

Voluntary Control of Sexual Responding in Men and Women: Implications for the Etiology and Treatment of Sexual Dysfunctions

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Recent psychophysiological investigations have shown that biofeedback and operant conditioning procedures are associated with changes in genital vasomotor activity in men and women. Although the exact role played by biofeedback or operant contingencies in the establishment of genital vasomotor control has not been conclusively established, some degree of voluntary control has been reliably demonstrated over a response that is traditionally viewed as an involuntary component of the human sexual response cycle. The present article critically reviews the experimental literature pertinent to the issue of voluntary self-control of sexual responding and makes recommendations concerning future research. The implications of this literature for traditional etiological theories and treatment approaches for sexual dysfunctions are discussed. The potential of biofeedback and operant techniques for shaping genital responses, increasing discriminability, enhancing body awareness, and facilitating cognitive labeling of genital sensations are discussed as they relate to the stated goals of sex therapy.

Leading sexologists distinguish between arousal and orgasmic phases of the human sexual response cycle (Kaplan, 1974; Masters & Johnson, 1966). *Orgasm* is a rather vague term used to describe a constellation of subjective sensations, emotions, and physiological reflexes that occur at the peak of

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sexual excitement. The physiological component alone is relatively complex, consisting of three neurologically separate events: (a) bladder neck closure, (b) seminal emission, and (c) ejaculation, in the male. Consequently, relatively little biobehavioral research involving human orgasmic responding has been accomplished.

Sexual arousal also involves a rather complicated series of psychological and physiological events; however, investigators have experienced greater success in developing instrumentation for the noninvasive monitoring of some genital responses in men (see Farkas, Evans, Eifert, Wittlieb, & Vogelmann-Sine, 1979; Rosen & Keefe, 1978) and women (see Geer, Morokoff, & Greenwood, 1974; Hatch, 1979). These technological advances have allowed an integrated psychophysiology of sexual arousal to emerge, and a limited yet significantly informative literature on this topic has now been compiled (see Bancroft, 1980; Hatch, 1981; Heiman & Hatch, in press). Sexual arousal in both sexes is best conceptualized as a whole-body response (Masters & Johnson, 1966) involving such diverse general reactions as hyperventilation, tachycardia, myotonia, and sweating, as well as more specific vasomotor changes in the genital organs. However, the genitals are the only organs that have been shown to reliably respond differentially to erotic and nonerotic stimuli (Hoon, Wincze, & Hoon, 1976; Zuckerman, 1971). Therefore, most of the pertinent research, and consequently the present discussion, focuses on measures of genital vasocongestion.²

It has been generally accepted that since human sexual arousal is the physiological result of autonomic vasomotor reflexes, it is not amenable to voluntary control. Masters and Johnson (1970) strongly reinforced this belief by making it the foundation of their treatment program for erectile failure: "The major therapeutic contribution involves convincing the emotionally distraught male that he does not have to be taught to establish an erection. He cannot be taught to achieve an erection any more than he can be taught to breathe. Erections develop just as involuntarily and with just as little effort as breathing. This is the salient therapeutic fact the disturbed man must learn. No man can will an erection" (p. 196). This proclamation has strongly influenced contemporary medical theory concerning both the etiology and the appropriate treatment of arousal disorders. Sex therapists commonly operate upon the assumption that hypothetical constructs such as "spectator role" and "performance

²The recent appearance of a number of reports on new psychophysiological instruments for recording other aspects of sexual arousal (Bohlen & Held, 1979; Gillan & Brindley, 1979; Hatch, Heiman, & Hahn, 1979; Henson, Rubin, & Henson, 1978; Levin & Wagner, 1978) suggests that this problem is gradually being corrected.

demands" cause sexual dysfunction. The primary goal of sex therapy is, therefore, frequently to create a sexual atmosphere in which these factors will not be present. If this is successful, sexual arousal is then expected to occur as naturally as breathing. Behavioral techniques following the Masters and Johnson (1970) format have been highly successful in eliminating various sexual dysfunctions. However, it should be pointed out that this success does not directly support the underlying rationale that the therapy releases the completely involuntary response from a hypothesized source of inhibition.

