SELF CONTROL OF PENILE TUMESCENCE

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ABSTRACT

This study of biofeedback training of increase in penile circumference commences with a review of some methodological issues in the field and a discussion of the physiology of erection, a response under primary control of the autonomic nervous system. A review of studies on the control of erectile processes suggests hypotheses that should predict the effects of two visual stimulation conditions, erotic and landscape slides, and two biofeedback training conditions, contingent and yoked control. Thirty-two university students in a 2 X 2 independent groups design responded with penile circumference changes that were recorded over twenty-four minutes of visual stimulation and feedback training by means of a penile plethysmograph. Two dependent measures were recorded as deviations in millimeters from a pre-experimental baseline flaccidity measure, the first being peak erection during the whole session and the second being the tumescence level attained at the end of training. Multivariate Analyses of Variance on the two dependent measures did not indicate a significant effect of biofeedback training, erotic visual stimulation or an interaction between feedback and visual stimulation. There was a large error variance associated with the peak erection measure. The measure of tumescence level at the end of training tended to differentiate between feedback conditions but this effect marginally failed to reach significance. The results suggested several post hoc analyses to investigate further the large variation singularly associated with the feedback treatment. These analyses suggested that the feedback technique produced increased "within" and "between" subject variation.

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INTRODUCTION

This study investigated the effects of biofeedback training on increases in penile tumescence, a response under the primary control of the autonomic nervious system.

The topic is introduced by a brief review of some issues and methodological techniques of biofeedback training. The physiology of penile tumescence is then discussed and the conclusion is drawn that erection is an autonomic response relatively free of non-autonomic mediating responses. Then follows a more comprehensive review of those studies which investigated the abilities of human males to control their erectile processes. The review leads to the formation and testing of experimental hypotheses as to the effects upon erection of (1) biofeedback training, (2) erotic visual stimulation, and (3) the interaction between feedback and erotic stimulation.

Introduction to Biofeedback Methodology

According to Schwartz and Beatty (1977) biofeedback "refers to a group of experimental procedures in which an external sensor is used to provide the organism with an indication of the state of a bodily process, usually in an attempt to effect a change in the measured quantity". Other authors (Black, Cott and Pavloski, 1977) would restrict the scope of body processes to those of the autonomic and central nervous systems. The method of presenting the indication, or feedback, has varied. Some have displayed a continuous "read out" of changes in the response under study (Klinge, 1972), others have provided immediate financial or other tangible incentives for attaining pre-specified criteria (Shapiro, Schwartz and Tursky, 1972), while others have used the combination of a read out and other incentives (Brenner and Kleinman, 1970). The different body processes have included such systems as electrodermal changes (Klinge, 1972), heart rate (Brenner, Kleinman and Goesling, 1969) and blood pressure (Shapiro, Schwartz and Tursky, 1972).

Basic to biofeedback methodology is the notion that providing a motivated individual with immediate information about a bioelectric response should result in the individual gaining self-control over the response. Currently there are two views, not mutually exclusive, as to why the information leads to self-control of the response.

According to the "awareness" point of view, the close contiguity of the information and the response makes the subject aware of the response, and the awareness leads to control of the response. The central concept here is "voluntary control", and this accounts for the prevalence of the term in the biofeedback literature. The alternative notion, operant conditioning, avoids the complex non-specific concept of volition. According to this view the biofeedback information is a reinforcer which leads an increase in the probability of the operant response. In comparing the two views Black, Cott and Pavloski (1977) suggest that neither of them truly specifies the underlying mechanism by which the effect on the response occurs; but they consider the operant conditioning approach superior because of its rigorous methodology and empirically based concepts and principles. They also note the existence of compelling evidence to support both views.

Two methodological issues in biofeedback research need to be described because they are relevant to the present study.

The first is the degree to which training is specific to the response of interest. For example, in the case of biofeedback training of increased penile tumescence, it may be that the feedback merely may produce increased general relaxation which, inter alia, enhances erectile ability. To date, those investigating biofeedback of penile tumescence have not been particularly concerned with this issue, apparently being more interested in demonstrating the possibility of penile control than in elucidating the mechanism or specificity of such control.

The second issue concerns the potential properties of the actual feedback stimulus itself which may act to elicit the response. In the above example certain qualities of the feedback stimulus might directly elicit erection or a state more conducive to erection that would be confounded with any direct effect of the feedback. The more favoured approach in dealing with this issue has been to use the "yoked" control groups. In yoked designs the experimental subject receives the reinforcing stimuli contingent on the response but the yoked partner receives them only if and when the experimental subject does. The purpose of this type of control is to equate both subjects with respect to the number and duration of reinforcing stimuli presented. However, only the experimental subject receives it consistently contingent upon the response. The usual approach has been to tell both subjects that the feedback is contingent on the response, but while this may insure that yoked subjects pay attention to the stimulus it has certain defects for feedback training of erectile processes because of the potential confusion resulting from false feedback to the control subjects. Because of this concern in the present study an alternative method was devised to insure that the yoked subjects attended to the feedback stimulus.

The physiology of erection will be described prior to a Review of Studies which have investigated the control of erectile processes. These studies lead to the conclusion that penile tumescence is primarilly controlled by the autonomic nervous system but is also potentially enhanced by contraction of specific muscles in the groin area.

THE PHYSIOLOGY OF ERECTION

Anatomy of the Penis: The shaft of the penis is composed of three longitudinal columns of erectile tissue enclosed in fibrous coverings which in turn are completely surrounded by another covering of the same tissue (Deep Facia). Two of the columns, both called corpora cavernosa penis, lie side by side and form the dorsal part of the penis. A third column, the corpus spongiosum, lies ventrally in a groove between the two other columns and partly separates them. This column is also identified by the name corpus cavernosum urethra because the urethra passes through it. The distal portion of the corpus spongiosum expands over the ends of the corpora cavernosa to form the acorn-shaped glans while the proximal end expands to form the bulbus penis and it is here that the urethra enters the penis. The proximal ends of the corpora cavernosa diverge and curve downward to fit against the pubic arch. In this position the bodies are identified as the crura penes and are attached to the pubic arch.

The blood supply to these three bodies is shown in Figure 1. Arteries pass through the centres of the three cylindrical bodies as well as the dorsal side of the corpora cavernosa. A large vein (the superficial dorsal vein) runs along the dorsal side of the penis outside of and between the corpora cavernosa. Smaller veins run along the ventral side of the penis, two on either side of the corpus spongiosum.

Each of the cylindrical bodies contains hollow spaces capable of engorgement with arterial blood. Erection is begun when arterial blood flows into these spongelike spaces causing engorgement, inflation, and rigidity of the entire structure. The mechanism by which this is accomplished will be outlined after the anatomy of the penis is more fully described.

A bilaterally symmetrical muscle, the bulbocavernosus, extends from just in front of the anus to just above the scrotum and completely surrounds the bulbus penis. Its action is to squeeze the bulbus penis thus emptying the urethral canal after urination but it is also believed to be involved in penile erection by restricting venous outflow from the three erectile bodies, (Masters and Johnson, 1966). Another voluntary muscle, the ischiocavernosus situated bilaterally to the bulbocavernosus and surrounding each crus penis, is believed to fulfil a similar function by compressing the crura and the veins leaving the penis.

Neurophysiology of erection: The human erection response has been classified into two categories mainly on the basis of the stimuli involved in producing it; but, as will be seen, there is an anatomical basis for the dual classification as well.

The first type, reflexogenic, occurs in response to exteroceptive stimuli (e.g. tactual stimulation of the genitalia) and interoceptive stimuli (e.g. gladder functions). From several studies Weiss (1972) suggests the pudendal nerve as the afferent leg of the reflex arc for reflexogenic erections. The efferent leg is via parasympathetic outflow from sacral cord roots 2, 3, and 4. These roots are also the source of impulses that control the bladder and bowel (nervi erigentes).

In response to auditory, visual, olfactory, tactile and/or imaginative stimuli, erotic centres in the brain are said to be aroused and result in outflow from the thoracolumbar area of the spinal cord to produce the second type of erection, psychogenic. Much of the work in localizing the cerebral erotic centers has been done by electrically stimulating cortical and brain stem structures in monkeys. The evidence for the efferent spinal cord pathways to the erectile tissue has come from the study of spinal cord injuries in humans.

Dealing first with the cerebral erotic centres, MacLean (1966) has isolated the major cerebral effector pathways for erection in monkeys from the septal area down to a position just lateral to the pyramidal tract between the pons and medulla. The path is joined by outflows from the limbic extrapyramidal and neocortical area. Because the septal area is believed to be a pleasure centre (Teitelbaum, 1967) and the limbic system is said to coordinate sensory input with visceral function, the pathways and the outflows from other areas suggest integration of those systems for erectile function.

Unfortunately, little is known of the pathways from the brain stem to the two erection centres on the spinal cord. Inferences regarding the nature of the two spinal centres and their pathways to the erectile tissue is based on data from patients with spinal cord injury or surgical destruction. The following is a summary of the findings:

1. Entire denervation of the pelvic region prevents reflexogenic erection. That is, erection could not be elicited by stroking the genitalia (Kuhn, 1950).
2. In the same patient erections could be elicited by symbolic erotic stimulation-psychogenic erection (Kuhn, 1950).
3. Patients with spinal cord transections above the sacral cord roots were able to have reflexogenic erections but could not get erections to purely psychogenic material (Weiss, 1972).
4. Earlier work done by Root and Bard (1947) indicated that cats with sacral spinal cord destruction were also unable to have reflexogenic erections (from manipulation of the penis) but

were able to produce psychogenic erections to a female in estrus. However, when the sacral destruction was combined with thoracolumbar symathectomy no erections were possible.

5. Patients with motor nerve damage in the sacral portion of the spinal cord were not able to have reflexogenic erections but were able to have psychogenic erections (Bors and Comarr, 1960).
6. No disturbance of erection is reported by Rose (1953) after bilateral lumbar sympathectomy and very little is produced by bilateral thoracolumbar sympathectomy (Whitelaw and Smithwick, 1951).

Certain conclusions can be drawn from the above summary. There are two centres of the spinal cord involved in erection. One is a parasympathetic outflow located in the sacral spinal cord and is responsible for initiating reflexogenic as well as psychogenic erections. The other centre is a sympathetic outflow located in the thoracolumbar region which can mediate psychogenic but not reflexogenic erections. Further, Weiss (1972) reports research which found that the autonomic nerves from the thoracolumbar region contained both vasodilator (Cholinergic) and vasoconstrictor (Adrenergic) fibres. The significance of these opposing sets of fibers for erection is not understood at present, although the sympathetic vasoconstrictor fibres are believed to be involved in detumescence of the penis (Nocenti, 1961).

