times/second for matched groups of sexually dysfunctional women during stimulus series 1: anxiety-erotic (A-E) or neutral-erotic (N-E) stimuli prior to false positive vaginal blood volume feedback or no feedback.

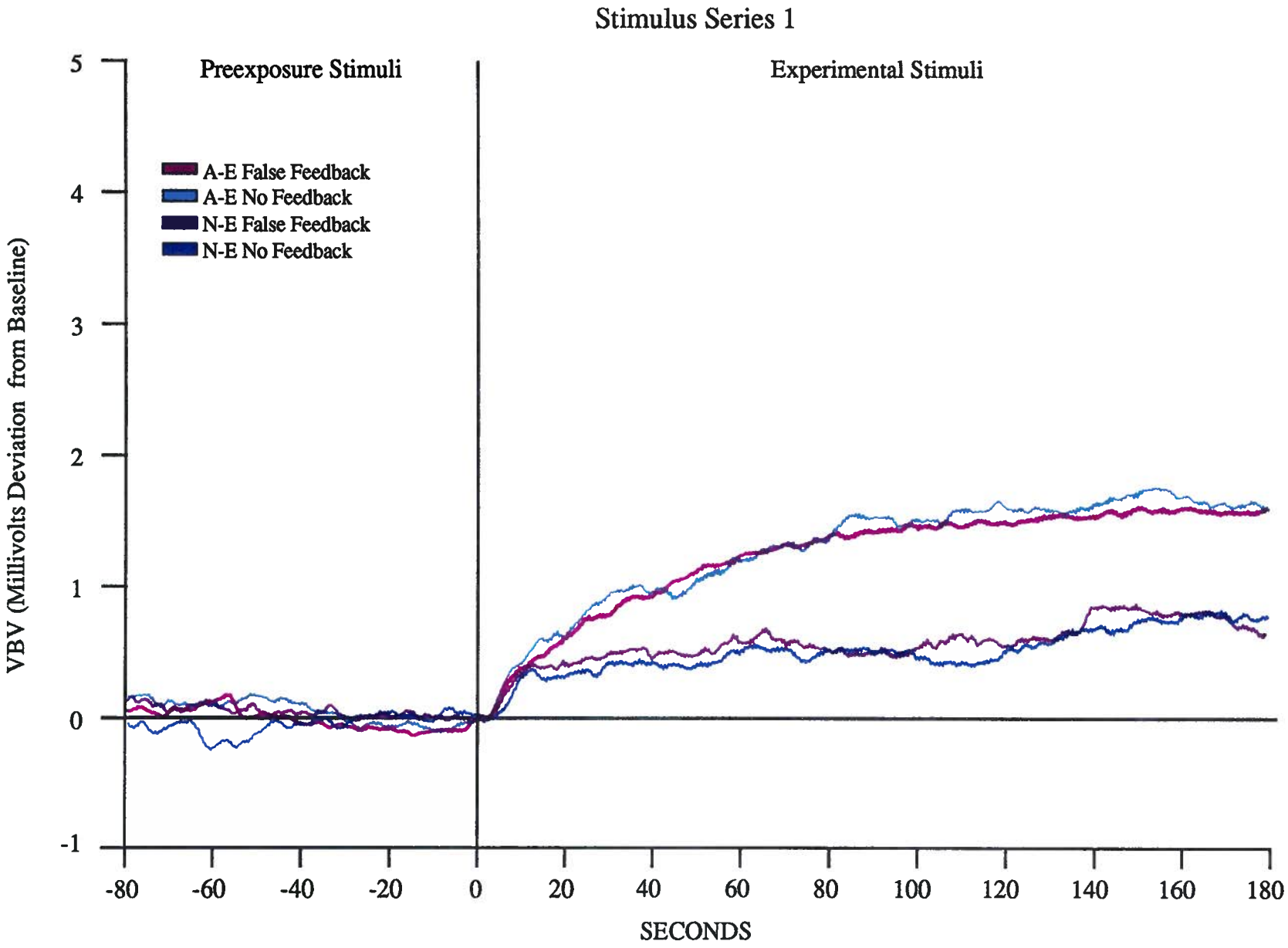
Stimulus Series 1
Preexposure Stimuli
Experimental Stimuli
A-E False Feedback
A-E No Feedback
N-E False Feedback
N-E No Feedback
VBV (Millivolts Deviation from Baseline)
5
4
3
2
1
0
-1
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
SECONDS

Figure 1.

anxiety remained significant at each time block throughout the remainder of the erotic stimuli.

Subjective sexual arousal. Mean subjective ratings of sexual arousal for sexually dysfunctional women during anxiety-erotic and neutral-erotic conditions at rating 1 are presented in Figure 2. A 2 X 2 (Stimulus X Feedback) ANOVA was computed to investigate the effects of exposure to an anxiety-eliciting stimulus on subjective perceptions of sexual arousal. No significant feedback effect or Stimulus X Feedback interaction was found which verifies the assumption that prior to implementing the feedback conditions, false and no feedback groups demonstrated similar levels of arousal. There was also no significant stimulus effect, which indicates that despite the finding that women exposed to anxiety-eliciting as compared to neutral stimuli demonstrated significantly greater genital responses, they reported no significant differences in their subjective perceptions of sexual arousal.

Effects of False Positive VBV Feedback

Subjective sexual arousal. To investigate the effects of false positive VBV feedback on cognitive expectations of sexual arousal, a 2 X 2 X 3 (Stimulus X Feedback X Rating) MANOVA was performed. Mean subjective ratings of sexual arousal for sexually dysfunctional women during ratings 1 and 2 are presented in Figure 2. Rating 1 shows no differences between feedback groups nested within stimulus conditions. Comparison of ratings 1 and 2, shows that each stimulus pair divides following implementation of the feedback condition. At

Figure 2. Mean subjective ratings of sexual arousal for matched groups of sexually dysfunctional women during anxiety-erotic (A-E) or neutral-erotic (N-E) stimuli and false positive vaginal blood volume feedback or no feedback, at rating 1 (following stimulus series 1), rating 2 (following feedback), and rating 3 (following stimulus series 3).