VOLUNTARY CONTROL OF SEXUAL AROUSAL RESPONSES IN THE MALE

Recently, the completely involuntary nature of the arousal reflex has been tested empirically, and the results have raised questions about the universal validity of the theory that sexual responsiveness is completely involuntary. Laws and Rubin (1969) selected subjects who showed erections in response to an erotic film and, after collecting baseline data, instructed them to attempt to inhibit their erectile reflexes during subsequent presentations of the film. It was reported that some degree of success at voluntary suppression was achieved. Responding later returned to basal levels when subjects were once again instructed to allow erections to develop naturally. Moderate ability to produce erections in the absence of external eliciting stimulation was also shown. These results were extended in a follow-up study (Henson & Rubin, 1971) that included an additional control for the subject's attention to the erotic stimulus. The ability to voluntarily suppress erections was again demonstrated even when subjects were required to pay close attention to the film and give a verbal report of its content after viewing it.

These demonstrations of voluntary control over the erectile response led to speculation that the response might be amenable to instrumental contingencies as well as instructional control. Rosen (1973) examined this hypothesis by testing the effects of response-contingent feedback on subjects' ability to voluntarily suppress penile tumescence that was elicited by erotic tape recordings. Binary feedback was presented in the form of a dim red light that could be turned off by suppressing erections. A group that received response-contingent feedback was able to maintain their erectile responses below a criterion level for a significantly greater amount of time than were control groups that received instructions only, noncontingent yoked feedback, or no treatment. The results were important in showing that the erectile reflex is susceptible to suppression as a function of

instrumental contingencies. It was suggested that instrumental contingencies may play an etiological role in some cases of psychogenic impotence.

The ability of response-contingent feedback to facilitate, as well as suppress, the erectile reflex in the absence of external eliciting stimulation has also been examined. Rosen, Shapiro, and Schwartz (1975) used a combination of visual analogue feedback, plus supplemental monetary reinforcements, in an operant shaping paradigm. It was shown that erections were facilitated to a significantly greater extent by contingent than by non-contingent feedback. The authors also noted that the feedback situation, which required subjects to closely monitor their erectile responding, created a situation that was in some ways analogous to what Masters and Johnson (1970) described as "performance demand." Polygraph records and self-reports of the subjects confirmed that they were not calm and relaxed during the experiment. It is noteworthy that these subjects were able to demonstrate voluntary increases in penile tumescence in spite of these presumably unfavorable conditions. In another biofeedback study, Price (1973) provided a combination of analogue and binary feedback to one group of heterosexual men and no feedback to another group. The superiority of the feedback group was shown in terms of both a shorter latency to peak erection and a longer duration of erection once achieved.

Only a few attempts have been made to employ instrumental conditioning or biofeedback techniques in the clinical setting. In an uncontrolled case study, Quinn, Harbisan, and McAllister (1970) attempted to shape an erectile response in the presence of a female slide stimulus in a homosexual subject who had previously undergone aversive conditioning therapy for homosexual arousal. This unfortunately eliminated all sexual arousal. The reconditioning procedure involved reinforcing progressively larger erectile responses with sips of cold lime juice while the subject was in a state of fluid deprivation. Binary feedback was also provided in the form of a light that was lighted on each successful trial. The ability to produce erections in the presence of a female slide did develop during the procedure. However, since no control for the possible effects of other life events was included, it is not possible to evaluate the independent contribution of the reinforcement contingencies or biofeedback in this study.

In another study, Shaefer and Colgan (1977) reinforced two heterosexual male subjects with the opportunity to masturbate to orgasm after reading a passage of erotic literature. Over the course of six trials, these subjects developed larger erectile responses to the literature than did a control group of six subjects who were not allowed to masturbate after reading the material. It is not clear exactly what was reinforced in this study, however, since masturbation occurred at the end of each session, regardless of the level of erectile responding that occurred during the preceding trials.

