

Voluntary Control of Penile Tumescence

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This study investigated the voluntary control of penile tumescence in the absence of external erotic stimulation. Twelve experimental subjects were given analogue visual feedback and monetary rewards for increases in penile diameter as measured by a strain gauge. Twelve control subjects were given no analogue feedback and noncontingent rewards but the same instructions to maximize erections. While both groups were capable of voluntary penile tumescence, significantly improved performance was observed in the experimental group. Two distinct psychophysiological patterns of voluntary penile tumescence were observed. A "tension" pattern was associated with marked heart rate acceleration, irregular respiration, and variable penile response. A "relaxation" pattern was associated with stable heart rate, regular respiration, and smooth tumescence curves. In using these procedures for the treatment of sexual dysfunctions, it is suggested that feedback and reward be given for a combined pattern of sexual and autonomic responses.

INTRODUCTION

In a previous study (1) elicited penile tumescence was shown to be susceptible to suppression by instrumental conditioning. A red light was presented to normal male volunteers whenever their erection exceeded a criterion increase, and in this way they learned to significantly inhibit tumescence over the course of three experimental sessions.

Simple instructions to enhance or inhibit erection have also been found to af-

fect penile tumescence in the presence or absence of erotic stimuli (2,3). It seems that subjects who are readily able to conjure up sexual images or fantasies are able to utilize these images to "voluntarily" control the engorgement of the penile corpora. Such a finding is consistent with research indicating effects of conscious thought processes on other physiological variables (4).

Although the above studies provide strong evidence for some degree of instrumental or voluntary control of erection, several experimental questions are indicated: (1) Do feedback and reward enhance control of erection in the absence of erotic stimulation? (2) Can feedback and reward be shown to provide greater control than instructions alone in the facilitation of erection? (3) To the extent that voluntary control of tumescence can be developed, what psychophysiological mechanisms are involved?

The present study was designed to investigate the voluntary control of erection

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in the absence of external erotic stimulation. An attempt was made to evaluate the extent to which feedback and reward procedures enhance such control. Moreover, by concurrently monitoring cardiovascular and respiratory changes, specific physiological mechanisms of control were examined.

METHOD

The research was conducted in the Psychophysiology Laboratories of Harvard Medical School at the Massachusetts Mental Health Center. Penile tumescence was monitored and recorded following the same procedure as in the previous study (1). Other physiological responses recorded were beat to beat changes in heart rate by means of a Lexington Instruments cardiotelemetry, and respiration by means of a strain-gauge belt. In order to provide analogue visual feedback for penile tumescence increments, a small orange light located directly in front of the subject was programmed for light intensity changes proportional to increases in penile diameter. In addition, two other signal lights were utilized: a bright, white light signaled a bonus of 25 cents each time the subject reached criterion for that trial, and a blue light indicated the end of the trial.

The subjects were 24 paid volunteers without any history of sexual dysfunction. All subjects received a thorough preexperimental briefing session in order to explain the general purpose of the study, and to obtain informed consent. Subjects who appeared anxious about the procedures were excluded. After subjects were comfortably seated in the sound- and temperature-controlled experimental room, the physiological recording apparatus was attached and the experiment began.

Following a preexperimental adaptation period, each subject received two 20 min experimental sessions. In order to maximize the control of tumescence, a shaping procedure was employed. On the first trial, the white bonus light was presented to experimental subjects who showed a penile diameter increase of at least 1.5 mm. After each successful trial, the criterion was raised by 0.5 mm penile diameter. Each trial was programmed to continue until the subject attained the criterion for that trial, or 100 sec had elapsed. A variable intertrial interval of 20-40 sec was employed, with the contingency that the

subject's penile volume had to be returned to baseline level before the next trial was begun.

The 12 subjects in the control group received similar experimental instructions and procedures except that the orange analogue light remained constant, and bonuses were programmed noncontingently. Yoked bonuses ensured a comparable incentive level for control subjects. These subjects therefore received the same duration and order of trials as well as payment for the experiment, but were unassisted by the analogue feedback and contingent rewards. In the previous study (1) the feedback light had produced suppression of response and therefore it was unnecessary in this experiment to control for the eliciting effects of the feedback stimulus.