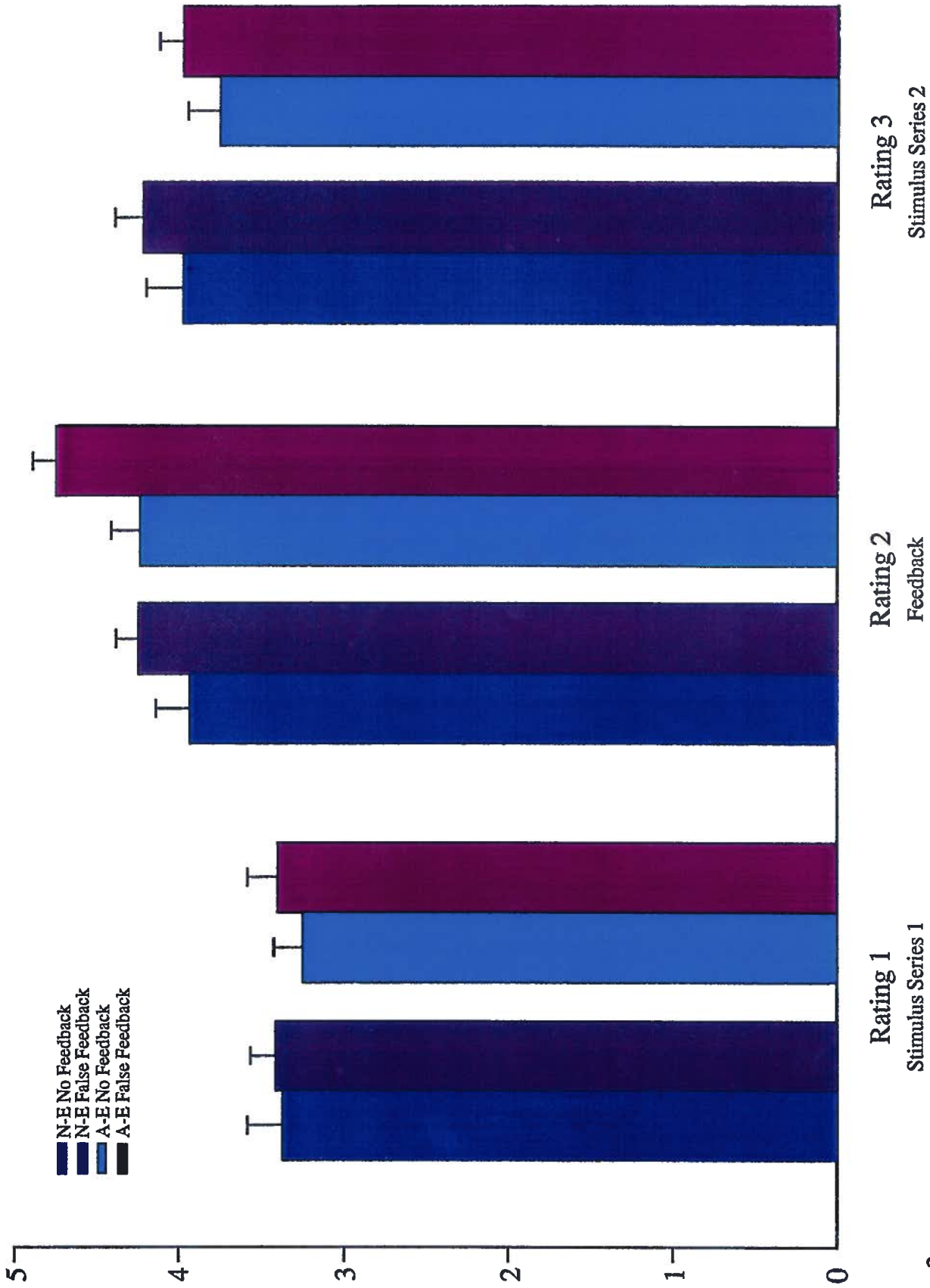
SUBJECTIVE RATING OF SEXUAL AROUSAL
0
1
2
3
4
5
N-E No Feedback
N-E False Feedback
A-E No Feedback
A-E False Feedback
Rating 1
Stimulus Series 1
Rating 2
Feedback
Rating 3
Stimulus Series 2

Figure 2.

rating 2, the two groups that received false positive VBV feedback demonstrated greater cognitive expectations of sexual arousal than the no feedback groups in both the anxiety-erotic and neutral-erotic conditions. Simple effects analyses of the Stimulus X Feedback X Rating interaction were performed to compare perceptions of sexual arousal at rating 1 and future expectations of arousal at rating 2 for each group. Analyses revealed that women who received neutral preexposure and no feedback demonstrated no significant change in their expectations of sexual arousal. In contrast, women who received false positive VBV feedback reported significantly increased expectations of sexual arousal in both the neutral-erotic, $F(1, 60) = 8.15$, $p = .006$, and anxiety-erotic, $F(1, 60) = 21.29$, $p < .00001$, conditions. Interestingly, dysfunctional women exposed to anxiety preexposure and no feedback also evidenced significantly increased expectations, $F(1, 60) = 11.50$, $p = .0016$. These findings reveal that false positive feedback of genital vasocongestion was effective in significantly increasing cognitive expectations of sexual arousal. It also reveals that exposure to an anxiety-eliciting stimulus paired with an erotic stimulus was in itself effective in significantly increasing expectations.

Physiological sexual arousal. To investigate the effects of false positive VBV feedback on actual vasocongestive response, a 2 X 2 X 2 X 18 (Stimulus X Feedback X Series X 10-Second Time Block Mean) MANOVA was performed. Mean VBV data for sexually dysfunctional women during stimulus series 1 and 2

are presented in Figure 3. The data at stimulus series 1 show that there are no differences between feedback groups nested within stimulus conditions, and that the two groups exposed to anxiety preexposure demonstrated significantly greater genital arousal. Comparison of stimulus series 1 and 2 clearly shows that each stimulus pair divides following implementation of the feedback condition. During stimulus series 2, the two groups that received false positive VBV feedback demonstrated greater actual genital arousal than the no feedback groups in both the anxiety-erotic and neutral-erotic conditions. Simple effects analyses of the Feedback X Series interaction revealed that dysfunctional women who received no feedback regarding their genital responses to erotic stimuli demonstrated no significant change in their genital responses. In contrast, women who received false positive VBV feedback subsequently demonstrated a significant increase in their actual vasocongestion, $F(1, 60) = 15.86$, $p = .0004$. Specifically, post hoc comparisons between stimulus series 1 and 2 for each group at each time block revealed that women who received false feedback and anxiety preexposure subsequently demonstrated significantly enhanced genital arousal within 30 seconds of the onset of the erotic stimulus. This group continued to exhibit significantly greater genital arousal at stimulus series 2 as compared to 1 at each time block throughout the remainder of the stimulus. Women receiving false feedback and neutral preexposure demonstrated less enduring effects. Significant increases in genital arousal were found only during the three time blocks

Figure 3. Mean vaginal blood volume (millivolts deviation from baseline) sampled 5 times/second for matched groups of sexually dysfunctional women during anxiety-erotic (A-E) or neutral-erotic (N-E) stimuli, at stimulus series 1 (prior to) and stimulus series 2 (following) false positive vaginal blood volume feedback or no feedback.