Another single-case study was conducted by Rosen and Kopel (1977), in which a 45-year-old male transvestite-exhibitionist was treated using a biofeedback procedure. The subject was shown a transvestite-exhibitionist videotape and a heterosexual film in each session, during which he listened to a tape recording of his own alarm clock bell. The volume of the bell was made proportional to penile circumference, providing the subject with continuous analogue feedback. The subject's own alarm clock bell was chosen as the feedback stimulus because the authors felt it was a more "naturalistic" stimulus than light or other sounds. During 12 feedback sessions, the subject's erectile response to the transvestite-exhibitionist stimulus gradually declined to near zero, whereas his response to the heterosexual stimulus remained steady at 100% full erection. In a post-treatment assessment and in 4 follow-up assessment sessions conducted during the first 4 months following therapy, penile responding to the transvestite-exhibitionist stimulus remained minimal. Since a reversal did not occur upon removal of the feedback, it cannot be concluded that this response-contingent stimulus produced the behavioral change.

The subject was also interviewed 6 months and 16 months following therapy, but penile responding was not measured. During these follow-up assessments, both the subject and his wife indicated continued improvement both in their verbal reports during the interview and in their responses on a standardized psychometric instrument (Sexual Interaction Inventory; LoPiccolo & Steger, 1974). The therapists (Rosen & Kopel, 1977) later learned from the subject's wife, however, that they had been deceived by the couple, and in fact, the patient had resumed cross-dressing and exposure some time after therapy. The authors noted that they might have detected the deception earlier if they had continued the objective genital recording throughout the follow-up period. They stated, "The events of this case provide a striking demonstration of the unreliability of self-report data as a clinical outcome measure" (p. 915). It has been noted elsewhere (Freund, 1976; Laws & Holman, 1977), however, that voluntary distortion of "objective" physiological measures is also possible if the motivation to deceive is present.

In a study designed to separately evaluate the effects of biofeedback and tangible reinforcement on the voluntary control of erections, Barlow, Agras, Abel, Blanchard, and Young (1975) attempted to increase heterosexual arousal in three homosexual men. Visually presented analogue feedback was paired with a slide of a woman, and subjects were instructed to "try to become aroused" using the feedback for assistance. Feedback had no significant effect on the penile responses of two of the subjects. The third man showed "clinically significant" increases during feedback training, which continued following withdrawal of feedback, suggesting that factors other than the feedback may have been responsible for the

progress made. Stronger evidence for a reinforcement effect occurred when monetary rewards were made contingent upon the emission of a criterion surpassing response. One subject showed increases in erections when contingent social praise and money were added to feedback, which later declined when praise and money were delivered noncontingently. Social praise seems to have been the effective reinforcer since increases were once again shown when praise was delivered contingently and money noncontingently. The results were generally of moderate magnitude, and there was no evidence of generalization to no-feedback probe sessions, suggesting that the technique would probably not yield clinically significant increases in heterosexual arousal among homosexuals.

The clinical trials that could demonstrate the efficacy of biofeedback techniques in the treatment of erectile disorders in impotent men are still forthcoming. However, two preliminary reports using clinically impotent men as subjects have appeared in the literature. In one of these studies, Csillag (1976) used a combination of visual and auditory analogue feedback to test the ability of men with psychogenic impotence to develop voluntary control over their erectile reflexes. A group of six impotent men and a group of six normal men were tested in a 16-session experiment. Subjects were allowed to fantasize a sexually arousing situation and were exposed to erotic pictures both with and without feedback. Although the author pointed out a tendency for greater responding over trials in the impotent group, the responses of individual men showed considerable variability over trials. There was also a tendency for the normal men to show reduced responding over trials. These results cannot unequivocally be interpreted as demonstrating a facilitory effect of feedback on penile erection. It is noteworthy, however, that five of the six impotent men reported improved erectile ability away from the lab, and three reported improvement to a degree that enabled them to accomplish sexual intercourse.