Rosen (1977) denies sympathetic vasodilator innervation of the penis on the basis that abdominal sympathectomy does not interfere with erection. However, this does not consider the evidence that entire denervation of the sacral cord does not substantially interfere with erection either (Kuhn, 1950; Weiss, 1972).

While the above studies provide evidence that the two spinal erection centres are capable of producing erection individually, in the normal male they are more likely to act synergistically For example, the amount of genital stimulation required to produce a reflexogenic (parasympathetic) erection is considerably diminished in the presence of erotic psychic (parasympathetic and/or sympathetic) stimulation (Weiss, 1972)

Dynamics of Erection: The erection of the penis is essentially a hemodynamic process. The three erectile bodies previously referred to are made up of vascular spaces capable of distention with blood. When the penis is flaccid, arterial blood flows directly from arterioles to the venules. In response to impulses from the parasympathetic and/or sympathetic fibres, smooth muscles relax in tiny valvelike structures (polsters) at the anastamosis between the arterioles and the vascular spaces and blood flows directly into the vascular spaces. The result is increased size and rigidity of the penis.

There is controversy regarding the part, if any, played by decreased venous outflow. Garrett and Rhamy (1966) suggest that polsters located at the venous outflow of the erectile tissue contract when the arteriole polsters relax and thus enhance tumescense in the vascular spaces.

There is also speculation that the ischiocavernosus and bulbocavernosus muscles may, by reflexive or voluntary contractions, either pump blood to the penis or obstruct venous outflow from the penis. Bors and Comarr (1960) report normal erections in patients with complete paralysis of these muscles. Masters and Johnson (1966) cite evidence that erection is not affected by either set of muscles. In pilot work for the present study subjects were asked to contract these muscles during a polygraph recording of penile circumference. The increase brought about by contraction in the flaccid or partially erect state was minimal and the contraction produced a spiked polygraph recording similar to a much attenuated electromyograph recording. The only conclusion that can be drawn from the above information is that the ischio- and bulbocavernosus muscles do provide some erectile enhancement but their effect is minimal and easily detectable. They may, of course, provide stimuli for reflexogenic erection.

With such fragmentary evidence it becomes difficult to isolate the part played by each of the divisions of the autonomic nervous system. It appears certain that erection is an automomically mediated response. The parasympathetic and sympathetic divisions can, acting individually or synergistically, produce erections. However, whether they act synergistically or individually at particular sites in the penis to produce erections is not known.

Review of studies on the control of erectile processes: The detection and measurement of human penile erection received its impetus from a series of studies which attempted objectively to measure sexual arousal and particularly sexual preference. There had been general agreement that erection was an involuntary reflex over which man had very little direct control (Masters and Johnson, 1966). Therefore, erection was taken to be an objective measure of sexual arousal and preference, particularly in comparison to projective or paper-and-pencil tests (Freund, Sedlecek and Knob, 1965).

In the diagnosis of sexual preference the subject is given deviant and nondeviant stimuli and his erection is measured by a mechanical transducer and recorded on dynograph paper. Erotic preference is determined by comparing responses to deviant and non-deviant stimuli (Lee-Evans, Graham, Harbison, McAllister and Quinn, 1975).

The transducers have generally been of two types. The first involves placing the penis in a small airtight cylinder. A volumetric device is then used to measure air volume changes within the cylinder (Freund, Sedlecek and Knob, 1965). The second type involves placement of a variable resistor (usually rubber tubing containing mercury or carbon dust) around the circumference of the penis. Penile circumference changes are electronically recorded as changes in electrical resistance (Bancroft, Jones and Pullan, 1966). The complex assembly procedures involved in the volumetric method and the ready availability of interface equipment for the circumference method have considerably reduced the use of the former.

The assumption of the involuntary nature of penile erection was tested by Laws and Rubin (1969). Four subjects who had reported maximum erections to an erotic movie were selected from a group of seven volunteers. In the first of two experimental sessions the four subjects were shown the same erotic movie three times. During the first and third presentations subjects were instructed to do nothing to inhibit their erection but on the second presentation they were instructed to avoid getting an erection "....by any means other than not looking at the film". In an attempt to ensure that they would attend to the film the subjects were instructed to report immediately brief flashes of light which appeared on the projection screen from time to time during the sessions. Twenty-four hours later another film was presented three times except this time subjects were instructed to inhibit on the first and third presentations and not inhibit on the second. The average erection for all four subjects during the three "inhibit" presentations was 15% of full erection while the average during the "do not inhibit" presentations was 72% of full erection.

Laws and Rubin (1969) also asked their subjects to produce erections in the absence of erotic stimulation. All four subjects were able to produce some circumference increases. There were short duration peaks and one subject reached almost 90% of full erection but the average across the session was 13% of maximum. However, it should be remembered that the subjects were selected on the basis of their erection ability. One subject showed a latency of 10 minutes before any increase in circumference was shown.

The Laws and Rubin (1969) study has been criticized because subjects reported that they concentrated on asexual stimuli - one subject reported that he concentrated on counting the white flashes during the inhibit conditions. Henson and Rubin (1971) responded to this criticism by giving "inhibit" and "do not inhibit" film presentations in which subjects were required to give verbal descriptions of the film. The first film presentation was a simple "do not inhibit" condition, the second was a simple "inhibit" condition. Subjects were required to report white flashes during both. During the next presentation subjects were instructed to inhibit erection while their verbal descriptions were recorded. During the fourth presentation subjects were required to give verbal descriptions but were instructed not to inhibit erection. The fifth presentation was a "do not inhibit" condition similar to the first.

The circumferences achieved in the "verbal description - do not inhibit" condition were smaller than those produced during the two simple "do not inhibit" conditions. However, all of the "do not inhibit" conditions produced considerably larger erections than the conditions in which subjects had to give verbal descriptions and inhibit erection. The simple "inhibit" condition produced only slightly smaller circumferences than the verbal description/inhibit condition.

An elaborate statistical analysis of the verbal descriptions indicate that the "inhibit" and "do not inhibit" conditions did not produce differences in verbal response. This and the other results not only supported the results of the earlier (Laws and Rubin, 1969) study but also suggested that the self-generation of competing asexual stimuli is not essential for successful inhibition of penile erection. Taken together these studies demonstrate that instructed human males can exert control over the autonomic functions of penile tumescence and detumescence.

To the extent that detumescence might be subject to voluntary control, the possibility was argued that it might be amenable to biofeedback training. Rosen (1973) provided experimental subjects with tape recorded erotic passages and binary feedback, instructing them to suppress their erection by turning off a red feedback light which came on whenever their penile circumference exceeded a pre-set criterion. There were three control groups. Subjects in the yoked feedback control group individually received the exact on-off light sequences produced by their opposite numbers in the experimental group. The penile circumference changes of each experimental subject had been tape recorded, and the tape then was used to operate red light triggering device during the yoked subject's training session. The control subjects' circumference changes were recorded but not transmitted to the triggering device, thus they received equivalent feedback stimulation but independently of their own responding. This condition was meant to measure the inhibiting effect of the feedback light as such. The "instructions only" control group received neither feedback nor noncontingent yoked stimulation but were merely requested to inhibit erection during the erotic stimulation. This group was included to evaluate the effect of unaided instructions. A "no treatment" control group was not instructed to inhibit erection nor were they given any feedback. This group was used to evaluate the effects of habituation, if any, to the erotic narratives which all four groups experienced in common.

There were four sessions of 10 minutes each, spaced approximately one week apart. None of the experimental or control procedures were in effect during the first session. This baseline session was intended to indicate the tumescence produced by one of the erotic passages prior to treatment. Experimental conditions were introduced on the second session and remained in effect during the final two sessions.

Groups were compared on one dependent measure: percentage of time during the session that circumference remained above the criterion. Analysis of variance revealed that a large significant reduction in erection across sessions was achieved by the contingent feedback group. There was some decrement in erections shown by the control groups, but the decrease was not significant.

To evaluate whether subjects mentally "blocked out" the erotic passages, Rosen (1973) administered a debriefing questionnaire containing questions on content. No significant difference in recall scores emerged.

In commenting on the Laws and Rubin (1969) study Bancroft (1971) had suggested that, since the erotic passages were cognitively mediated, they could have been readily inhibited at the cognitive level, although he questioned whether they could have been as readily enhanced. Rosen

(1973) showed binary biofeedback training to be superior to "instructions only" in suppressing erection. Presumably, if cognitive inhibition were very effective, the control group should have shown better suppression, but it did not. The second part of Bancroft's (1971) comment, whether control could be established over increases in penile tumescence, was addressed by Price (1973).

In that study eight experimental subjects were instructed to maximize their erections to erotic narratives with the aid of binary and analogue feedback. Analogue feedback was provided by a meter indicating the degree of circumference increase from baseline. Binary feedback was in the form of a colored light which came on whenever circumference exceeded half the maximum increase shown by a group of pilot subjects who listened to the same narratives. Control subjects were simply told to enjoy the narratives.

There were four 10 minute sessions spaced one week apart. As in the Rosen (1973) study the first session was a baseline session in which no experimental conditions were in effect. This was followed by three experimental sessions.

The groups were compared on four dependent measures:

1. magnitude of change in tumescence (it is not clear how this was calculated, but it appears to be in the difference between the pre-session baseline and the point of maximum erection during the session).
2. subjective magnitude of erection.
3. latency from stimulus onset to peak erection.
4. amount of time erection remained above criterion.

The author noted wide individual differences in response and the data were not normally distributed.

The increase in tumescence for the feedback group consistantly exceeded that of the control group, but the difference failed to reach significance with multiple U tests. No differences emerged in the subjective rating of magnitude of erection. Subjects in the feedback group tended to reach peak erection faster but not reliably so. The one significant finding was that the feedback group remained above criterion longer than the control group.

Price (1973) interpreted the latter as a differential ability to maintain tumescence. He speculated that the feedback subjects were able to maintain larger erections because small decrements were noticable immediately and the feedback provided a goal that they could attempt to maintain. This same logic, however, could apply equally well to the effect of feedback on the other measure, magnitude of change in tumescence, yet no significant effect was obtained. The nature of the experimental procedures and the calculation of the measures themselves could have produced the difference in outcome.

