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INSTRUCTIONAL CONTROL OF AN AUTONOMIC SEXUAL RESPONSE[1]

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Four of seven human male subjects developed full penile erections when exposed to erotically stimulating motion pictures. Changes in penile size were detected by a mercury strain gauge transducer and automatically recorded on a continuous paper record. When instructed to inhibit penile erection in the presence of such effective stimulus films, every subject was able to reduce his erection by at least 50%. This inhibition was apparent as long as the instructions were in effect; when the instructions were removed and the film reshown, the erection returned almost to its maximum state. This was true whether the films were presented as few as three or as many as nine times in succession. When instructed to develop an erection in the absence of a film, every subject was able to do so, each reaching a peak of about 30% of his maximum. Such erections had longer latencies to the peak produced and lower maximum levels than those elicited by a film.

Penile erection is the male's first response to effective erotic stimulation (Masters and Johnson, 1966) and it is generally considered an involuntary reflex (see, for example, Houssay, 1955). In recent years, this concept of the "erection reflex" has been used to aid in the diagnosis (Freund, 1963, 1965, 1967; McConaghy, 1967) or the treatment (Bancroft, Jones, and Pullan, 1966; Marks and Gelder, 1967) of sexual deviancy. In the diagnostic paradigm, patients are typically shown pictures of nude women (normal stimuli) and of nude children or men (deviant stimuli) while the size of the penis is continually monitored. Individuals displaying increases in penile size in the presence of normal stimuli are diagnosed as normal; increases in the presence of deviant stimuli result in a deviant diagnosis; and increases to both or neither are not diagnosible (see, for example, Freund, 1963). The treatment paradigm is similar, except that when penile increases occur in the presence of deviant stimuli, they are punished, generally by painful electric shock (see, for example, Marks and Gelder, 1967).

Penile erection can be elicited by electrical stimulation of peripheral as well as central nerves (see Kuntz, 1953, for review) and by manual massage of the penile shaft even when the subject has no physical feeling of the action because of spinal cord destruction (Kuhn, 1950). However, penile erection may not be exclusively an involuntary reflex. Freund (1963) reported that some subjects can produce small increases in the size of their penes independent of erotic stimulation, apparently by spasmodically contracting muscles in the groin area. Conversely, erection maintained by ongoing sexual stimulation may be lost when a novel stimulus (such as a loud noise) is suddenly introduced in the situation (Masters and Johnson, 1966). Penile erection, therefore, may be a response under both voluntary and involuntary control. If there is voluntary control over the occurrence of penile erection, then a motivated subject should be able to inhibit erection in the presence of erotic stimuli and to produce erection in the absence of such stimuli.

METHOD

Subjects

Seven adult males (age 25 to 32 yr), all employees of Anna State Hospital, participated

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voluntarily, received no remuneration, and were informed of the nature of the experiment.

Apparatus

A mercury strain gauge, similar to that designed by Whitney (1949) and described by Wade (1954), was used to measure changes in penile circumference. The gauge was constructed of a 12-in. length of silicone rubber tubing, inside diameter 0.020, outside diameter 0.037 (Bard-Parker #3808 or Dow-Corning #602-131), filled with mercury and plugged at both ends with 2-in. by 0.025-in. lengths of platinum wire, which served as electrodes. Two sections of the filled tubing were glued with bathtub caulking into tracks which had been cut into a small, thin piece of plastic. When glued in place, a 3-in. long section of tubing projected above the plastic holder and formed a loop. This loop constituted one leg of a bridge circuit that was powered by four 1.35-v mercury batteries (Mallory #RM-42R) in parallel. A variable resistor on another leg was used to balance the resistance in the circuit. Any increases in the circumference of the transducer loop increased the resistance of the mercury in the loop and unbalanced the circuit. These small resistance changes resulted in changes in current flow that were amplified and recorded by a polygraph (Grass, Model 7). By placing the transducer loop over seven different cylinders of known size, it was determined that the current flow through the circuit was a linear function of the circumference of the loop throughout the range of circumferences used in the study (3 to 5 in.). The calibration of the transducer was checked before and after every session by placing the loop over two standard cylinders and recording the resulting current flow.

Stimuli

The stimuli employed were 200-ft, 8-mm motion pictures chosen for their erotic content. The films were presented on a rear-projection screen (glass Lenscreen, Polacoat, Inc.) producing a stimulus display 9-in. by 12-in. wide. The subject was seated on the opposite side of the screen, approximately 4 ft from it. Each film had a projection duration of from 10 to 12 min.

Chamber

The subjects' chamber was a 6-ft by 6-ft, soundproof, ventilated chamber (Industrial Acoustics Co., Model #1202) that could be locked from the inside. The chamber was maintained at approximately 80°F, 80% relative humidity, and was illuminated by one 7.5-w overhead light. A comfortable chair was located in the center of the chamber and faced the rear-projection screen. The screen, translucent and permanently emplaced, precluded visual contact from either side of the screen. A two-station intercom system was wired so that, in the resting state, both stations were on receive; transmissions from either station required the closing of a switch at the transmitting station.