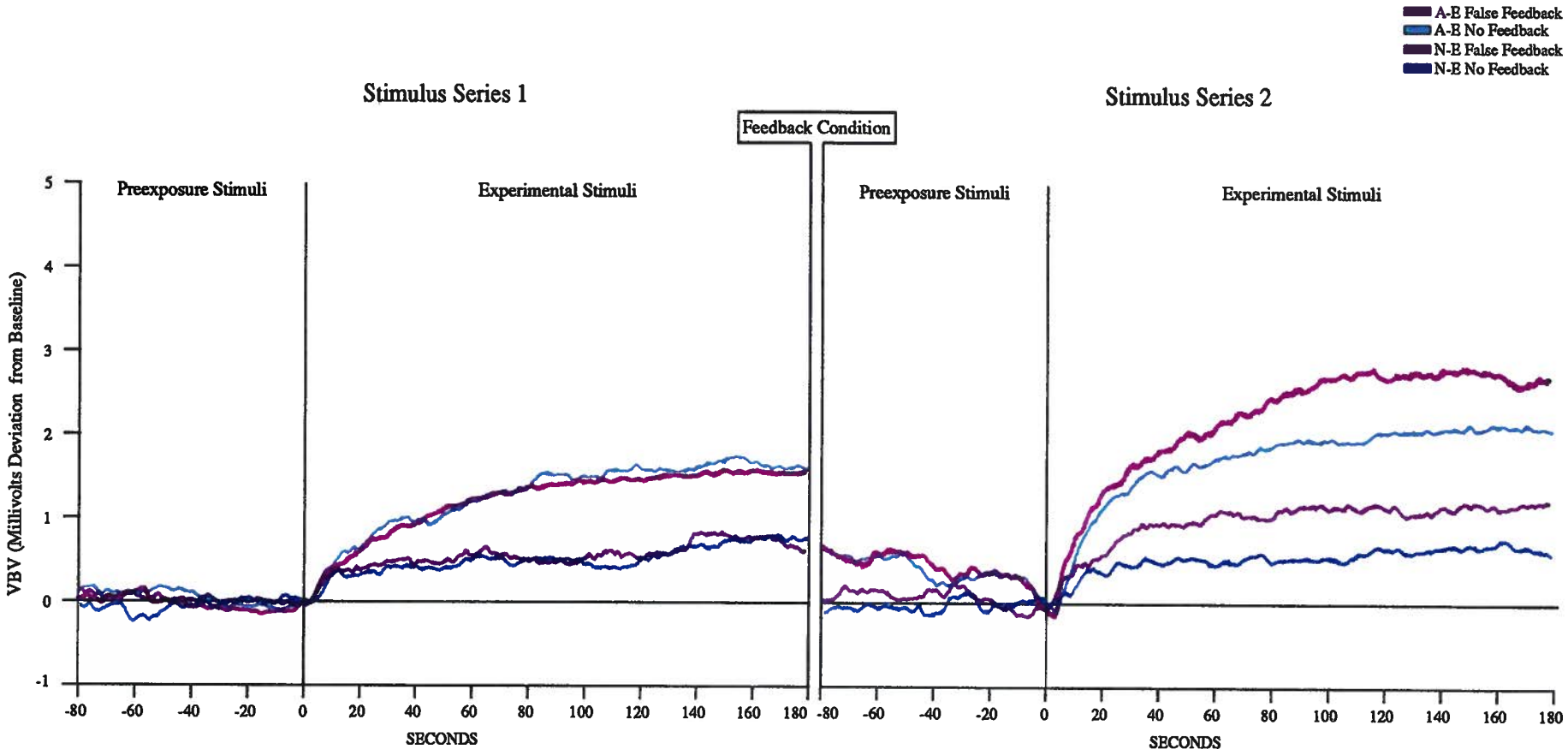
A-E False Feedback
A-E No Feedback
N-E False Feedback
N-E No Feedback
Stimulus Series 1
Stimulus Series 2
Feedback Condition
Preexposure Stimuli
Experimental Stimuli
Preexposure Stimuli
Experimental Stimuli
VBV (Millivolts Deviation from Baseline)
5
4
3
2
1
0
-1
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180
SECONDS
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180
SECONDS

Figure 3.

from 90 to 110 seconds. These findings reveal that false positive feedback of genital vasocongestion is effective in significantly increasing actual physiological sexual arousal and suggest that this effect is more enduring when combined with sympathetic activation.

Relationship Between Subjective and Physiological Responses

To investigate whether the modification of cognitive expectation alters actual physiological response, groups that received false VBV feedback were divided into subgroups on the basis of cognitive change. For each subject, t-tests for dependent samples were calculated between rating 1 and rating 2. Those subjects exhibiting a significant positive change in subjective ratings of sexual arousal from rating 1 to rating 2 were designated group 1 (positive expectations), and those with no significant change or a significant negative change, group 2. To verify that more women changed their cognitive expectations following false feedback as opposed to no feedback, these analyses were also performed for subjects in the no feedback groups. Analyses revealed that 14 women in the false feedback groups and only 7 in the no feedback groups demonstrated a significant positive change in their expectations. Of all subjects, only one in the neutral-erotic and false feedback group exhibited a significant negative change ($p < .01$).

A 2 X 2 X 2 X 18 (Group X Stimulus X Feedback X 10-Second Time Block Mean) MANOVA was performed on subjects that received false VBV feedback to determine whether significant positive

changes in expectations of arousal directly mediate genital response. Simple effects analyses of the Group X Series interaction revealed that women who did not exhibit a significant positive change in their expectations in response to false feedback, subsequently showed no significant change in genital response at series 2. In contrast, women who significantly increased their expectations, subsequently demonstrated a significant increase in their actual vasocongestive response, $F(1, 28) = 11.68$, $p = .0023$. Specifically, post hoc comparisons between stimulus series 1 and 2 at each time block revealed that significant positive changes in expectancy subsequently caused a significant increase in physiological response within 30 seconds of the onset of the erotic stimulus. As compared to their responses at series 1, at series 2 these women exhibited significantly greater genital arousal at each time block throughout the remainder of the erotic stimuli. These findings reveal that significant positive changes in cognitive expectations of sexual arousal directly and rapidly produce significant increases in physiological responding.

Effects of Sympathetic Activation and False Positive VBV Feedback

Physiological sexual arousal. Mean VBV data during stimulus series 2 are presented in Figure 4. These findings reveal that of the four conditions, the combined effects of sympathetic activation and false positive VBV feedback elicited the greatest absolute levels of physiological arousal. The

Figure 4. Mean vaginal blood volume (millivolts deviation from baseline) sampled 5 times/second for matched groups of sexually dysfunctional women during stimulus series 2: anxiety-erotic (A-E) or neutral-erotic (N-E) stimuli following false positive vaginal blood volume feedback or no feedback.