Magnitude of change in tumescence appears to have been the difference between a pre-session baseline measure and the highest peak reached during the session. The time above criterion, on the other hand, was a cumulative measure of the total number of minutes each subject remained above criterion. The former represents one "high point" during the session while the latter involves the accumulation of time across the whole session.

Price's (1973) subjects had been recruited by an advertisement for an experiment studying "psycho-physiological responses to erotic stimuli" and then they were asked to wear an obvious measuring device on their penes. Subjects in the "no instruction" groups were probably operating under their own instructional sets which varied with time as each subject speculated about the purpose of the experiment. A consequence could have been the great variation of which Price (1973) complains. Under these conditions the maximum erection attained by the control subjects might well have approached (at least momentarily) those obtained by the normally superior experimental subjects. However, because of the variation due to the suggested changing instructional set, the control subjects would have experienced longer and more frequent periods of relative detumescence than experimental subjects. In short, the momentary high points of the controls would approach the high points of the experimentals but the low periods experienced by the controls would far outweigh those experienced by the experimentals. It may be that standardized instructions, even pseudo-instructions, to the control group would have produced a clearer distinction between groups on both measures.

In summary, Laws and Rubin (1969) and Henson and Rubin (1971) had demonstrated that volunteer subjects could suppress their erections to erotic passages and Rosen (1973) demonstrated that ability to suppress erection could be improved by binary feedback. Price (1973) provided modest evidence that subjects with binary and analogue feedback could maintain erection longer than uninstructed controls.

Rubin and Henson (1975) tested six subjects' abilities to enhance erection to erotic visual stimuli or fantasy alone. During the first of four 10 minute experimental periods, subjects were shown an erotic motion picture and told to relax and enjoy it. The same movie was shown during the second session in which subjects were told to enhance their erections by any means other than manipulation. The third session was similar to the first - i.e. relax and enjoy. During the fourth session no erotic stimulation was presented but subjects were instructed to enhance their erections "....by any means except physical manipulation". To ensure attention to the movie, the signal detection procedure (flashing light) of Laws and Rubin (1969) was used.

The dependent measure used by Rubin and Henson (1975) was circumference change represented as percentage of full erection. The range was from baseline flaccidity (0%) to an empirically determined full erection (100%). Graphic data presented for each subject across the four conditions contained a considerable amount of unexpected variation. Two of the subjects averaged less than 20% of full erections during both "relax" conditions but the average increased to over 70% in the "enhance" condition, and to over 40% in the "fantasy" condition. On the other hand two other subjects produced sizeable erections which averaged over 60% in all conditions. However the highest average for both subjects occured in the "enhance" condition and the lowest in the "fantasy" condition. The remaining two subjects produced sizable erections during the first "relax" condition, but responded erratically during the final three conditions. With the large variation shown by individual subjects across each of the conditions there is insufficient evidence to conclude that subjects were able to comply with instructions in any consistent fashion.

The authors classified the subjects into two groups on the basis of their responses to the "enhance" condition and analyzed the data from four subjects who had shown sizeable responses in that condition. The necessity for such selected data analysis indicated that the reliability of the data across subjects was very limited. The erections achieved by subjects in each of the conditions ranged from minimum to maximum, although there appeared to be a tendency for erections to be slightly smaller in the "fantasy" condition when compared to the "enhance" condition. However, the "enhance" condition always preceded the "fantasy" condition, so the tendency could have resulted from habituation to the experimental situation.

In the same year Rosen, Shapiro and Schwartz (1975) published a study in which experimental subjects, provided with feedback and reward but no erotic stimulation, were compared to yoked controls. Analogue feedback was provided by varying the intensity of a light in the experimental chamber with changes in circumference. There were six trials in each of two 20 minute sessions. For experimental subjects each trial was programmed to continue either until they had reached a pre-set criterion or 100 seconds had elapsed. At the end of each trial a bonus light (25¢) was illuminated if the subject had reached the criterion. The yoked controls received the same length and number of rewarded trials as their experimental counterparts, but non-contingently. They received no analogue feedback stimulation. It is important to note that the durations of the trials for the control subjects were pre-determinded by the length of time it took their experimental partners to reach criterion.

The dependent measures were: (1) change in penile circumference from the beginning to the end of each trial, and (2) percentage of trials on which subjects reached criterion. Both these measures showed significant differences between groups. Unfortunately, both are very susceptible to a bias which may have been operating against the control group.

Previous studies (e.g. Laws and Rubin, 1969) have shown considerable variation in the time it takes a subject to start getting an erection as well as in the time it takes to reach peak erection. The pairing of a relatively slow experimental subject with a faster control should not result in a bias against the control because there would be ample time for him to reach maximum erection on any trial. There would be no bias against the experimental subject because he would have had up to 100 seconds to reach maximum. No bias is present in the case of combining a slow experimental with an equally slow control, or in the case of a fast experimental with an equally fast control. However, in the case of the fast experimental paired with a slow control there is a bias against the latter, because he would lack the full 100 seconds to reach his maximum potential.

Some of the difference between the groups may have resulted from the feedback/financial reward treatment. There is, unfortunately, no way to tell how much of the difference was due to the treatment and how much was due to the bias against the control group. But the study was interesting for the following reasons. First, it involved a comparison of a biofeedback condition with a non-biofeedback condition which was not confounded by concurrent differences in instruction as the Price (1973) study was. Second, both groups received their treatments in the absence of erotic stimulation. Third, the treatments were followed by some apparent differences between groups.

To summarize the findings of the studies dealing with increases in tumescence, human males can apparently increase penis size as a result of simple instructions (Laws and Rubin, 1969) but this ability was, at least slightly, enhanced by providing erotic stimulation (Rubin and Henson, 1975). In the presence of erotic stimulation men can maintain erections longer with bio-feedback than without (Price, 1973). This effect is qualified by the effects of instructional differences. Finally, even in the absence of erotic stimulation subjects can increase their erections and attain a pre-set criterion but this ability is enhanced by the provision of feedback and financial reward (Rosen, Shapiro and Schwartz, 1975).

The above summary indicates the need to determine the effects of feedback not confounded by the sequence of various within-subjects stages or the effects of simultaneous differences in instructions. It also indicates the need to equalize the amount of time provided for each subject to reach his full erection. Also, there has been no test of the potentially enhancing effects of providing subjects with erotic stimulation along with the feedback.

A very recent study by Csillag (1976) attempted to compare the effects of four different stimulation/feedback conditions. The responses of six patients suffering from erectile impotence were compared with those of six volunteers with no erectile dysfunction. Each subject served in each of the following conditions:

1. no erotic stimulation, no feedback
2. no erotic stimulation but visual and auditory feedback
3. erotic slides, no feedback
4. erotic slides with visual and auditory feedback.

The conditions were administered in the same order, once a day for eight consequtive days.

Analysis of Variance with four factors (2 x 2 x 2 x 8) showed only one interaction to be significant. Daily circumference changes decreased over the eight days for the normals but increased for the patients.

The results should be interpreted with caution because there were methodological problems with the study which require further clarification.

For example, the author states that the normal subjects habituated to the experimental situation causing the decrement across days. Possibly they progressively lost interest as the experiment continued, and accordingly showed a decrement in circumference changes from day to day. It is likely that the decrement would have occurred also within each day, with the result of confounding conditions with sequence and a biasing against the feedback and erotic stimulation conditions because they always occurred later in the sequence.

An unfortunate problem with the analysis was that it compared feedback with no feedback and erotic with fantasy conditions using the averaged data from all eight days. Any effect apparent at the end of training might have been blanketed in the overall analysis.

The present study involved approximately the same conditions as the Csillag (1976) study but an independent groups design and a massed trials procedure were used. The intention was to optimize the likelihood of differences being significant and uncomplicated by design flaws.

Specifically, the design was a 2 x 2 factorial with two dependent measures. One of the independent variables was type of visual stimulation, erotic or non-erotic (variable S). The other independent variable involved two levels of "biofeedback", contingent and non-contingent (variable F). The four groups constituted by combinations of these two variables were:

Group BF-E: biofeedback, erotic colour slides

Group BF-L: biofeedback, landscape colour slides

Group YC-E: yoked control, erotic colour slides

Group YC-L: yoked control, landscape colour slides

BF and YC constitute the two levels of variable F, while E and L constitute the two levels of variable S.

From cited literature the following were selected for examination:

Hypothesis I: Subjects provided with analogue feedback contingent upon circumference changes should attain higher levels of tumescence than subjects provided with similar but non-contingent stimulation.

Hypothesis II: Subjects receiving erotic stimulation should attain higher levels of tumescence than subjects not so provided.

Hypothesis III: There may be an enhancing effect of erotic stimulation on biofeedback training leading to a significant interaction between the effect of feedback and erotic stimulation.

METHOD

Subjects: Thirty-six males were recruited by telephone from a list of volunteers from the University of Victoria, Psychology Department subject pool. Only volunteers who were at least 21 years old had been included on the list. At the time of the phone call all potential subjects were informed that they might be exposed to erotic slide material and could decline to participate if they might be offended by it. One subject refused to participate at that point. The age ranged between 21 and 40 years. Informal questioning at the beginning of the experiment revealed no sexual dysfunction. Each subject was paid $2.00 for participating. Due to technical difficulties with the polygraph during the recording session, the records of two subjects had to be replaced by those from two additional subjects. The difficulties were not related to experimental conditions. Also, one subject declined participation after the measuring device was described, and was replaced.

Stimuli: Twenty-four 5 x 5 cm colour slides were made from erotic pictures taken from popular men's magazines. All had been judged high on scales of attractiveness and eroticism (Penner, 1974). The non-erotic slides were 24 scenes of landscapes which had been chosen to approximate the light intensities emitted from the erotic slides.

Rosen, Shapiro and Schwartz (1976) suggest that relaxed subjects are capable of larger and smoother tumescence records than subjects who are more tense. To optimize relaxation, taped Mozart piano concertos were provided. The list of musical selections appears in Appendix A.

Apparatus: A schematic diagram of the experimental apparatus is shown in Figure 2. Changes in penile circumference were measured by an EKEG Electronics (Vancouver, British Columbia) penile plethysmograph.

The device was essentially the same as the one described by Bancroft, Jones and Pullan (1966). It had been constructed from 8 cm of 4.5 mm rubber surgical tubing which was tightly packed with carbon dust. The ends were sealed and joined by a short cord. Electrical leads were inserted through the tubing to make contact with either end of the carbon packing. As the circumference of the rubber ring was increased, the inter particulate pressure in the carbon dust decreased, increasing the resistance to an electrical current passed through it. The power source was a 1.25 Permacell dry cell. The resting level of the plethysmograph was 70 ohms. The calibration was checked each day by using internal calipers to stretch the ring 5 mm and evaluating the resulting polygraph pen deflections for consistency.