Detection Signals

To increase the probability that the subjects were attending to the films, they were required to respond to brief (100-msec) flashes of light that appeared either at the top or bottom of the projected image. The lights were scheduled (each on an independent VI 30-sec schedule) so that one or the other was illuminated on the average of once every 15 sec. The response was the depression of a button located on an arm of the subjects' chair. Both signals and responses were recorded on a multi-pen event recorder. An accurate signal detection was defined as a detection response occurring within 1 sec of a signal. Signal detection responses were required during every film presentation.

Procedure

Using a small plastic cylinder as a model, the experimenter explained how to fit the transducer on the center of the penile shaft, making sure that the plastic holder was on the underside of the penis and that the electrode wires were free of any external obstructions. The subject was told that, after he had fitted the loop in place, he was not to touch the transducer or his penis during the experiment and to avoid moving about in the chair.

The subject's placing the transducer on his penile shaft always resulted in a short period of variability of penile size, probably because of the penile manipulation involved in the action. This variability generally subsided in less than a minute, and the current flow recorded on the polygraph after stabilization was used as the subject's baseline (flaccid state) for that session.

Full erection was determined from the verbal report of each subject during a sample film presentation. In every case these verbal reports correlated with the maximum penile size consistently recorded for that subject by the transducer circuit. Partial erections were defined as any penile size that resulted in a current flow greater than the flaccid state baseline and less than full erection. Such erections were reported as a percentage of full erection, with the baseline being 0% and full erection 100%.

During experimental sessions, the first stimulus was not presented until the flaccid baseline had been stable for at least 30 sec. Subsequent stimuli were not presented until the penile responding had returned to within 5% of the flaccid baseline and remained stable for at least 30 sec.

To determine the effect of wearing of the transducer in the stimulus situation, each subject was exposed to a film projected completely out of focus. Under these conditions no subject produced an erection more than 7% of his maximum and two subjects produced no erection at all.

Each subject was then shown one stimulus film three times in succession. For the first film presentation, the subject was instructed to do nothing to inhibit his sexual response to the film. For the second film presentation, the subject was instructed to avoid getting an erection by any means except not watching the film. For the third film presentation, the instructions to do nothing to inhibit the response were repeated. After an interval of at least 24 hr, the subject's ability to inhibit an erection to a previously unseen film was determined by changing the sequence of instructions during three successive presentations of a different film, *i.e.*, the subject was instructed to inhibit erection during the first presentation, not to inhibit during the second, and to inhibit again during the third. To determine the effects of long-term exposure to these procedures, two subjects were shown a film nine times in succession. Instructions to inhibit or not to inhibit were alternated with each successive film presentation. The subjects did not remove the transducer or leave the chamber for the duration of the session.

To determine if a subject could produce an erection in the absence of an external erotic stimulus, he was seated in the experimental chamber, which was devoid of any erotic stimuli, and was instructed to produce a penile erection by any means except manipulating himself. The subject was informed that any attempt at self-manipulation would be detected by the experimenter. Self-manipulation appeared in the polygraph tracing as spiked deviations of short duration and was easily discriminated from the smooth and regular tracing seen in the absence of self-manipulation. The length of these experimental sessions varied, depending upon the subject's ability to produce the response.

RESULTS

The calibration of the transducer did not change within or between sessions; the two standard cylinders always produced the same current flow at the start and end of every session.

Of the seven volunteers, four produced full erections; the film was not effective in producing full erections in the other three subjects and they were not used.

All subjects detected the stimulus lights in the film display area at at least 90% accuracy regardless of the instructional conditions. There was very little difference in accuracy between the conditions; detections were made with 93% accuracy during all film presentations when the instructions were not to inhibit penile erection, compared to 95% accuracy when the instructions were to inhibit the response. There were very few false positives; in 1718 signal presentations, only six responses were recorded when a detection signal had not occurred.

Figure 1 shows that during the first film presentation (left panel, first 10 to 12 min), when subjects were instructed not to inhibit their penile erection, every subject produced a full erection. The increase in penile size occurred very rapidly, and full erection was generally obtained within 3 min from the onset of the film. In three of the four subjects, almost full erection was maintained for the duration of the film. Average erection for all subjects for this period was 76% of maximum. Detumescence also occurred rapidly; penile size generally returned to the baseline within 3 min after the end of the film. During the second film presentation (left panel, area enclosed by dotted lines), when subjects were instructed