All subjects were instructed to maximize erections in the presence of the orange light, without any overt bodily movement. Questionnaires were administered after each session, and all subjects were debriefed after the second experimental session.

RESULTS

Penile tumescence was scored by measuring the strain-gauge diameter increase from the beginning to the end of each trial. Figure 1 indicates that the shaping procedure was effective in that progressively larger penile diameters were obtained on each successive trial. An

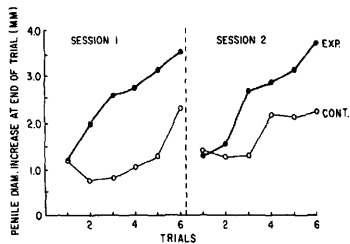


Fig. 1. Mean penile diameter increase over six trials in the two experimental sessions. The 12 subjects receiving feedback and reward are indicated by the solid circles, and the controls by the open circles.

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analysis of variance performed on these data show that the trials effect was significant ($p < 0.001$), as was the groups \times trials interaction ($p < 0.05$). The significant interaction effect indicates that the experimental group benefited more from the repeated trials than the control group. Another measure of effectiveness of the procedures is the percentage of trials in each session that the subject successfully attained the criterion for that trial. The group means for this result are presented in Table 1.

TABLE 1. Mean Percent Criterion (Rewarded) Responses per Session.

MEAN % CRITERION (REWARDED) RESPONSES/SESSION		
	Session 1	Session 2
EXP.	65.4	71.58
CONT.	29.1	41

A major purpose of this study was to develop some notions concerning the psychophysiological mechanisms of tumescence control through the analysis of associated cardiovascular and respiratory changes. In reviewing the cardiometer and respiration data, two different patterns of response are clearly apparent. Figures 2 and 3 show sample polygraph records of these patterns. The response configuration in Fig. 2 is indicative of a "tension" pattern, involving marked heart rate acceleration, irregular respiration, and more variable penile response during tumescence. The "relaxation" pattern, indicated in Fig. 3, consists of regular cardiometer and respiration records, as well as smooth, regular penile tumescence curves. It should be

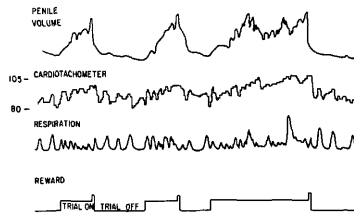


Fig. 2. Representative portion of a sample polygraph record. This record illustrates the "tension" pattern of response: irregular tumescence, heart rate increase, and irregular respiration.

noted that all tumescence responses indicated in these two figures were criterion responses (i.e., earned the subject a bonus), but that different psychophysiological patterns were employed.

The magnitude of heart rate changes associated with the "tension" pattern is indicated in Fig. 4. A Fabritek Signal Averager was used to average the subject's cardiometer response over a series of successive tumescence responses. In order to select records that represented the two characteristic patterns of response, four independent raters rated all tumescence

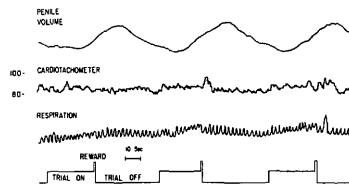


Fig. 3. Sample polygraph record illustrating the "relaxation" pattern of smoother tumescence changes, steady heart rate and regular respiration.

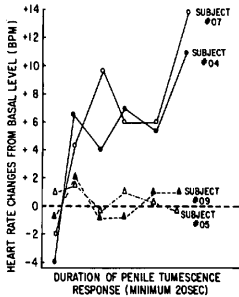


Fig. 4. Heart rate averaged over tumescence responses for four subjects. Subjects #07 and #04 had irregular tumescence records, while subjects #09 and #05 were judged to have "relaxed" tumescence responses.

responses. All raters judged the penile tumescence responses of subjects #09 and #05 to be "relaxed," and those of subjects #04 and #07 to be "tense." The raters were unaware of the associated heart rate or respiratory changes, but based their ratings entirely on the regularity of the tumescence records. The heart rate differences between "relaxed" and "tense" responses is clearly evident in the figure.