Changes in electrical potential were recorded in duplicate on two channels of a Grass Model 7 polygraph. The polygraph pen deflections for experimental subjects were also recorded on a Sony tape recorder Model TC-366-4 by transmitting the output from the J6 terminal on one of the polygraph channels to the tape recorder via a Vetter frequency converter.

The layout of the sound attenuated, temperature controlled experimental chamber is shown in Figure 3.

Stimulus slides were projected from outside the chamber onto a 0.6m. by 1.2m. screen inside the chamber by a Kodak, Ektagraphic model 2F slide projector. Music was provided through Procom model PR3000 headphones from a Sony model TC-357-4 tape recorder.

Procedure: The full text of the instructions to the subjects appears in Appendix B. Briefly, they were asked to increase their erections during designated experimental periods by any means, including fantasy, but not by physical manipulation or by contraction of the muscles in the groin area.

Each subject was instructed to place the plethysmograph proximal to the coronal ridge and extend the leads over the top of his trousers. This was done privately, in a separate room. Then he was seated in the experimental chamber, the plethysmograph leads were connected to the polygraph terminal in the experimental chamber and the procedure was explained. A diagram depicting the sequence of experimental events is shown in Figure 4.

To provide feedback to experimental subjects, the output from the J6 terminal on one of the polygraph channels was connected to a voltmeter. The meter was illuminated during appropriate experimental periods but was not observable during other periods. The full excursion of the meter indicator was from "10 o'clock" to "2 o'clock" on the meter face and was adjusted to represent the full excursion of the polygraph pens.

To provide each control subject with yoked "feedback" the taped record of their experimental partner's circumference changes was transmitted directly to the voltmeter via the Vetter frequency converter. This procedure provided the yoked subject with the exact sequence of the meter oscillations produced by his experimental counterpart.

Experimental subjects were informed of the significance of the meter and were told that movement of the indicator to the right meant increased circumference. Yoked subjects were not informed of the true significance of the oscillations, but were instructed to pay attention to them because of possible erectile enhancement. This instruction was included to ensure that control subjects would pay attention to the meter oscillations.

After the polygraph machine was calibrated and running, the subjects were instructed to contract the (ischio- and bulbocavernosus) muscles at the base of the penis to provide an example of the contraction configuration on the polygraph record. Also, they were told not to contract these muscles during the experiment because they interfered with the recording and could be detected.

After instruction, each subject was left alone in the chamber, the lights were dimmed and the music commenced.

Each subject initially furnished three minutes of "baseline" measurement of flaccid penis circumference prior to being shown an erotic slide for one minute. The response to this slide, the latter being the same for all subjects, was used as a final calibration check of the polygraph recording channels. After the calibration slide period, baseline measurement resumed for a further two minutes, immediately followed by the first stimulus slide and successive ones, at one minute intervals, until all 24 had been shown. All subjects were shown the slides in the same order. During periods when no slides were being shown, a dark blue tint was projected onto the screen.

Each subject was randomly assigned to one of four experimental conditions defined as follows:

Biofeedback with erotic slides - the subject was instructed to use the feedback of his own circumference changes and the slides to assist him in getting a larger erection. Group BF-E

Yoked control with erotic slides - the subject was asked to pay attention to the meter and use the slides to assist him in getting a larger erection. Group YC-E

Biofeedback with landscape slides - each subject in this condition was given virtually the same instructions as in the yoked-erotic condition; that is, pay attention to the meter and use the slides.

Group YC-L

The feedback or yoked "feedback" continued for five minutes after the end of the last experimental slide. During this period subjects had been instructed to get as big an erection as possible while viewing only the meter.

Measures: Changes in penile circumference were represented in polygraph pen deflection from a constant line 0.5 cm from the lower edge of the polygraph paper and were recorded in millimeters every 10 seconds during the experimental session. All other measures were calculated from these data points.

A pre-experimental baseline measure was calculated by averaging the data points within the two minute pre-experimental period. This measure represented the subjects' pre-treatment flaccid state.

The six data points within each slide presentation were averaged, the subject's pre-experimental baseline was then subtracted from this average, resulting in twenty-four individual "slide scores" for each subject.

The first dependent measure, terminal magnitude of polygraph pen deflection from baseline, was calculated by subtracting the baseline measure from the average magnitude of pen deflections on the last four slides. This measure represented the increase in erection size at the end of training.

The second dependent measure, maximum pen deflections from baseline, was calculated by finding the maximum pen deflection during the whole slide period, and then averaging the two points immediately before the point of maximum pen deflection with the two data points immediately after. This score represented the peak erection obtained. The averaging procedure was meant to attenuate the effect of a spurious momentary peak.

RESULTS AND DISCUSSION I - ORIGINAL HYPOTHESES

The means and standard deviations for each group on the two dependent measures and baseline are shown in Table I. Figure 5 shows the mean increases from baseline attained by each group across blocks of four slides.

Prior to any analysis on experimental treatment data, the presence of pre-existing differences on the baseline measure was evaluated not as a statistical necessity (because all treatment scores are stated as deviations from baseline), but rather as a methodological consideration. Pre-treatment group differences could have affected the eventual outcome. Table II summarizes the Analysis of Variance performed on the pre-experimental baseline. There were no significant differences between treatment groups, although the difference between erotic and landscape groups approached significance ($\underline{F}$ 1,28 = 3.8, $p < .061$). Since it preceded any differential operations performed on the groups, this effect must be accidental, and it is unrelated to any of the post-treatment group differences.

In the case of a design having multiple dependent measures taken from independent groups of subjects in different experimental conditions, Hummel and Sligo (1971) recommend that an overall multivariate analysis of variance be performed on all the variables simultaneously. If the multivariate test is significant, individual univariate tests on each of the dependent measures can then be interpreted. The data were analysed by means of a Multivariate Analysis of Variance (MANOVA) computer program (Clyde, 1969) using Wilk's Lambda Criterion to test the significance of the discriminant functions. Each treatment effect in the design is tested separately and involves a linear combination of the variables such that the function maximally discriminates between groups.

Table III shows the results of the multivariate test of the interaction between the two treatments, as well as a summary of the univariate tests on each of the dependent variables. The multivariate test failed to reach significance. No interaction of the two treatments was evident on either of the dependent variables.

Table IV shows the overall multivariate test of the feedback effect and the univariate tests of each of the dependent measures. Although the univariate test of one of the measures, average magnitude of the deviations from baseline at the end of training, shows a significant difference between groups, the non-significant multivariate test shows the difference to be questionable.

The multivariate and univariate tests of the difference between erotic and landscape groups are shown in Table V. In this case neither the multivariate nor the univariate tests reached acceptable levels of significance.

The mean increases from baseline attained during the five minute "feedback only" period are shown for each group in Figure 6. The average tumescence of Group BF-E dropped below the pre-experimental baseline and remained there most of the period. Group BF-L maintained tumescence well above the other groups. Both YC Groups maintained approximately the same average level of tumescence as shown during the preceding slide stimulation period.

These data fail to confirm the effectiveness of the feedback technique (Hypothesis I) or the erotic stimulation used (Hypothesis II) and there was no interaction of the two treatments (Hypothesis III). However, the means shown in Table 1 indicate that all four groups showed some increase in tumescence above baseline. This tendency is consistent with the conclusions of other investigators (Laws and Rubin, 1969; Rubin and Henson, 1975) that instructing subjects to increase tumescence can result in at least partial erections.

The group means for one of the dependent measures shown in Table I, maximum pen deflections from baseline, show slight differences between the feedback conditions BF and YC and larger differences between slide conditions E and L, but the differences did not approach significance on any test. The large standard deviations of maximum pen deflections from baseline, shown in Table I indicate a considerable amount of error variance associated with this measure. Such variance suggests that the erotic stimulation, and the feedback to a lesser extent, were effective in enhancing the maximum erection attained by some subjects but not others.

These results are similar to those reported by Price (1973) who used a dependent measure similar to the maximum pen deflections from baseline measure used in this study. Price (1973) reports a substantial (but untested) effect due to erotic stimulation as well as a small and non-significant effect due to contingent feedback. He also noted "... wide individual differences in responding and the data were not normally distributed."

In the present study the maximum pen deflections from baseline measure apparently contributed little more than error variance to the multivariate tests on both dependent measures. As such its value in future studies in this area is questionable.

The other dependent measure, terminal magnitude of the deviation from baseline at the end of training, showed more promising results.

Although the erotic slides were apparently ineffective in enhancing erection, the subjects in the BF Groups tended to show larger circumference increases by the end of training than yoked control subjects. When asked "What did you think of the slides?" during the post-experimental debriefing session, most of the subjects who had seen the erotic slides indicated individual preferences for specific slides but found the slides, overall, to be unexciting. Some subjects also noted that the change from slide to slide disrupted their fantasies. The use of an erotic movie instead of a series of slides might have resulted in greater and smoother circumference increases, but it might also have deterred subjects from attending to the feedback stimulus. The procedure of providing erotic narratives with visual feedback, as was done by Price (1973) may be a more effective method.

RESULTS AND DISCUSSION II - POST HOC ANALYSES

Examination of Table I reveals that the terminal magnitude measures show different degrees of variability above pre-experimental baseline, depending on whether a feedback or yoked condition followed the baseline condition. The effect was most pronounced in the group receiving erotic stimulation as well as biofeedback, but both of the feedback groups showed variances in terminal erection that were considerably greater than the variances shown by the yoked control groups. There were several possible implications of the BF/YC differences in variance, one being that biofeedback (relative to yoked stimulation) works extremely effectively for part of the time, but so as to increase the variance measure greatly, the mean only slightly, and that this effect is furhter amplified by concurrent erotic stimulation. First, however, it is necessary to ascertain by post-hoc analyses whether the variance differences are significant and whether their origin is in between-subjects-within-groups or within-subjects-within-groups variations. Post-hoc analyses increase the chance of capitalizing on chance differences and should be viewed with caution. However, they are useful to suggest tentative hypothesis for future testing.