The other study produced more encouraging results. Herman and Prewett (1974) treated a 51-year-old man who reported that he had always had difficulty maintaining an erection in both homosexual and heterosexual encounters. He also had difficulties during masturbation and had ejaculated only once in his life. During the baseline period, the subject showed only a very slight erectile response to slides of nude men and women. During therapy, response-contingent proportional feedback was provided, and the man was instructed to attempt to achieve an erection using any means outside of manipulation. No external, eliciting, erotic stimulus was provided during this time. Over the course of 10 contingent feedback training sessions, the subject showed a steady increase in this erectile response to male and female stimuli in postsession probes during which feedback was unavailable. He also reported that he was able to masturbate to ejaculation during this time, and that he had begun to date a woman about whom he began to have erotic

fantasies. During the next phase of the study, noncontingent feedback was substituted for six sessions. During this interval, the penile response to male and female slides declined, and the subject reported he had lost the ability to masturbate, and heterosexual petting had become unarousing for him. With the reinstatement of contingent feedback, penile responding to slides returned, and the subject again reported success at masturbation with heterosexual fantasies and resumed dating. He also reported two successful homosexual encounters. The authors hypothesized that the procedure was successful because it made the subject aware of previously indiscriminable changes in his penis. They noted that very small erections (less than 3% of full erection) could be detected and reinforced with the procedure and suggested that this high sensitivity might make it a useful procedure for treating impotence where sensation is compromised, such as in spinal cord injury. Even with normal men it cannot be assumed that a high degree of discriminability over low-level erectile responding exists in the absence of feedback simply because the male genital is external. On the contrary, data indicating that men are often unaware of small changes in their erectile responding have been reported (Barlow, Becker, Leitenberg, & Agras, 1970).

VOLUNTARY CONTROL OF SEXUAL AROUSAL RESPONSES IN THE FEMALE

Vasocongestion of the female genitalia is considered to be a closely analogous phenomenon to penile erection in the male (Masters & Johnson, 1966), and researchers have begun to explore the possibility that these vascular changes may also be amenable to voluntary control. For example Hoon, Wincze, and Hoon (1977) reported case studies of two women who were given analogue visual feedback for changes in vaginal blood volume. In the first phase of the study, the women were provided with vaginal feedback and were instructed to try to increase a physiological response, but they were not told what response was represented by the feedback. Neither subject was able to produce significant elevations in vaginal blood volume under these conditions. In the next phase, feedback was withdrawn, and the subjects were asked to engage in erotic fantasy. In this condition, significant elevations in vaginal blood volume from baseline were shown by one subject but not by the other. In the final phase, both subjects were instructed to attempt to increase vaginal blood volume using both feedback and erotic fantasy. Both subjects were able to significantly elevate response levels from baseline under these conditions. Since one subject was able to increase vaginal blood volume with feedback and fantasy but was unable to do so using erotic fantasy alone, the feedback may have facilitated this response. The effect cannot, however, be conclusively attributed to the feedback.

Since treatments were administered in the same order to both subjects, and no reversal condition was attempted, treatment sequence effects or experience with erotic fantasy could also be involved.

Another study of the ability of women to control their vaginal blood volumes with biofeedback was conducted by Cerny (1978). Separate groups of 10 women each were exposed to contingent, auditory, analogue feedback, noncontingent feedback, or no feedback while they viewed an erotic videotape. On half of the trials, subjects attempted to augment their vaginal responses to the stimulus, while on the other half of the trials, they attempted to reduce their responses. The results showed that women were able to exercise inhibitory voluntary control over vaginal blood volume, but biofeedback was not shown to facilitate the control beyond that achieved with instructions alone. Voluntary increases in vaginal blood volume were not demonstrated. Similar results were obtained on the vaginal pulse amplitude measure.