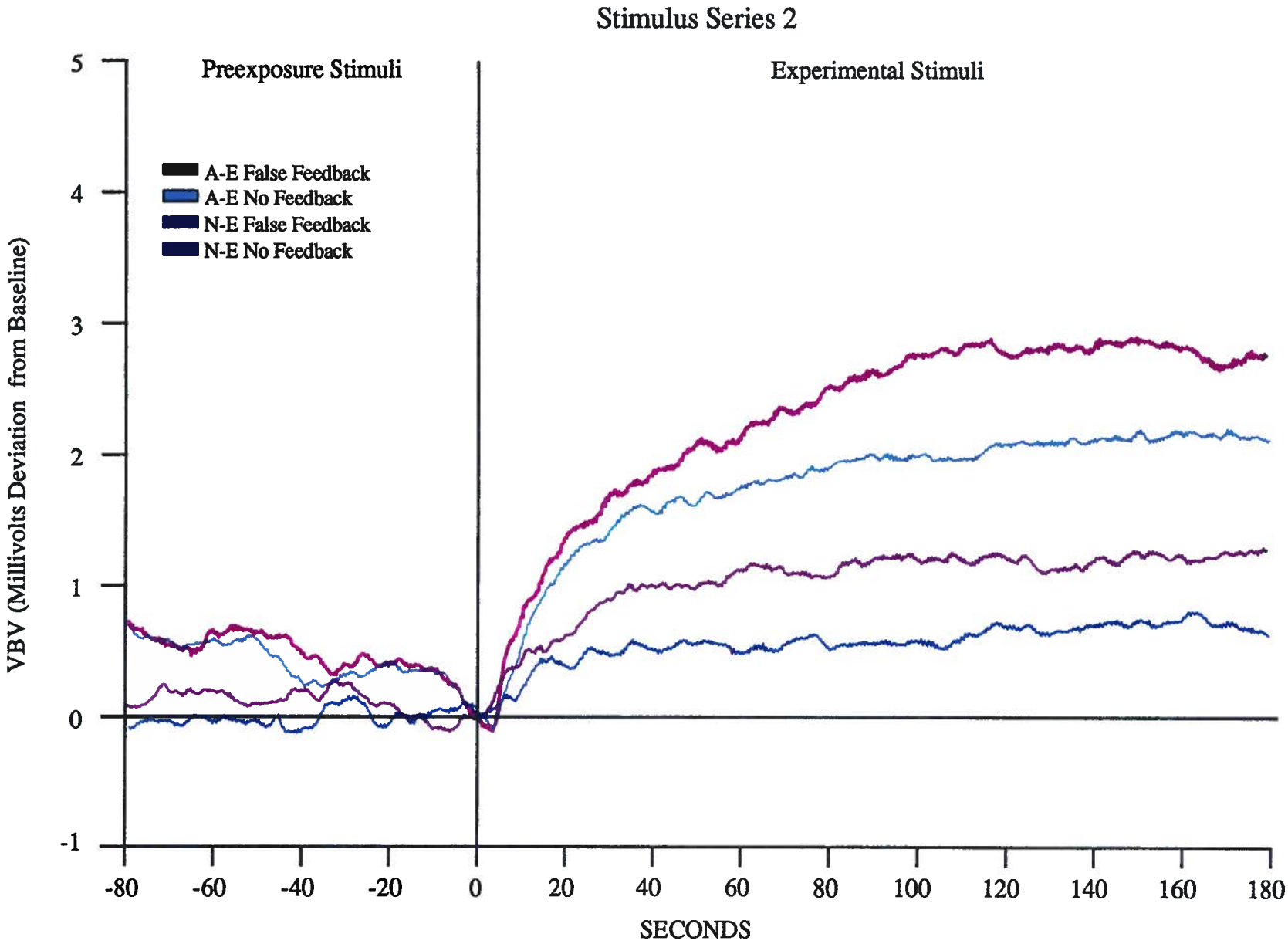
Stimulus Series 2
Preexposure Stimuli
Experimental Stimuli
A-E False Feedback
A-E No Feedback
N-E False Feedback
N-E No Feedback
VBV (Millivolts Deviation from Baseline)
5
4
3
2
1
0
-1
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
SECONDS

Figure 4.

four groups were not statistically compared at stimulus series 2 because it is possible that the group with the greatest absolute level of vasocongestion at stimulus series 2 may not have achieved the greatest increases in genital response from baseline levels at stimulus series 1, to stimulus series 2. Recall that only the false feedback groups were found to demonstrate significant increases in physiological arousal from stimulus series 1 to 2. To investigate if sympathetic activation combined with false VBV feedback elicited a greater increase in physiological arousal than false feedback alone, a 2 X 2 X 36 (Stimulus X Feedback X 10-Second Time Block Mean) MANOVA was performed. A simple effects analysis compared the effectiveness of anxiety versus neutral preexposure and false feedback in increasing physiological arousal as a function of time across stimulus series 1 and 2. This analysis revealed that false positive feedback combined with anxiety preexposure caused significantly greater increases in genital arousal than false feedback alone, $F(35, 2100) = 2.90$, $p < .000001$. Of the four conditions, the combined effects of sympathetic activation and false VBV feedback therefore elicited the greatest increases in physiological arousal.

Subjective sexual arousal. Mean subjective ratings of sexual arousal during ratings 1, 2, and 3 are presented in Figure 2. Rating 2 shows that women in the anxiety preexposure and false feedback group reported the greatest expectations of sexual arousal. Simple effects analyses of the Stimulus X

Feedback X Rating interaction were performed within the initial 2 X 2 X 3 (Stimulus X Feedback X Rating) MANOVA to compare rating 2 (expectations) and rating 3 (experience) for each group. Analyses revealed that women in the anxiety preexposure and false feedback group reported that their subjective experience was significantly less than their expectations, $F(1, 60) = 8.52$, $p = .0051$. To investigate if sympathetic activation combined with false VBV feedback elicited a greater increase in subjective perceptions of sexual arousal than sympathetic activation or false feedback alone, simple effects analyses were performed to compare ratings 1 and 3 for each group. Analyses revealed that women in the neutral preexposure and no feedback group reported no significant change in their experience of sexual arousal at rating 3. Similarly, although women in the anxiety preexposure and no feedback group exhibited a significant increase in their expectations, anxiety preexposure alone did not elicit a significant change in their subjective perceptions of sexual arousal at rating 3. Despite the finding that women in the anxiety preexposure and false feedback group reported a significant increase in their expectations and demonstrated the greatest increases in genital vasocongestion, they did not report a significant increase in their subjective perceptions of sexual arousal. Only the women who received neutral preexposure and false feedback reported a significant increase in their subsequent experience of sexual arousal, $F(1, 60) = 7.63$, $p = .0076$. These analyses revealed that false positive feedback of genital vasocongestion caused

significantly increased subjective perceptions of sexual arousal, and that of the four conditions, false VBV feedback alone therefore elicited the greatest increases in subjective perceptions of arousal.

Discussion

The findings from this investigation identify the interactive mechanisms by which cognitive and physiological response components mediate sexual arousal, and provide major implications for developing a new model and treatment approach for sexual dysfunction. The results reveal that for sexually dysfunctional women:

1. Sympathetic activation enhances genital arousal.
2. False positive feedback of genital vasocongestion (VBV) increases subjective expectations (N-E and A-E) and the subsequent experience of sexual arousal (N-E).
3. False positive VBV feedback increases actual genital response (N-E and A-E).
4. Positive expectations following false VBV feedback directly increase actual physiological response.
5. The combined effects of sympathetic activation and false positive VBV feedback elicit greater increases in cognitive expectations and subsequent genital arousal than either sympathetic activation or false feedback alone.

These results (a) reveal that cognitive and physiological processes are key components of sexual response, (b) identify interactive mechanisms by which these components mediate

sexual arousal, (c) suggest a cognitive-physiological model of sexual dysfunction, and (d) provide evidence that effective interventions for the modification of dysfunctional patterns of sexual arousal be directed toward increasing physiological response and altering negative cognitions via sympathetic activation and feedback.