The purpose of the first post hoc analysis was to determine whether the groups differed significantly in "within-group" variation. Several alternative tests are available. Three of them, those proposed by Hartley, Cochran and Bartlett, are oversensitive to departures from normality (Winer, 1971; Keppel, 1973). Another test, proposed by Levene (1960) is particularly appropriate here because it has been shown empirically to be sensitive only to heterogeneity of within-group variances. The test consists of an ordinary analysis of variance performed on transformed scores. The transformed scores are referred to as "Z scores" but are merely deviations of the original raw scores from the group mean expressed as absolute values in the original metric. (The more familiar "Z" score is also a deviation score but is expressed in standard deviation units). The transformation of the present data involved subtracting each subject's magnitude of pen deflections above baseline from the group mean for the same dependent measure, and expressing the result in absolute terms.

The means and standard deviations of the transformed scores are shown for each group in Table VI. Table VII summarizes the Analysis of variance on the transformed data and indicates a significant difference in the within-group variation of the feedback condition compared to the yoked condition ($\underline{F}$ 1,28 = 7.22, p .01). A similar analysis performed on the baseline measures failed to yield significant differences. Such analysis indicated that the between-subject variation within the feedback condition was significantly greater than within the yoked condition. This suggested that there might be different within-subject variations within each of the groups over the data points of the last four slides.

The calculation of the within-subject variation was as follows:

The measure that formed the basis for the transformation used in the first post-hoc analysis was the average of "slide scores" 21 through 24. As previously described, "slide scores" were the averages of the six data points within each slide presentation, expressed as deviations from baseline. The variation across the six data points within each slide presentation served as the basic data for the second post-hoc analysis. The standard deviation of the distribution of each subject's scores within each slide were calculated. These calculations resulted in four standard deviations for each subject. The average of the four was the dependent variable in the Analysis of Variance summarized in Table VIII which shows a significant difference in the average standards deviations in the feedback condition compared to the yoked condition, (F 1,28 = 6.92, $p < .02$). The results of the analysis of variance and the group differences depicted in Figure 7 indicate that the within-subject variation in the feedback condition was significantly greater than in the yoked condition. A similar analysis of data points across the baseline period failed to yield significant differences.

The first post hoc analysis indicated that the between-subject variation within the feedback condition was significantly greater than the between-subject variation in the yoked condition. In other words, the scores in the feedback condition had a wider dispersion about their mean than those in the yoked condition. The second post hoc analysis indicated that the within-subject variation across the last four slides also was significantly greater in the feedback condition compared to the yoked condition. Similar analysis of the baseline measures failed to indicate similar differences prior to the commencement of training.

A third post hoc analysis was done to determine the consistency of the tumescence levels shown by individual subjects across the last four slides. The measures used in this analysis were the "slide scores" obtained by each subject on slides 21 through 24. The intercorrelation coefficients in Table IX show that the yoked subjects were more consistent from slide to slide than the feedback subjects.

These three analyses suggest that the feedback technique employed here produced increased <u>within</u> and <u>between</u> subject variation. This effect was not evident in the yoked control subjects. However, there is a possibility that these analyses have capitalized on chance variation. Also, the procedure of analysing standard deviations is not referenced in the statistical literature and is open to future review. However, the post hoc analyses were intended only to be guides to further research, particularly research on the possible phasic properties of biofeedback applied to penile erection.

GENERAL DISCUSSION

Perhaps the most important conclusion to be drawn from this study is the realization of the need for more basic research on the variables, and more particularly the interaction of those variables, that affect biofeedback training of erection. As Price (1973) and Rosen, Shapiro and Schwartz (1975) suggest, preliminary studies in this field have tended to suggest more questions than they have answered.

The erotic stimulation used in the present study failed to produce much difference between those subjects receiving it and those receiving the landscape slides. The reason may have been the erotic quality of the slides themselves. Subjects reported that the slides were in general unexciting. It could also have been the method of presenting the erotic stimulation. Each slide lasted for one minute only, there were necessary brief interruptions as the slides changed, with different slides being presented after arbitrary fixed intervals. This procedure would understandably interrupt any attempts at fantasy. There was no, by the subjects, mention of the potential disruption caused by the requirement to divide their attention between the slides and the feedback meter, although this may have contributed to the problem. Possibly, presentation of the erotic stimulation and the feedback stimulation in different modes, as Price (1973) did, would avoid these methodological problems.

Feedback tended to improve terminal tumescence, but the BF-YC difference was not significant statistically. The planned and unplanned analyses suggest that biofeedback did enhance tumescence but in a highly variable fashion. The increase in variability was evident not only between subjects at the end of training but also within subjects across the last few minutes of training.

It is clear that pictures of nude females have considerable erotic interest for men, and it is generally accepted that such pictures initiate fantasy and in turn, full erection in various real-life situations. However, the pictures did not have this effect in the laboratory; Table I indicates that average at best, only 60 percent of average peak erection and usually much less. The peak erection itself never came (by subjects' reports) close to full erection. It is clear that in the fullyclothed, novel, perhaps threatening laboratory situation, erection was considerably inihibited relative to what would be achievable in more normal circumstances.

Given that the erotic stimulus effects were subject to inhibition, there is every reason to believe that the biofeedback effects would be subject to similar inhibition. In other words, an experiment such as this one, in a highly emotionally-sensitive area such as the male sexual response, is very much subject to Type II, or beta errors, the errors of failing to reject the null hypothesis when in fact it should have been rejected.

The present findings, while disappointing, are therefore understandable. The original hypotheses, based upon an expectation of general, consistent, ongoing, and systematic within-subjects and between-subjects erectile effects, were formulated in the usual way to show between-groups differences in average tumescence, but expectation of such reliable behaviour was probably overly optimistic when the friable nature of the response within a laboratory context is considered. What was found in the post-hoc analyses was what, with greater foresight, might have been expected: that biofeedback tended to increase tumescence some of the time, and for some of the subjects; also that this effect was accentuated by provision of erotic stimuli, but again, only some of the time for some subjects. If one were to assume that the "best" performance of the "best" subjects in each group typified potential performance in less inhibited circumstances, then the original hypotheses might have been supported.

The present study was not designed to examine the increases in variability in any decisive way, but the phenomenon is important and worthy of further investigation. The apparent phasic increases brought about by the biofeedback training could have implications for clinical and purely experimental research. In clinical studies of erectile dysfunction biofeedback training may serve to increase the operant level of the response making it amenable to further shaping by other, stronger reinforcement procedures. In purely experimental research Rosen, Shapiro and Schwartz (1975) have reported that increases in marked heartrate increases and irregular respiratory patterns were associated with irregular tumescence records. More research on the relationship between erectile processes and other autonomic response systems is needed. A strong case can be made for future research, if it is to be decisive, to occur in life situations considerably more natural and less inhibiting than the psychophysiological laboratory. This would be necessary in order to demonstrate reliably the phenomenon in question, and to provide a base for extension of the research findings to clinical applications.

TABLE I

GROUP MEANS AND STANDARD DEVIATIONS ON THREE MEASURES IN MILLIMETERS

		PRE-EXPERIMENTAL BASELINE		DEPENDENT MEASURES: TERMINAL MAGNITUDE OF PEN DEFLECTIONS FROM BASELINE		DEPENDENT MEASURES: MAXIMUM PEN DEFLECTIONS FROM BASELINE	
		MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.
EROTIC	FEEDBACK	4.78	3.91	4.76	7.35	23.67	19.12
	YOKED	4.37	5.86	2.00	3.08	17.41	18.29
LANDSCAPE	FEEDBACK	1.75	2.65	7.72	4.91	12.96	11.36
	YOKED	1.89	2.69	3.17	2.71	14.22	16.22

TABLE II

ANALYSIS OF VARIANCE SUMMARY ON EXPERIMENTAL BASELINE

	SUM OF SQUARES	df	MEAN SQUARES	F	p =
FEEDBACK	0.16	1	0.16	0.01	.92
SLIDES	60.80	1	60.80	3.80	.06
FEEDBACK X SLIDES	0.59	1	0.59	0.04	.85
RESIDUAL	448.01	28	16.00		
TOTAL	509.56	31			

TABLE III

MULTIVARIATE ANALYSIS OF VARIANCE SUMMARY TABLE

ON TWO DEPENDENT VARIABLES - TEST OF INTERACTION EFFECT

MULTIVARIATE TEST OF FEEDBACK X SLIDES

F	df(hypothesis)	db(error)	p =
0.77	2	27	.47

UNIVARIATE TESTS

Variable	Mean Square	F (1,28)	p =
Terminal Magnitude*	6.44	0.27	.61
Maximum**	113.25	0.41	.52

* Terminal magnitude of pen deflections from baseline

** Maximum pen deflections from baseline

TABLE IV

MULTIVARIATE ANALYSIS OF VARIANCE SUMMARY TABLE

ON TWO DEPENDENT VARIABLE - TEST OF FEEDBACK EFFECT

MULTIVARIATE TEST OF FEEDBACK

F	df(hypothesis)	df(error)	p =
2.61	2	27	.092

UNIVARIATE TESTS

Variable	Mean Squares	F (1,28)	p =
Terminal Magnitude*	106.43	4.48	.04
Maximum**	50.00	0.18	.67

* Terminal magnitude of pen deflections from baseline

** Maximum pen deflections from baseline

TABLE V

MULTIVARIATE ANALYSIS OF VARIANCE SUMMARY TABLE

ON TWO DEPENDENT VARIABLES - TEST OF SLIDES EFFECT

MULTIVARIATE TEST OF SLIDES

F	df(hypothesis)	df(error)	p =
3.24	2	27	.06

UNIVARIATE TESTS

Variable	Mean Squares	F (1,28)	p =
Terminal Magnitude*	33.95	1.43	.24
Maximum**	386.42	1.41	.24

* Terminal magnitude of pen deflections from baseline

** Maximum pen deflections from baseline

TABLE VI

GROUP MEANS AND STANDARD DEVIATIONS FOR TRANSFORMED SCORES ACCORDING TO LEVENE (1960)

CONDITIONS		MEAN	STANDARD DEVIATION
EROTIC	FEEDBACK	5.33	4.65
	YOKED	2.62	1.28
LANDSCAPE	FEEDBACK	4.39	1.44
	YOKED	2.11	1.51

TABLE VII

ANALYSIS OF VARIANCE SUMMARY TABLE ON TRANSFORMED SCORES ACCORDING TO LEVENE (1960)

	SUM OF SQUARES	df	MEAN SQUARES	F	p =
FEEDBACK	49.74	1	49.74	7.22	.01
SLIDES	4.23	1	4.23	0.62	.44
FEEDBACK X SLIDES	0.36	1	0.36	0.05	.82
RESIDUAL	192.87	28	6.89		
TOTAL	247.20	31			