DISCUSSION

The data presented confirm the hypothesis that voluntary control of penile tumescence is possible in the absence of external erotic stimulation. While both groups in this experiment were able to produce erections on cue, the addition of analogue feedback and reward produced significantly greater improvement over the course of the two training sessions. Moreover, the cardiometer and respiratory data suggest two distinct patterns of psychophysiological mediation: tension and relaxation.

In interpreting this result it is important to bear in mind the nature of the experimental demands. Subjects were placed in a somewhat stressful situation (attachment of electrodes and transducers in an isolated experimental chamber) and required to produce erections on cue in order to earn bonuses. Some subjects may have reacted to this situation in a manner analogous to the "performance demand" situation described by Masters and Johnson (5). Although these subjects were able to achieve some degree of penile tumescence, it is apparent from their polygraph records (Figs. 2 and 3) that they were unable to remain calm and relaxed in the process. One might even speculate that this pattern of autonomic response is a likely precursor to premature ejaculation. Although it is not clear what causes some subjects to become tense in this situation while others remain relaxed, review of the postsession questionnaires indicates that the relaxed subjects seemed to feel generally more positive about the experience.

While this study was conducted with normal volunteers in an artificial laboratory situation, certain clinical inferences can be drawn from the results. Feedback and reward procedures appear to facilitate voluntary control of penile tumescence, and one case study in the literature (6) describes the use of such procedures in the treatment of a homosexual. However, the different autonomic patterns obtained in this study suggest an important limitation on the clinical use of feedback and reward. It is likely that the individual with an erectile disorder would be especially anxious concerning this response, and would therefore produce a tension-like pattern of response, which might compound the problem. A possible solution might lie in feedback and reward for an integrated pattern of autonomic responses (7).

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SUMMARY

This study was conducted in order to investigate the possible voluntary control of penile tumescence in the absence of external erotic stimulation. To the extent that tumescence is psychogenically as well as reflexogenically mediated, the use of feedback and reward are indicated for the enhancement of voluntary control.

Twenty-four normal male volunteers were divided into two groups. In the experimental group, subjects were provided with analogue feedback in the form of a variable intensity orange light for increases in penile tumescence. Subjects also earned a bonus each time tumescence exceeded a predetermined criterion in accordance with a shaping procedure. Control subjects received no analogue feedback and noncontingent rewards. Two 20 min experimental sessions were used for all subjects, and postsession question-

naires were completed after each session.

Results indicated that while both groups were capable of voluntary control of tumescence, the feedback and reward procedures significantly improved performance over trials. This study also attempted to assess the psychophysiological mechanisms involved in voluntary penile control. Heart rate and respiration data in this regard suggest two distinct patterns of response: tension and relaxation. The artificial demands of the experiment may well have contributed to the tension pattern observed in certain subjects.

The different psychophysiological patterns of response suggest a cautious extrapolation of these procedures to the clinical situation. While biofeedback procedures may be useful in the treatment of psychogenic potency disorders, it might be necessary to utilize a pattern of autonomic response, rather than penile tumescence alone.

REFERENCES

1. Rosen RC: *Suppression of penile tumescence by instrumental conditioning*. *Psychosom Med* 35:509-514, 1973
2. Laws DR, Rubin HB: *Instructional control of an autonomic sexual response*. *Appl Behav Anal* 2:93-99, 1969
3. Henson DE, Rubin HB: *Voluntary control of eroticism*. *Appl Behav Anal* 4:37-44, 1971
4. Schwartz GE: *Cardiac responses to self induced thoughts*. *Psychophysiology* 8:462-467, 1971
5. Masters WH, Johnson VE: *Human Sexual Inadequacy*. Boston, Little Brown, 1970
6. Quinn JT, Harbisan JJ, McAllister H: *An attempt to shape human penile responses*. *Behav Res Ther* 8:213-216, 1970
7. Schwartz GE: *Voluntary control of human cardiovascular integration and differentiation through feedback and reward*. *Science* 175:90-93, 1972