Sympathetic Activation Enhances Genital Arousal

Women exposed to an anxiety-eliciting as compared to neutral-control stimulus, demonstrated a significantly enhanced rate and magnitude of genital arousal within 10 seconds of viewing an erotic stimulus. As can be seen in Figure 1, this effect of stimulus was found for both the false feedback and no feedback groups. This investigation provides two between-group replications of the previous within-subject finding that anxiety preexposure elicits enhanced genital arousal for sexually dysfunctional women (Palace & Gorzalka, 1990), and is consistent with the literature on sexually functional women and men (Barlow et al., 1983; Dutton & Aron, 1974; Heiman & Rowland, 1983; P. W. Hoon et al., 1977b; Wolchik et al., 1980).

Despite their increased genital responses, women who viewed anxiety as compared to neutral preexposure stimuli reported no significant differences in their perceptions of arousal at rating 1. The finding of a desynchronous relationship between subjective and physiological sexual response in dysfunctional women is consistent with previous research (Morokoff & Heiman, 1980; Palace & Gorzalka, 1990, 1992; Steinman et al., 1981; Wincze et al., 1976). These

findings may be explained by a combination of cognitive and physiological factors. First, Palace and Gorzalka (1990, 1992) revealed that sexually dysfunctional as compared to functional women were less attentive to bodily cues of autonomic and sexual arousal, and actually exhibited lower autonomic lability and vasocongestive response. Second, because women possess a less obvious physiological feedback system (e.g., vaginal vasocongestion versus erection), those women who experience less physiological responsivity may encounter difficulty attending to and labeling bodily cues. Finally, social dictates and lingering double standards governing women's sexual behavior may compound these factors by further discouraging women from attending to or verbally acknowledging genital cues, particularly in the context of anxiety-eliciting films.

The results of the pilot study for this investigation revealed that anxiety as compared to the neutral stimuli elicited significantly greater anxiety and autonomic arousal for sexually functional women. From among a group of five potential anxiety-eliciting stimuli, including the film previously used in the P. W. Hoon et al. (1977b) investigation, the two anxiety stimuli employed in the present study produced the greatest mean levels of heart rate and the highest mean subjective ratings of anxiety and autonomic arousal; and evoked increased heart rate and significantly greater perceptions of sympathetic activity as compared to neutral stimuli. These findings suggest that the anxiety manipulations in the

present study were effective in eliciting moderate levels of sympathetic activation.

The finding that heart rate was not significantly increased during anxiety-eliciting as compared to neutral stimuli for sexually dysfunctional women is consistent with the literature which shows that heart rate is not significantly increased by anxiety induction. Anxiety, as defined by an anxiety-evoking film (P. W. Hoon et al., 1977b), verbal demands to maintain an erection (Heiman & Rowland, 1983), and shock threat contingent on erection (Barlow et al., 1983), have not revealed significant increases in heart rate. P. W. Hoon et al. (1977b) found that despite the absence of significant heart rate changes, sexually functional women described the films as very vivid and anxiety-producing. They suggest that this finding is consistent with the conclusions of Obrist, Lawler, and Gaebelein (1974) that significant heart rate increases can only be elicited by intense stress or phobic anxiety, which may inhibit sexual arousal, as opposed to moderate sympathetic activation.

An additional explanation for the finding that heart rate was not significantly increased by anxiety induction is that sexually dysfunctional women have lower autonomic reactivity than sexually functional women, and were therefore less able to subjectively or physiologically discriminate anxiety-eliciting or erotic stimuli. This explanation is supported by the Palace and Gorzalka (1990) finding that sexually functional as compared to dysfunctional women exhibited greater autonomic

response lability, as demonstrated by greater fluctuations in their VBV responses to anxiety and erotic stimuli, and significantly greater decreases in VBV during anxiety-eliciting stimuli. Similarly, Palace and Gorzalka (1992) found that dysfunctional women exhibited consistently lower levels of VBV and subjectively reported sexual and autonomic arousal than functional women. In addition, whereas functional women were able to discriminate erotic stimuli in terms of physiological sexual arousal (VBV) and subjective perceptions of sexual and autonomic arousal, the dysfunctional women were able to discriminate stimuli only on the basis of subjective reports of sexual arousal. These findings are consistent with data on men (J. G. Beck & Barlow, 1986), which show that during shock-threat instructions sexually dysfunction men demonstrated significantly lower autonomic arousal, as defined by EKG and skin conductance measures, than functional men.

Taken together, the findings from our program of research suggest that sexually dysfunctional women are less able to attend to or report cues of autonomic arousal than sexually functional women because they actually possess less physiological reactivity to which to attend. Women with greater response lability may therefore experience proportionately more anxiety (sympathetic activity) as well as genital arousal. Accordingly, increasing low response lability through sympathetic activity may reverse the dysfunctional process by facilitating the physiological responsivity required to subsequently modify conditioned cognitive expectations.

This explanation is supported by the present findings that the anxiety-eliciting stimuli were effective in significantly increasing genital arousal and subsequent subjective expectations of arousal.

A. T. Beck (Marmor, 1987) states that when individuals are in a heightened state of affective arousal, they are more susceptible to therapeutic intervention. He argues that the most effective techniques of cognitive and behavior therapy involve arousing anxiety to achieve an increased state of reactivity: "if change is going to take place, it has to take place when the person is in some type of heightened state" (p. 278). This idea is consistent with Lacey's (1967) psychophysiological hypothesis which suggests that changes in heart rate and blood pressure can influence cortical activity and thereby affect sensitivity to stimuli. In other words, increased autonomic arousal may facilitate the acquisition of a learned response. For sexually dysfunctional women, it may be that increasing autonomic responsivity not only increases the capacity for heightened physiological response, but facilitates learning and therefore a more rapid extinction of conditioned negative response patterns. Future research is needed to determine if functional and dysfunctional women differ in general autonomic responsivity to environmental stimuli. The present findings suggest, however, that sexually dysfunctional women may have low autonomic reactivity which inhibits their ability to respond to autonomic or sexual arousal, and that mild levels of sympathetic activation stimulate a sexually

functional process of sexual response.

False Positive VBV Feedback Increases Cognitive Expectations and Experience

False positive VBV feedback, which indicated floor to ceiling increases in the subject's vasocongestive response to an erotic stimulus, was followed by a significant increase in rated expectations of sexual arousal. This finding validates the effectiveness of the feedback manipulation in modifying cognitive expectations. Interestingly, sympathetic activation induced by an anxiety-eliciting stimulus and no feedback was also followed by a significant increase in rated expectations of sexual arousal. This finding suggests that general autonomic arousal was effective not only in enhancing genital response but, although not reported at rating 1, was detected, correctly labeled, and subsequently effective in increasing cognitive expectations of sexual arousal at rating 2.

Women who received false positive VBV feedback and neutral preexposure subsequently also reported a significant increase in their subjective experience of sexual arousal. The finding that false feedback of genital vasocongestion is effective in modifying subjective perceptions of sexual arousal is consistent with the literature showing that heart rate and electrodermal activity are effective in altering subjective perceptions of fear and anxiety (e.g., Borkovec et al., 1974; Gaupp et al., 1972; Holmes & Frost, 1976; Kent et al., 1972; Koenig, 1973; Lick, 1975; Rosen et al., 1972; Wilson, 1973), attractiveness (e.g., Barefoot & Straub, 1971; Bloemkolk

et al., 1971; Botto et al., 1974; Goldstein et al., 1972; Hirschman et al., 1977; Kerber & Coles, 1978; Misovich & Charis, 1974; Stern et al., 1972), unpleasantness (Thornton & Hagan, 1976; Young et al., 1982), persuasion (Hendrick et al., 1975), life stress (Stern et al., 1980), and depression (Stern et al., 1978).