Zingheim and Sandman (1978) attempted to teach a group of 10 women to exercise bidirectional discriminative control over their vaginal pulse amplitude, using binary visual biofeedback. The subjects were able to significantly increase vaginal pulse amplitude (vasodilate) but were unable to significantly decrease vaginal pulse amplitude (vasoconstrict) with biofeedback. Their results were thus opposite to those reported by Cerny (1978), in which decreases but not increases were shown. Since subjects were not requested to modify their vaginal blood volumes without feedback in the Zingheim and Sandman (1978) study, it cannot be determined whether presenting feedback would have had any advantage over merely instructing subjects to perform the desired response. However, because there was no significant improvement across trials, the question may be raised as to whether or not any learning actually occurred. Although the investigators requested the subjects specifically not to engage in sexual fantasy, vaginal vasodilation such as that reported would be expected if erotic cognitive behavior did occur. The results do, however, replicate earlier findings of Heiman (1977) and Hoon et al. (1977) that women can voluntarily modify vaginal vasocongestion upon request in the absence of an external eliciting stimulus.

Emily Hoon (1980) directly compared visual and auditory feedback in a bidirectional control design. When responding under decrease instructions was compared to responding under increase instructions, the difference in vaginal blood volume was statistically significant. However, most of the effect was due to an increase in vaginal blood volume under the increase instructions, the decrease below baseline being slight. Visual feedback was associated with a greater degree of voluntary control over vaginal blood volume than was auditory feedback; however, there was not a statistically significant difference between responding under the visual feedback and the instructions-alone conditions.

Although much remains to be learned about the specific mechanisms involved, these studies (Cerny, 1978; Hoon, 1978; Hoon et al., 1977; Zingheim & Sandman, 1978) do show that women, as well as men, can exert some degree of voluntary control over a physiological response that is normally considered an involuntary component of the sexual arousal pattern. The ability of response-contingent biofeedback to facilitate this ability has not, however, been conclusively demonstrated in women.

SYNTHESIS AND CLINICAL EVALUATION

Although much remains to be learned about the mechanisms and processes involved, the studies reviewed above do show that men and women are able to exert some degree of voluntary control over a physiological response that is traditionally considered an involuntary component of the sexual response cycle. The immediate importance of these results is not in terms of clinical application. At present, biofeedback should remain a research tool in the area of sexual dysfunction, since its clinical efficacy has not been conclusively established. Of greater immediate importance, however, is the fact that some degree of voluntary control and amenability to instrumental contingencies has been shown. This fact forces attention upon heretofore largely ignored possibilities in relation to etiology and treatment of some forms of sexual dysfunction. It is also significant that consideration has been given to the possibility of directly modifying the physiological component of sexual dysfunction. In the final analysis, the increase in genital blood volume associated with sexual arousal is a hemodynamic event requiring either an increase in arterial inflow or a decrease in venous outflow, or both. The vascular end organs that control these events are innervated by autonomic nerves. Any form of therapy must ultimately explain its effectiveness in modifying this system, and it is believed that biofeedback, used as a research tool, could be very helpful in advancing our understanding of this psychophysiological process.

The theory that autonomic psychophysiological disorders may be learned instrumentally (Miller, 1975; Shapiro & Schwartz, 1972) may now be logically extended to encompass the area of sexual response. The theory that anxiety and other dysphoric affective states are the primary determinants of sexual dysfunction has enjoyed a long and popular history. It is now known that the relationship between anxiety and sexual arousal is complex (Bancroft, 1974) and undoubtedly does not account for the majority of psychogenic arousal difficulties. Operant and biofeedback strategies have made the theory of instrumental control over sexual responding a tenable alternative. This theory also suggests alternative methods for the modification of some sexual arousal problems in men and women. For example, Rosen (1976) reported on several male patients who had a history of masturbating to orgasm without achieving an erection. He suggested that