TABLE VIII

ANALYSIS OF VARIANCE SUMMARY TABLE ON AVERAGE "WITHIN SUBJECT" STANDARD DEVIATIONS ON THE LAST FOUR SLIDES

	SUM OF SQUARES	df	MEAN SQUARES	*F*	p =
FEEDBACK	919.88	1	919.88	6.92	.02
SLIDES	8.31	1	8.31	0.06	.80
FEEDBACK X SLIDES	15.92	1	15.92	0.12	.73
RESIDUAL	3721.24	28	132.90		
TOTAL	4665.35	31			

TABLE IX

CORRELATION MATRIX SHOWING INTERCORRELATION COEFF-

ICIENTS OF "SLIDE SCORES ON LAST FOUR SLIDES"(PEARSON r)

	FEEDBACK SUBJECTS			YOKED SUBJECTS		
	SLIDE 21	SLIDE 22	SLIDE 23	SLIDE 21	SLIDE 22	SLIDE 23
SLIDE 22	.92*			.46		
SLIDE 23	.54	.30		.59*	.86*	
SLIDE 24	-.11	-.09	.31	.70*	.74*	.85*

* p less than .01

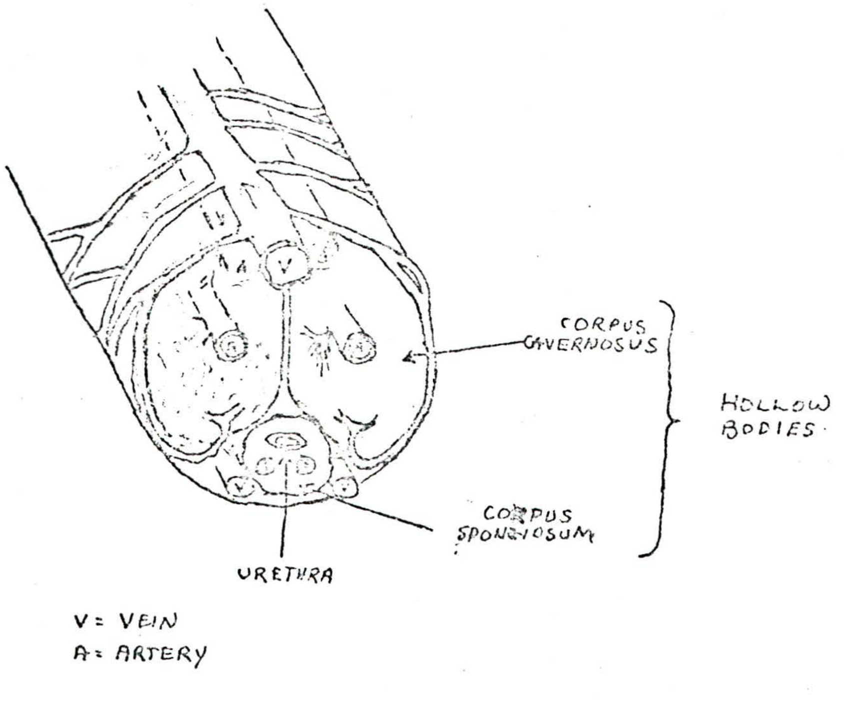
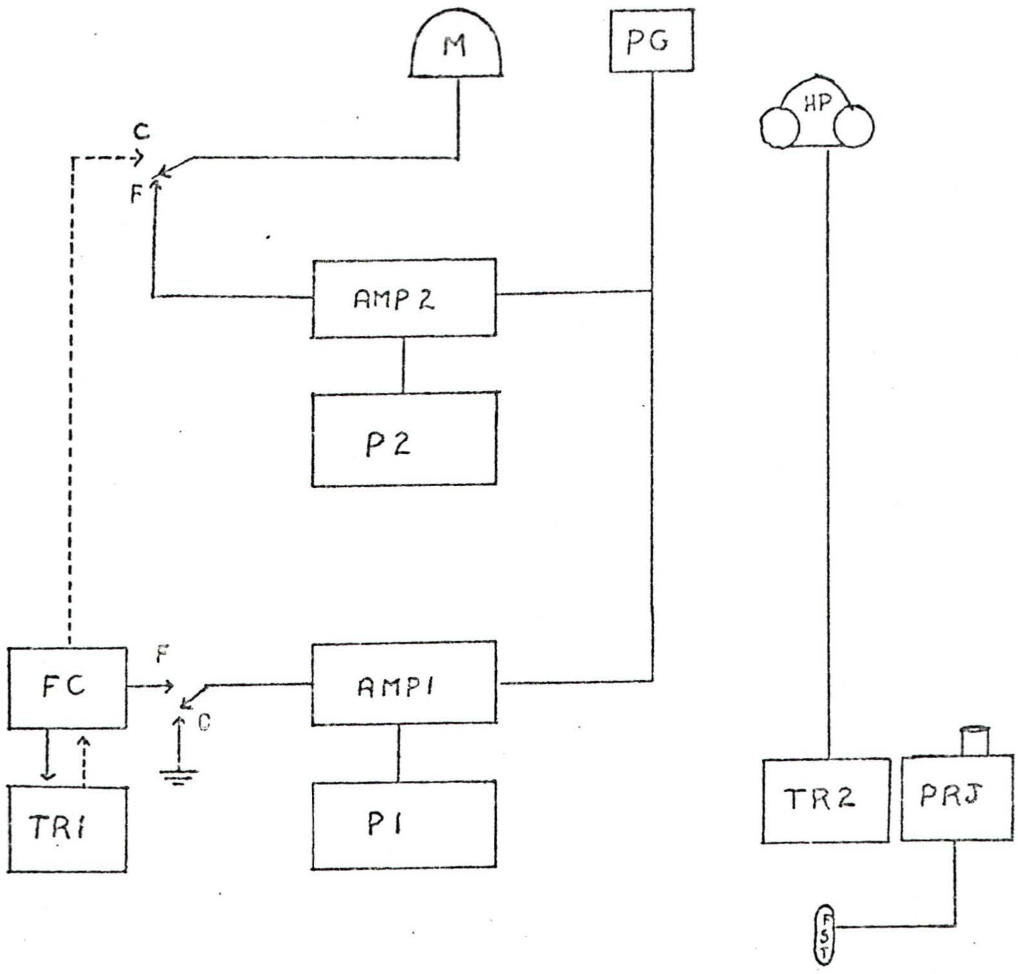


FIGURE 1 INTERNAL STRUCTURES OF THE HUMAN PENIS, CROSS SECTION PROXIMAL TO GLANS.



AMP1 - POLYGRAPH PRE-AMPLIFIER #1
AMP2 - POLYGRAPH PRE-AMPLIFIER #2
C - SWITCH POSITION FOR YOKED CONTROL SUBJECTS
F - SWITCH POSITION FOR FEEDBACK SUBJECTS
FC - FREQUENCY CONVERTER
HP - HEADPHONES
M - VOLTMETER
P1 - POLYGRAPH RECORDING PEN #1
P2 - POLYGRAPH RECORDING PEN #2
PG - PENILE PLETHYSMOGRAPH
PRJ - PROJECTOR
TR1 - TAPE RECORDER (RESPONSE)
TR2 - TAPE RECORDER (MUSIC)
FST - FILM STRIP TIMER

FIGURE 2 SCHEMATIC DIAGRAM OF EXPERIMENTAL APPARATUS.