False Positive VBV Feedback Increases Actual Genital Response

The actual vasocongestive responses of women who were shown false positive VBV feedback significantly increased following the onset of the erotic stimulus. Specifically, women exposed to false feedback and anxiety-eliciting stimuli demonstrated a significant increase in their genital responses within 30 seconds of the onset of the erotic stimulus and remained significantly more aroused throughout the remainder of the film. In contrast, women exposed to false feedback and neutral preexposure demonstrated significantly greater genital responses for only 30 seconds of the erotic stimulus. Women who received no feedback about their genital responses to erotic stimuli, showed no change in vasocongestion in either stimulus condition. These findings suggest that the effects of sympathetic activation potentiate the effects of false positive feedback in enhancing physiological arousal.

Despite a consensus in the literature that false physiological feedback is effective in modifying cognitive and behavioral processes, there are mixed results regarding its effectiveness in modifying actual physiological processes. The present study controlled for the potential confounding effects

of attention, and minimized distraction and subject demand characteristics that may account for previous contradictory findings. The finding that false VBV feedback is effective in modifying actual vasocongestion is consistent with the literature showing that bogus feedback exerts an effect on heart rate, EDA, and alpha activity associated with fear and anxiety (e.g., Borkovec, 1973; Borkovec & Glasgow, 1973; Gaupp et al., 1972; Lick, 1975), attractiveness (e.g., Bloemkolk et al., 1971; Kerber & Coles, 1978), unpleasantness (e.g., Hirschman & Hawk, 1978; Young et al., 1982), alpha experience (Plotkin, 1980; Valle & Levine, 1975), discomfort (Hirschman, 1975), and attitude (Detweiler & Zanna, 1976).

Positive Expectations Increase Actual Physiological Response

Women who significantly increased their expectations following false positive VBV feedback demonstrated a significant increase in their actual vasocongestive response within 30 seconds of exposure to an erotic stimulus. In contrast, women who received false feedback but did not exhibit a significant positive change in expectations, showed no change in physiological response. These findings reveal a direct feedback loop in the mediation of sexual arousal where cognitive expectations of sexual arousal directly and immediately influence actual physiological response.

Sympathetic Activation and False Positive VBV Feedback Elicit the Greatest Cognitive Expectations and Physiological Arousal

Women who received anxiety preexposure and false positive feedback of genital vasocongestion demonstrated the greatest

expectations of sexual arousal. It is interesting that these women expected levels of arousal comparable to those reported by sexually functional women in the anxiety-erotic condition in the Palace and Gorzalka (1990) investigation. Women who were exposed to anxiety-eliciting stimuli paired with false feedback also achieved the greatest increases in genital arousal. At stimulus series 2 (Figure 4), these sexually dysfunctional women achieved levels of vasocongestion comparable to sexually functional women in the Palace and Gorzalka (1990) investigation. Despite their heightened expectations and genital responses, subjects in this group did not report significantly increased subjective perceptions of arousal at rating 3 (Figure 2). This finding is consistent with the finding at stimulus series 1 and rating 1 that the subjective and physiological responses of dysfunctional women were desynchronous.

The finding that women in the anxiety preexposure and false feedback group did not report significantly increased arousal at rating 3 is particularly curious given that they appeared to detect physiological changes following SNS activation at stimulus series 1, as evidenced by their significantly increased cognitive expectations at rating 2. That is, following exposure to anxiety-eliciting stimuli and false feedback, these women accurately anticipated their enhanced physiological responses at stimulus series 2, but did not acknowledge it when it subsequently occurred. One explanation for this finding is that the neutral nature films

provide an ambiance that is more conducive to verbal reports of sexual arousal than the more aversive anxiety-eliciting stimuli. The use of films for SNS activation, although effective in altering physiological response, may create cognitive dissonance where women are aware of heightened arousal but hesitate to report it.

Cognitive and Physiological Response Components Mediate Sexual Arousal

The results of this investigation challenge the Schachter and Singer (1962) and Valins (1966) theories of emotion. Schachter and Singer assert that an emotional response is produced when cognitive labels are attached to ambiguous physiological states of arousal. The findings at ratings 1 and 3, that women who demonstrated significant increases in genital response following sympathetic arousal did not label their experience as increased sexual arousal, autonomic arousal, or anxiety, does not support this view. Valins contends that emotion is an entirely cognitive phenomenon, and that changes in an emotional state may be accomplished in the absence of actual physiological changes. The finding that false VBV feedback modified actual genital arousal, challenges the assumption that changes in behavior are based exclusively on cognitive changes. Rather, the present findings show that very real differences in physiological response accompanied cognitive change. The findings that false positive VBV feedback modified cognitive expectations, actual physiological response, and subsequent perceptions of arousal; that altering

cognitive expectation directly caused a change in physiological response; and that the interaction of false feedback and sympathetic activation elicited the greatest change in expectations and genital response, provide evidence that the interaction of cognitive and physiological processes mediate the experience of sexual arousal. Rosen and Beck (1988) emphasize that "the subjective experience of arousal should be viewed as the sine qua non for defining a sexual response" (p. 37), however, these results strongly indicate that the influence of both cognitive and physiological components of arousal are imperative to understanding and modifying the processes that determine sexual response.

Processes of Female Sexual Arousal

The present findings identify mechanisms by which cognitive and physiological components interact to mediate sexual arousal. Sympathetic activation (increased autonomic arousal) induced by an anxiety-eliciting stimulus was highly efficient in directly enhancing physiological sexual response. Interestingly, sympathetic activation was also successful in increasing cognitive expectations of sexual arousal. It was not, however, immediately effective in modifying subsequent physiological response or subjective perceptions of sexual arousal. This process, as demonstrated by the A-E no feedback group in the present study, is diagrammed in Figure 5 (top).

The process for false positive VBV feedback was somewhat different. False positive feedback of vaginal vasocongestion increased cognitive expectations of sexual arousal, which in