masturbation and orgasm under these conditions could conceivably serve to reinforce the flaccid penile state and consequently reduce the probability of an erection occurring on future occasions. This analysis would suggest that focusing the man's attention *directly on* his penile state (i.e., adopting a spectator role) during masturbation so that orgasm could be avoided in the flaccid state might be necessary to interrupt the contingency. A truly psychophysiological approach to the treatment of sexual dysfunction cannot exist without due consideration to both the psychological and the physiological components of the disorder. Recent studies employing biofeedback and instrumental conditioning suggest that within such an approach the physiological as well as the psychological component may be an appropriate target for therapeutic intervention.

The exact role played by biofeedback or response-contingent reinforcement in modifying sexual responding has not been conclusively determined, but available results do not suggest that shaping an arousal response in sexually dysfunctional individuals would be clinically feasible at the present time. Such a goal may be naive to begin with. However, there are alternative potential applications of biofeedback that deserve exploration. For example, it has been noted that some sexually dysfunctional women do not respond with the normal degree of vaginal vasocongestion and lubrication in the early stages of sexual arousal and fail to advance further on the sexual arousal continuum (Kaplan, 1974). Biofeedback might be useful for increasing such a woman's ability to achieve higher levels of genital vasocongestion during the early stages of arousal and for making these physiological changes more discriminable to her. Greater awareness during the early stages of arousal is considered an important ingredient in maintaining and enhancing female sexual arousal, and awareness-enhancing techniques have been incorporated into standard sex therapy programs (Kaplan, 1974; Masters & Johnson, 1970).

Biofeedback has the potential for presenting to individuals of both sexes information about physiological changes in sexual arousal that would otherwise be too small to be detected. The availability of such information about slight increases and decreases in arousal might allow the individual to learn to more accurately discriminate changes in arousal levels. Learning to make fine discriminations in arousal levels might be particularly important in women who have not grown up, as males have, with a readily available source of visual feedback. Indeed, some young women in this society may be actively discouraged from experimenting with or even attending to genital sensations during their psychosexual development. Kaplan (1974) has also noted that sensory projections from the internal genitals are relatively poorly represented in the female cortex. Brener (1977) has emphasized the potential of biofeedback for increasing the discriminability of many visceral responses, and similar techniques would probably be useful for enhancing awareness of sexual sensations.

A related benefit of exposure to biofeedback might be in assisting individuals to become more in touch with and confident of their sexuality. Emily Hoon (1980 p. 186) quoted the following statement made by a female subject following her experience with biofeedback: "it increased my awareness of my sexuality not as a partner but as an individual. This may encourage me to focus more on what I am feeling during sex.' I would submit that this is itself a significant achievement. If biofeedback could produce similar effects in persons experiencing arousal problems, the results could be therapeutic.

A recent study (Morokoff & Heiman) showed that the vaginal responses of women undergoing therapy for arousal disorders did not differ significantly from those of normal women during exposure to erotic stimuli. Such findings suggest that in some cases the deficit associated with arousal dysfunctions may be one related to an inability to correctly label sensations as sexual rather than an actual deficit in physiological responsivity (Heiman, 1976; Heiman & Hatch, in press). Teaching female patients to correctly relabel physical sensations has been reported to produce positive results where sexual feelings were formerly mislabeled as anxiety or tension (Lobitz, LoPiccolo, Lobitz, & Brockway, 1974). Biofeedback would seem to hold potential for facilitating this process.

It is known that erotic fantasy or other cognitions play an important role in determining the sexual response cycle, and sex therapy patients are often encouraged to use cognitive strategies to augment sexual arousal (Kaplan, 1974). It has also been demonstrated in the laboratory that cognitive activity can affect physiological sexual arousal in both sexes (Heiman, 1977; Hoon et al., 1977). Providing feedback of the physiological aspects of the sexual response while patients engage in various forms of fantasy activity might enable them to isolate types of cognitive activity that either facilitate or inhibit sexual arousal. Geer (1976, 1979) has suggested that highly individual specific elements of the context in which sexual activity occurs can have dramatic effects on sexual arousal. Immediate feedback might facilitate an awareness of the contingency between specific ideations and physiological arousal.