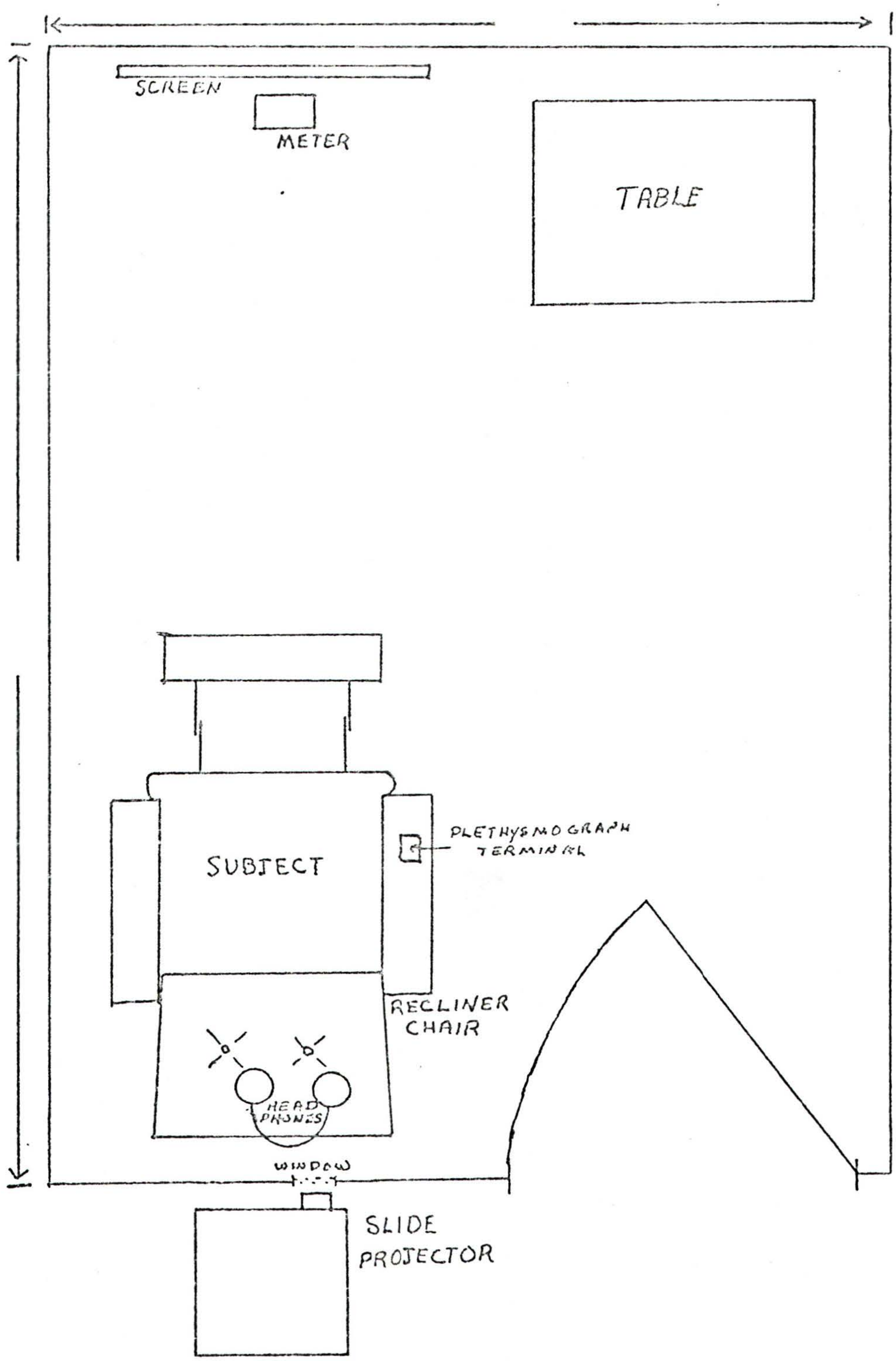


FIGURE 3 · LAYOUT OF EXPERIMENTAL CHAMBER

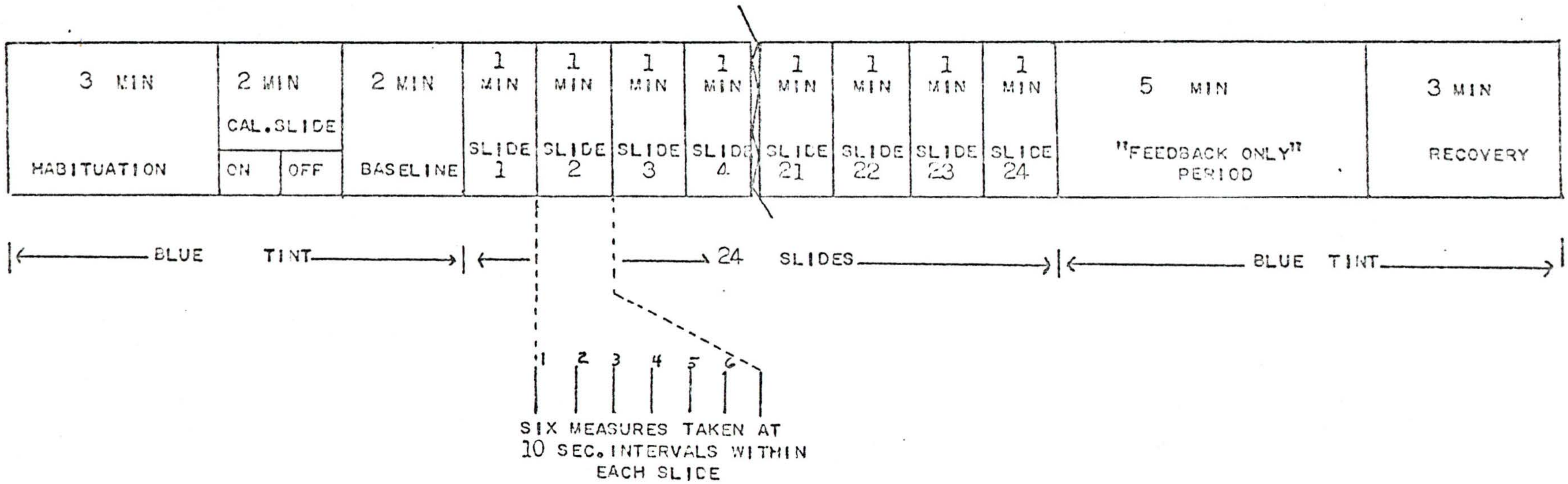


FIGURE 4 DIAGRAM OF THE SEQUENCE OF EXPERIMENTAL EVENTS

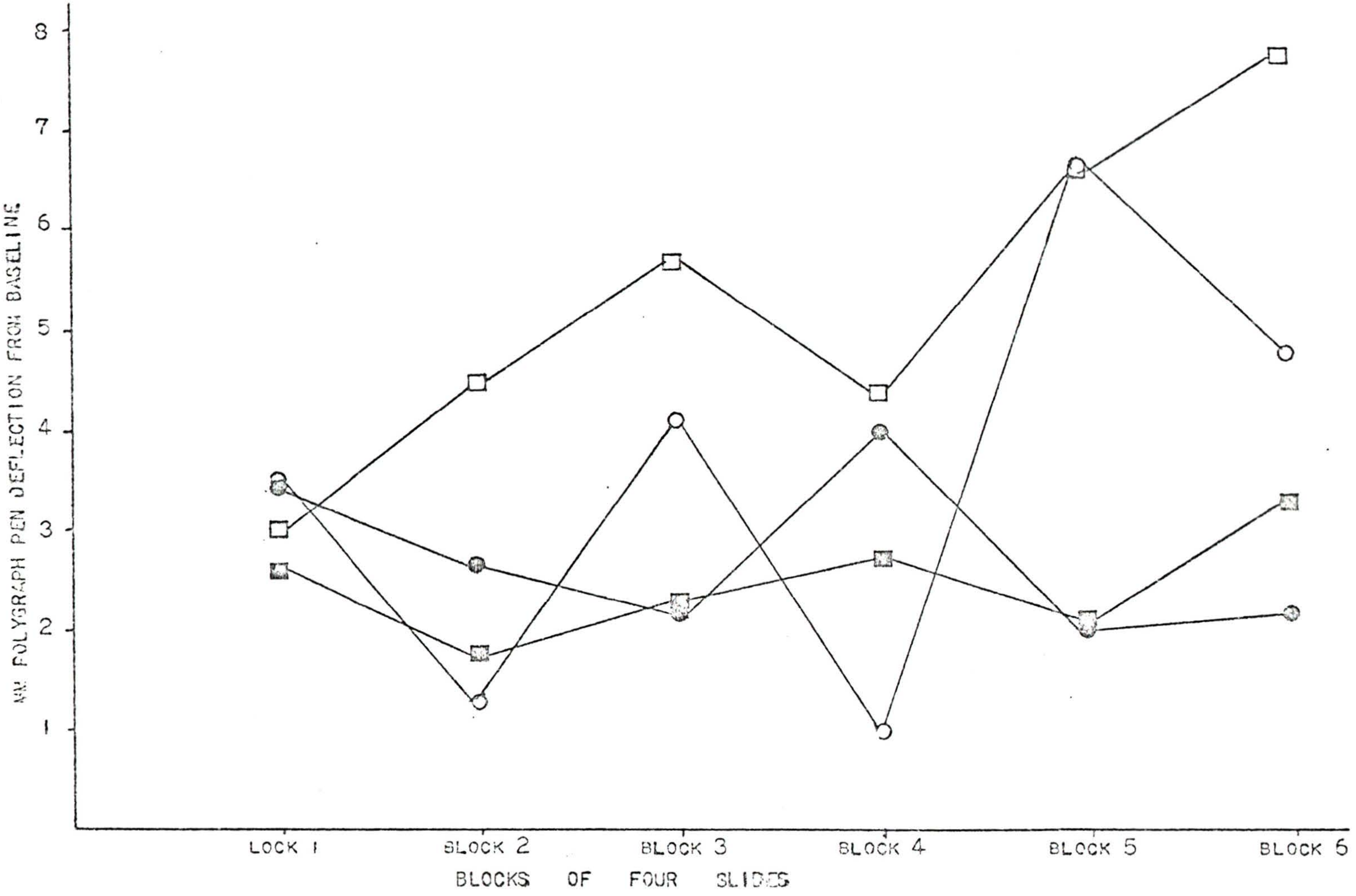


FIGURE 5 MEAN INCREASES FOR EACH GROUP AS A FUNCTION OF PRACTICE

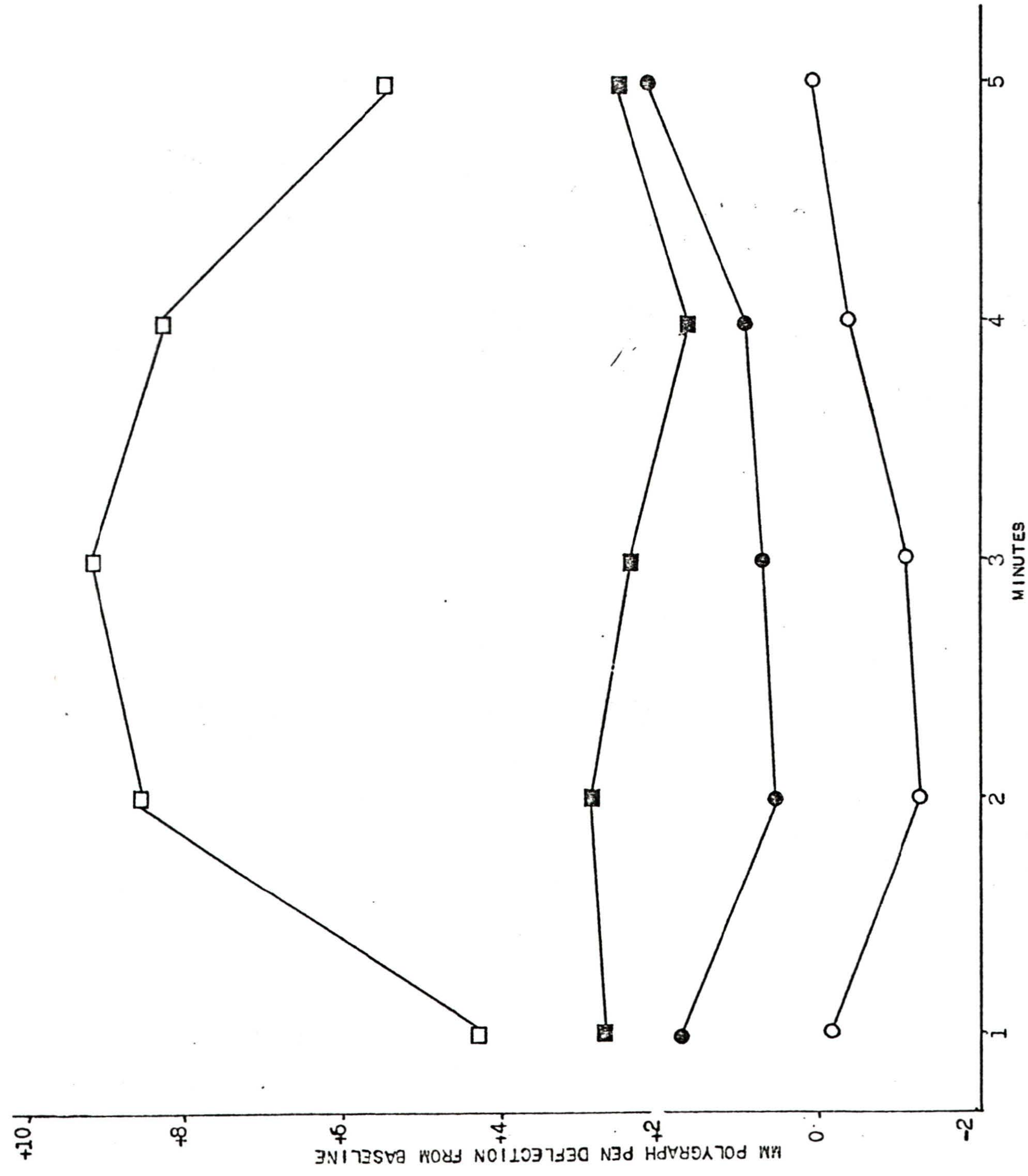


FIGURE 6 GROUP MEANS ACROSS ONE MINUTE PORTIONS OF THE "FEEDBACK ONLY" PERIOD

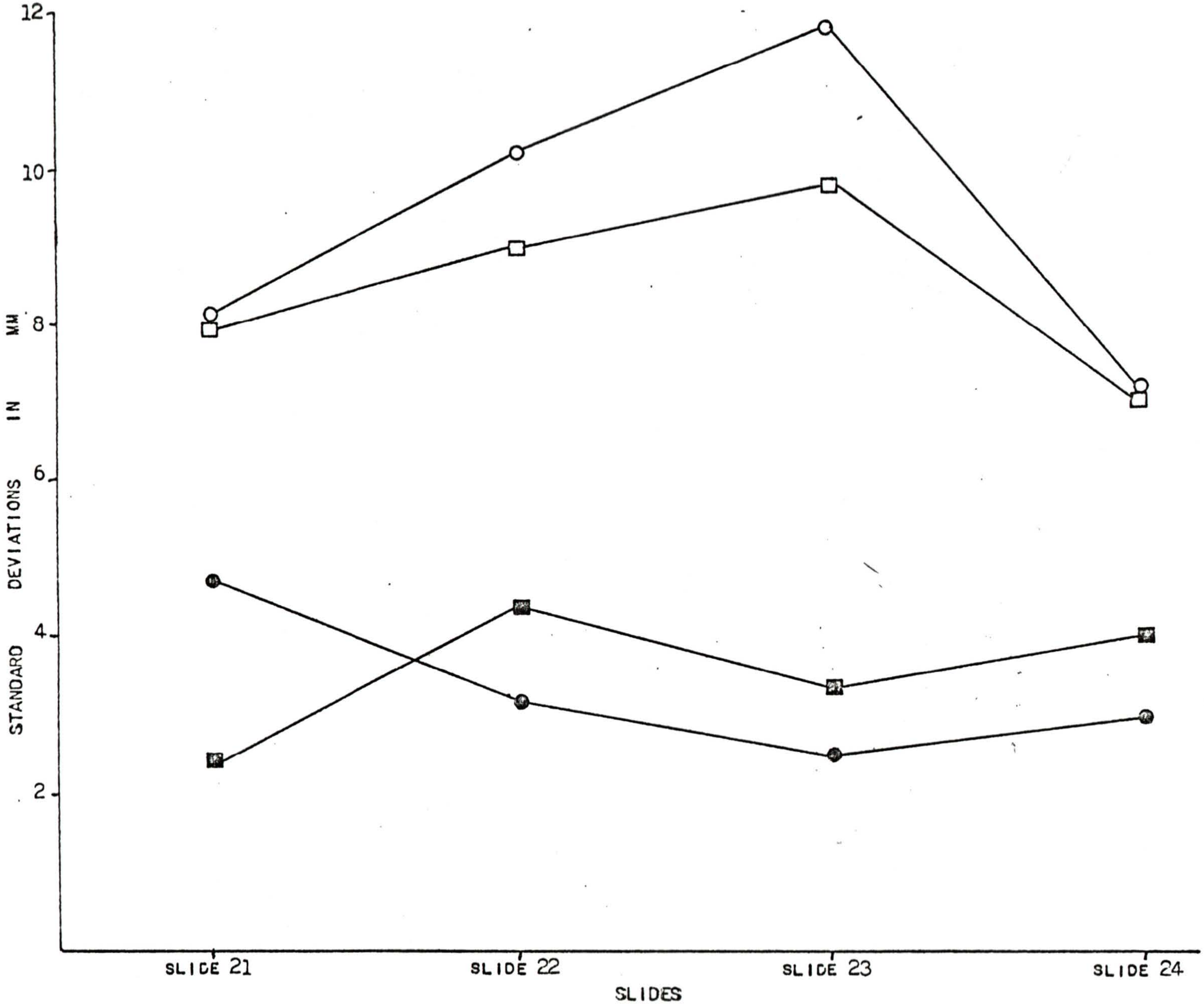


FIGURE 7 MEAN WITHIN-SUBJECTS STANDARD DEVIATIONS ON THE LAST FOUR SLIDES

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APPENDIX A

Mozart: Concerto No. 1 in D major for horn, K. 412

Mozart: Concerto in E flat major for horn, K. 447

Mozart: Concerto No. 2 in E flat major for horn, K. 417

Mozart: Concerto No. 4 in E flat major for horn, K. 495

Vivaldi: Concerto in A minor for flute, two violins and continuo.

APPENDIX B

I'm sure you realize, (subject's name), that many people have Physiological problems which make it difficult, if not impossible to have a normal sex life. For men this usually shows up as an inability to get an erection. Up until a few years ago men with these kinds of problems were simply out of luck, very little could be done for them. Some were too embarassed to even talk to their doctors about the problem. Maybe Masters and Johnson broke the ice, but now people believe they have a right to a normal sex life; and are asking for therapy.

A number of people have been working on this problem in Canada and the U.S. and have had some success but much of the difficulty seems to lie in getting the initial responses of erection - those minute changes at the beginning of an erection which we may not even be aware of. If we can get the man to reliably produce those initial stages then therapy may go easier.

That's what we're doing here. We're trying to build an environment that will optimize a person's chance of getting an erection. You are going to be presented with some stimuli and your erection is going to be measured - don't worry, you'll be wearing your normal cloths just as you are now. (TAKE ENVELOPE CONTAINING PLETH. FROM DRAWER) This is called a penile plethysmograph and it's used to measure erections. It's simple to put on and you do it down the hall in private but first, now that you know what the experiment is all about, I must ask you if you want to continue. If not you can leave now and that's all there is to it. (WAIT FOR RESPONSE) Also, if at any time during the procedure you want to leave just holler out and I'll turn everything off and you will be free to leave. (SHOW DRAWING OF PENIS) Please excuse this drawing -

it's my own art work. Just fit it on over the end of your penis so that the cord (INDICATE CORD ON PLETH. AND DRAWING) is on the bottom and the leads (INDICATE LEADS ON PLETH. AND DRAWING) are on the top. Then bring the leads up over your belt. Come out here and I'll show you where to put it on.(INDICATE WASHROOM)

(ON HIS RETURN) I'll just plug those leads in here. By the way the only power that goes through there is from this little battery.

Let me explain the procedure. First, I'm going to ask you to do a couple of things to help calibrate the polygraph machine. Then you'll put on the earphones on, I'll leave, the lights will dim and the music will start. For the first few minutes there will be a blue slide projected on the screen. During the time of the blue slide just sit quietly and relax - don't try to get an erection. After a few minutes one slide will come on. Fantasize to the slide if you wish but get as big an erection as possible during the time the slide is on. After a few moments the slide will go off and the blue slide will reappear. During that time think of a math. problem or whatever, but forget your erection. After a few more minutes a series of slides <u>and this meter</u> will come on. During the time that the slides and meter are on I'd like you to pay attention to them and get as big an erection as possible. Use the slides to fantasize if you wish.