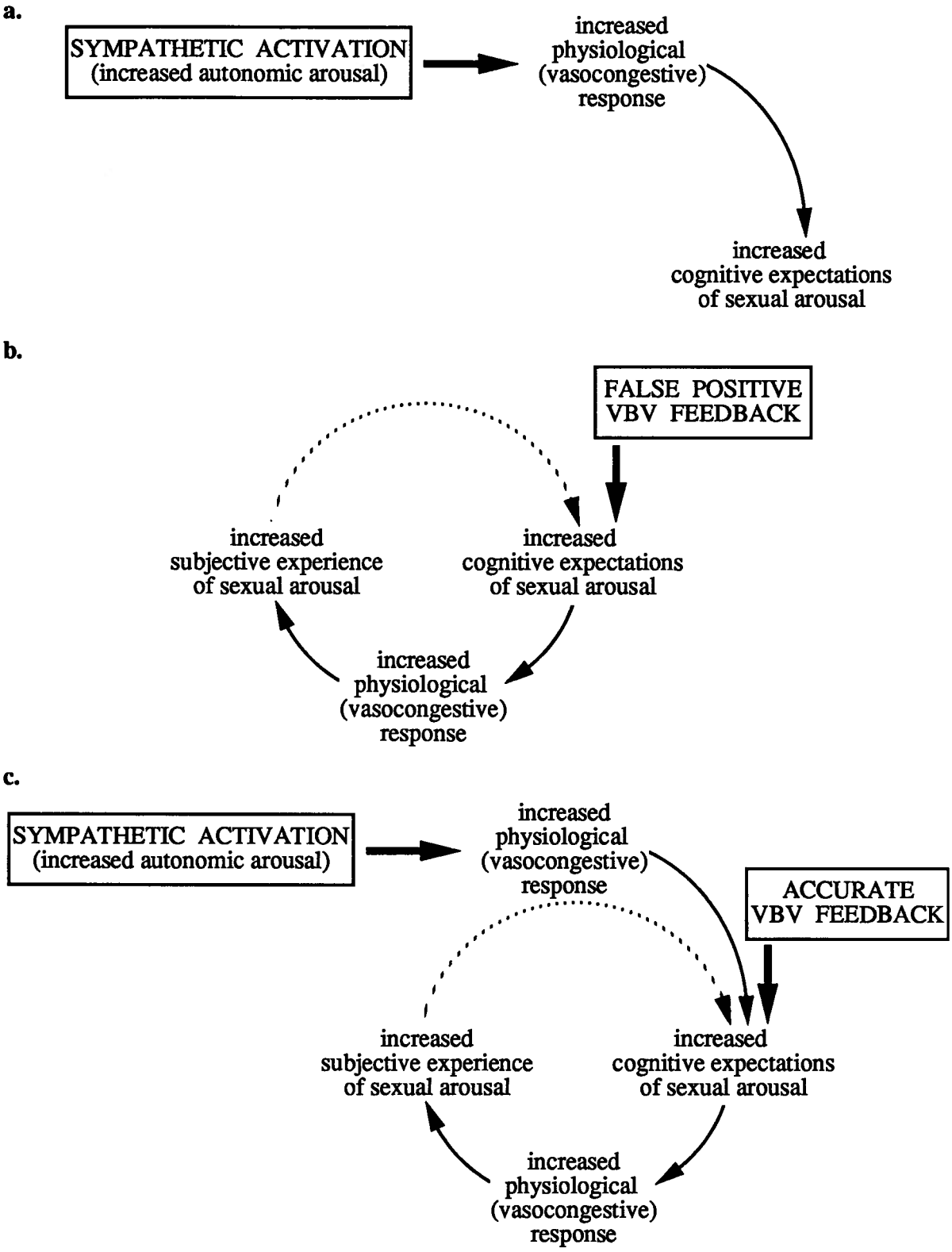

Figure 5. Processes by which cognitive and physiological response components interact to mediate sexual arousal: (a) process by which sympathetic activation (increased autonomic arousal) enhances sexual arousal, (b) process by which false positive VBV feedback enhances sexual arousal, and (c) proposed process by which sympathetic activation combined with accurate VBV feedback reverses the dysfunctional process and initiates a positive cognitive-physiological feedback loop of sexual arousal.

turn directly enhanced actual physiological response. This interaction between cognition and physiological response is extremely rapid, as demonstrated by the finding that irrespective of stimulus condition, positive changes in expectation were accompanied by a significant increase in genital response within 30 seconds of exposure to an erotic stimulus. Significant changes in expectation and genital response consequently also altered subjective perceptions of the experience of sexual arousal. Although it was not examined in the present investigation, increased subjective appraisals of arousal may further influence future expectations, thus completing the feedback loop. This process, as demonstrated by the N-E false feedback group in the present study, is diagrammed in Figure 5 (middle).

The results of this study reveal that the combined effects of sympathetic activation and false positive VBV feedback (A-E false feedback group) surpass the effects of either sympathetic activation or false feedback alone in the modification of dysfunctional patterns of sexual arousal. The finding that false VBV feedback was more effective in increasing genital response following anxiety as compared to neutral preexposure, reveals that the effectiveness of false feedback is moderated by the effects of sympathetic activation. Because anxiety-eliciting stimuli enhance genital response, the false feedback was less "false," for these women, i.e., genital arousal was amplified and therefore feedback was more accurate and genital cues may have been more easily detected. Although women in

this group did not report increased arousal at rating 1, false feedback may have served to substantiate or facilitate the correct labeling of genital cues. As can be seen at rating 2 (Figure 2), this information subsequently caused significantly increased expectations that surpassed the expectations reported by women in other conditions. False positive feedback therefore has a more rapid and enduring effect for women exposed to anxiety-eliciting stimuli because sympathetic activation provides a very real increase in vasocongestion, which in turn causes greater expectations, and subsequently a further increase in actual genital response. Hirschman and Clark (1983) and Rosen and Beck (1988) emphasize the importance of attending to the prepotency of cognitive factors and de-emphasizing physiologically-based treatments. The present findings reveal, however, that sympathetic activation plays an important role in modifying dysfunctional response since its genital arousing-enhancing effects can replace the false-positive component of feedback with a true-positive response. If accurate feedback were provided to sexually dysfunctional women in the absence of sympathetic activation, negative cues of low physiological response could exacerbate the dysfunctional process by validating negative expectations and further impeding physiological response.

As evidenced in Figure 4, the effectiveness of sympathetic activation is also diminished in the absence of feedback. Sympathetic activation without feedback cannot alter the conditioned lack of attentional focus or facilitate the ability

to correctly label these new genital sensations. The findings at ratings 1 and 3 (Figure 2) that significantly increased genital responses for women in the anxiety-erotic conditions were not subsequently accompanied by significantly increased subjective ratings, provide evidence that these women have not learned to recognize or label their genital sensations. Recall that men in the Sakheim et al. (1984) study demonstrated that visuosensory awareness and attention to penile tumescence provided a significant cue for subjective appraisals of sexual arousal. Men who were prevented from viewing their genital responding by a sheet covering their genital area, exhibited significantly lower levels of genital arousal than men who were allowed visual attention to penile response. Accordingly, in the present study, the purpose of the polygraph chart depicting vaginal vasocongestion was to provide dysfunctional women with information similar to that provided by erection. The present findings are consistent with the Sakheim et al. (1984) study, and reveal that for women as well as men, visual attention to vasocongestion elicits significantly greater physiological levels and subjective appraisals of arousal. In addition, although the women who received anxiety preexposure and no feedback demonstrated significant increases in physiological response at stimulus series 1 and reported greater expectations of arousal at rating 2, without the reinforcement provided by visual verification that they had responded physically and labeled their sensations accurately, subsequently showed no significant change in genital response at series 2 or

perceptions of arousal at rating 3. The additive function of feedback is therefore to provide information that both facilitates and reinforces the correct labeling of genital responses elicited by sympathetic activation.