The above remarks have focused on vasomotor aspects of the sexual response. There are other aspects, however, that may be appropriate for biofeedback or operant conditioning therapy, and these deserve brief mention. Vaginismus is a condition characterized by a spastic contraction of the sphincter vaginae and levator ani muscles near the vaginal introitus, which makes intromission painful or impossible. Biofeedback might allow women suffering from this condition to become more aware of and relax these muscles. It has also been reported (Klein-Graber & Graber, 1978) that female orgasmic difficulties are related to poor tonus of the pubococcygeus muscle. In such cases, biofeedback might prove helpful in teaching awareness of this muscle and in increasing its strength. Group norms and

methodological standards for measuring intravaginal pressure have now been reported (Levitt, Konovsky, Freese, & Thompson, 1979) and should be helpful in further exploration of these issues.

DIRECTIONS FOR FUTURE RESEARCH

There is, of course, a large difference between showing that vasomotor responding in the genitals is modifiable with operant conditioning or biofeedback and demonstrating that sexual arousal has been successfully manipulated. The first issue is of theoretical interest since research in this area will advance our understanding of biofeedback and genital physiology in general. For example, it would be of interest to sexual psychophysicists to know how voluntary vasomotor regulation differs between the skin and the genitals, since vasodilation in the genitals is controlled both sympathetically and parasympathetically. However, it has not been shown that the modifications in genital activity that are produced by such techniques represent changes in sexual arousal as perceived by the subject involved. Previous research has been unable to describe a consistent relationship between physiological and subjectively reported measures of sexual arousal in the laboratory setting (Geer et al., 1974; Hoon et al., 1976; Heiman, 1977; Heiman & Hatch, in press). Future research should continue to address this issue. It is important to know under what circumstances voluntary control of genital responding is possible, but it is also important to understand what meaning these changes have to the individual in terms of her or his sexuality.

It has also been shown that cognitive activity in the form of fantasizing about erotic material can augment sexual arousal in men and women (Heiman, 1977) and that exposure to distracting stimulation can lead to arousal decrement in men (Geer & Fuhr, 1976). Geer (1979) suggested that all the available results could be explained in terms of cognitive mediators, and he has yet to be proven wrong. The employment of such cognitive strategies in future studies of voluntary control should be monitored more closely than has occurred in the past. If cognitive mediation is involved, we should seek ways to utilize it systematically.

Other basic questions common to all areas of biofeedback and self-control research also remain unanswered. Does practice lead to improved performance, and what is the form of the acquisition function for the response? Does the response persist after the feedback or reinforcement is withdrawn, and does it generalize to the nonexperimental environment? What type of feedback is most effective, and what subject characteristics are associated with success and failure?

Future research should also begin to investigate self-control techniques in sexually dysfunctional populations. The apparent ease with which

sexually normal individuals demonstrate self-control when simply instructed to do so suggests that this ability might already be present to some extent. However, this is not necessarily true of sexually dysfunctional persons. Feedback procedures might produce much more dramatic changes in individuals who do suffer from sexual arousal deficits.

The therapeutic value of biofeedback and operant conditioning techniques for the treatment of human sexual disorders remains to be conclusively established. However, some degree of voluntary control over genital vasomotor activity has now been demonstrated in both sexes, raising significant questions concerning some widely held theories of human sexuality. The psychological and physiological mechanisms by which this control is exerted are not at this time well understood, and the general applicability of the instrumental model to sexual functioning cannot be assumed. Definitive answers to the many important questions that remain must await future experimentation; however, the progress made so far as a result of the investigations reviewed above virtually ensures that the necessary experiments will occur in the near future.

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