FOR FEEDBACK SUBJECTS:

The meter is connected directly to that plethysmograph and as the indicator moves to the right it will mean an increase in the size of your erection. It will tell you how you are doing. But remember that it is very sensitive and may wabble back and forth so don't become too concerned if it falls back. Just try to keep it as <u>much as possible to</u>

this side (RIGHT SIDE) of the meter.

FOR YOKED CONTROL SUBJECTS:

The meter is not connected to you, but you will see that after it comes on. There has been some suggestion by other researchers that the wabbling back and forth of the indicator somehow enhances a person's ability to get an erection. There is no physiological reason for this but maybe something else is operating. That's one of the things we would like to find out so please pay attention to the meter indicator as well as the slides.

ALL SUBJECTS:

The slides will eventually end, the blue slide will come back on but the meter will remain on. During this time try to get as big an erection as possible, as before, but pay attention to the meter only.

After a few minutes, the meter will go dark again, and only the blue slide will be visable. During this time just relax. After a few moments the music will end the lights will brighten and the experiment will be over.

Any questions? I'll go over the procedure again quickly. First, I'll get you to do a couple of things to calibrate the machine. After that, you'll put the earphones on, I'll leave, the lights will dim and the music will start. Start trying to get an erection when the first slide comes on. When that slide goes off forget your erection. After a few minutes a series of slides and the meter will come on.

FOR FEEDBACK SUBJECTS:

Use the meter and pay attention to the slides

FOR YOKED CONTROL SUBJECTS:

Pay attention to the meter and the slides

FOR ALL SUBJECTS:

To get as big an erection as possible. The slides will end and the meter will remain on, then just use (pay attention) to the meter. The meter will go off after a few minutes and eventually the music will stop, the lights will come on and the experiment will be over.

I'm just going to start the polygraph I'll be right back. (ON RE-TURN) (subject's name) there is a set of muscles that extend from just in front of your anus to your penis. If you contract those muscles you will feel your penis bob up and down. (REINSTRUCT UNTIL SUBJECT CONFIRMS) When I ask please do that. (REQUEST CONTRACTIONS UNTIL CON-FIGURATION IS CONSISTENT ON RECORDING PAPER) Now that I have described them I'm going to ask that you don't contract those muscles during the session. They make the recording pens go crazy and ruin the recording. Get comfortable, don't use your hands to get an erection, and remain quiet. Everything OK?

APPENDIX C

Well, that wasn't too bad was it? Before I ask you some questions are there any general comments?

What did you think of the slides?

Did you notice whether the meter was of any assistance? (PROBE WHETHER SUBJECTS BELIEVED METER WAS (WAS NOT) CONNECTED TO PENIS)

Were you at all intimidated by the machinery, me in the other room, the copper room?

You spent about 35 minutes in here, did you find it difficult to sit for so long? Concentrate? Fantasize? (PROBE BELIEF IN EXPERIMENT GENERALLY)

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Self control of penile tumescence

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