The present findings clearly reveal that the combined effects of a physiologically-based intervention to enhance sympathetic activation, and a cognitively-based intervention to facilitate labeling of genital cues, was the most effective method of modifying dysfunctional response. Women in the A-E false feedback group demonstrated important steps in the reversal of the dysfunctional process: an increase in physiological response, attention to and correct identification of this change, a significant positive change in expectations, and subsequently a further significant increase in genital response. It is important to recognize that within 3 minutes of exposure to an erotic stimulus, the dysfunctional women in this group achieved levels of genital arousal comparable to a demographically similar sample of sexually functional women (Palace & Gorzalka, 1990).

A Cognitive-Physiological Model of Sexual Dysfunction

The findings of the present study suggest a model whereby cognitive and physiological processes interact to disrupt sexual arousal. Research findings (Palace & Gorzalka, 1990, 1992) suggest that the desynchrony observed in sexually dysfunctional women may be accounted for by a combination of cognitive and physiological factors: low autonomic lability, lack of physically observable cues, and social demands.

These factors may facilitate a lack of attentional focus and incorrect labeling of bodily cues, which in turn become a conditioned negative expectancy that further attenuates or extinguishes physiological response to sexual cues. Sexual dysfunction may therefore be viewed as the result of an interactive process whereby cognitive and physiological components form a negative feedback loop of dysfunctional response: women with low physiological response (low autonomic lability) decrease subjective expectations and appraisals of arousal, and reciprocally, women with low expectations (lack of attentional focus or mislabeling of bodily cues) further inhibit physiological responsivity.

The Modification of Dysfunctional Patterns of Sexual Arousal

The findings of the present study suggest a general approach to the modification of dysfunctional patterns of sexual arousal. Specifically, strategies directed toward enhancing physiological responsivity and modifying negative cognitions via sympathetic activation and feedback may reverse the dysfunctional cycle and initiate a positive cognitive-physiological feedback loop of sexual arousal.

The present findings suggest that anxiety-eliciting stimuli facilitate sexual arousal through the direct instigation of generalized sympathetic activation. When sexual cues were provided, this enhanced sympathetic responsivity activated specific genital responses. In this way, sympathetic activation replaces the function of false positive feedback by providing a true-positive enhancement of genital response. If

sympathetic arousal facilitates learning, it would also hasten the extinction of conditioned negative response patterns, and the acquisition of new positive modes of responding. Feedback of genital vasocongestion can further provide observable and positive physical cues to validate and reinforce the experience elicited by sympathetic activation. That is, feedback can facilitate attentional focus and the correct labeling of bodily cues, which in turn will further extinguish conditioned negative expectations. The modification of negative expectations was found to directly facilitate enhanced physiological response to erotic cues and subsequently increase subjective perceptions of sexual arousal, which may further increase cognitive expectations. Although women exposed to anxiety-eliciting stimuli did not report significant increases in perceptions of sexual arousal, SNS activation was effective in significantly increasing their expectations regarding their ability to become aroused. By replacing the anxiety-eliciting films with a SNS-activating mechanism that is more conducive to acknowledging sexual arousal, SNS activity may also contribute directly to an increase in the subsequent reports of subjectively experienced arousal.

Accordingly, strategies directed toward increasing sympathetic activation through some form of physical activity or exercise, may provide an initial "jump start" or preparedness for sexual arousal which increases the likelihood of providing positively reinforcing genital feedback. As demonstrated in this study with false positive VBV feedback,

when accurate positive feedback is subsequently provided, women seeing positive results are likely to modify their negative expectations about their potential to become aroused. As also demonstrated in this study, positive changes in expectations may further potentiate increased physiological response and subjective appraisals of sexual arousal. This proposed arousal-retraining program specifically targets both cognitive and physiological response components and utilizes their interactive nature to reverse and reciprocally enhance the arousal process. This approach is diagrammed in Figure 5 (bottom). Although the efficacy of such a program awaits treatment-outcome evaluation, the present findings suggest that this approach may be effective in rapidly alleviating dysfunctional patterns of sexual arousal.

This investigation provides strong evidence that cognitive and physiological processes form a direct and immediate feedback loop in the mediation of sexual arousal. The combined effects of sympathetic activation and false positive feedback of genital engorgement interrupted and reversed the dysfunctional process by enhancing physiological responsivity, increasing cognitive expectations, and subsequently, increasing actual genital response to levels comparable with sexually functional women within 3 minutes. These findings suggest that dysfunctional patterns of sexual arousal may be modified by increasing response synchrony through the repeated pairings of sympathetic arousal and accurate feedback, which serve to heighten genital response, facilitate attentional focus and

positive appraisals of genital experience, and in turn, further potentiate physiological response. In this way, the mechanisms by which cognitive and physiological components interact to prevent arousal, may be reversed to produce an upwardly spiraling feedback loop of heightened sexual arousal.

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APPENDIX

Page

Film Scale 103

Code No._____

FILM SCALE

Instructions: Please use the following scale to evaluate how you felt during the last film. Please answer honestly and carefully. On the scale, circle any of the numbers from 1 (not at all) to 7 (intensely).

During the film, I felt:

1.	Faster breathing_____	1	2	3	4	5	6	7
2.	Faster heart beat_____	1	2	3	4	5	6	7
3.	Perspiration_____	1	2	3	4	5	6	7
4.	Feelings of warmth_____	1	2	3	4	5	6	7
5.	Any physical reaction at all_____	1	2	3	4	5	6	7

Continue on to the next page.

Code No._____

FILM SCALE (Continued)

Instructions: Please use the following scale to evaluate how you felt during the last film. Please answer honestly and carefully. On the scale, circle any of the numbers from 1 (not at all) to 7 (intensely).

During the film, I felt:

6.	Breast sensations	1	2	3	4	5	6	7
7.	Warmth in genitals	1	2	3	4	5	6	7
8.	Genital wetness or lubrication	1	2	3	4	5	6	7
9.	Genital pulsing or throbbing	1	2	3	4	5	6	7
10.	Any genital feelings	1	2	3	4	5	6	7
11.	Sexually aroused	1	2	3	4	5	6	7
12.	Worried	1	2	3	4	5	6	7
13.	Anxious	1	2	3	4	5	6	7
14.	Angry	1	2	3	4	5	6	7
15.	Disgusted	1	2	3	4	5	6	7
16.	Embarrassed	1	2	3	4	5	6	7
17.	Guilty	1	2	3	4	5	6	7
18.	Sensuous	1	2	3	4	5	6	7
19.	A desire to be close to someone	1	2	3	4	5	6	7
20.	Pleasure	1	2	3	4	5	6	7
21.	Interested	1	2	3	4	5	6	7
22.	Attracted	1	2	3	4	5	6	7
23.	Excited	1	2	3	4	5	6	7
24.	Sexy	1	2	3	4	5	6	7
25.	Dirty	1	2	3	4	5	6	7
26.	Loving	1	2	3	4	5	6	7
27.	Sexually attractive	1	2	3	4	5	6	7
28.	Inhibited	1	2	3	4	5	6	7
29.	Easy to arouse	1	2	3	4	5	6	7
30.	Incompetent	1	2	3	4	5	6	7
31.	Sexually turned off	1	2	3	4	5	6	7
32.	Offended	1	2	3	4	5	6	7
33.	Bored	1	2	3	4	5	6	7
34.	Feminine	1	2	3	4	5	6	7

Stop and wait for further instructions.