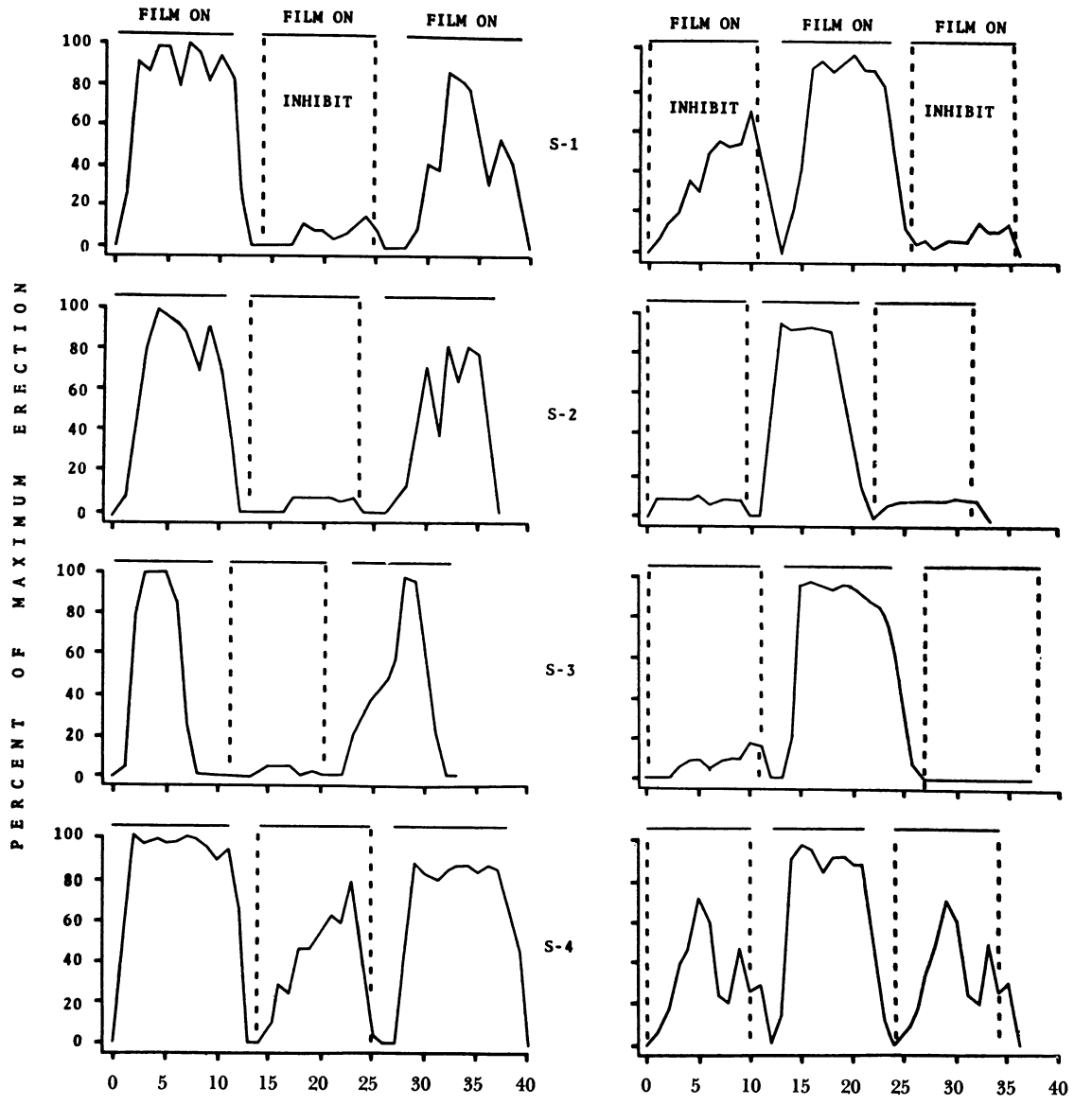

Fig. 1. Amount of penile erection elicited from four subjects by three successive presentations of an erotic film. The film was projected during those periods of time indicated by the horizontal lines above each graph. The left section shows performance when the subjects were instructed to inhibit erection during the second film presentation (enclosed in dotted lines). The right section shows performance when the subjects were instructed to inhibit erection during the first and last presentation (enclosed in dotted lines) of a previously unseen film. The subjects were instructed not to inhibit their response at all other times.

to inhibit their penile erection, no subject produced a full erection. The erections of three of the four subjects did not exceed 15% of maximum. The fourth subject produced a gradual increase in penile size, reaching a momentary peak of 80% of maximum just before the end of the film. The average erection for all subjects during this period was 14% of maximum. When the film was shown for the third time (left panel, last 10 to 12 min), during which the subjects were again instructed not to inhibit their penile erection, every subject again produced almost full erection. Although the increase in penile size

occurred somewhat more slowly, and the maximums reached were a little lower than during the first film presentation, they were always much greater than during the second film presentation when the inhibit instructions were in effect. The average erection for all subjects during this last period was 60% of maximum. The decrease in penile size to baseline after the end of the film was again very rapid.

The right panel of Fig. 1 shows that during the first presentation of a new film (right panel, first area enclosed by dotted lines), when subjects were instructed to inhibit their penile erection, no subject produced a full erection. Two of four subjects reached peaks of about 75% of maximum, the other two subjects did not exceed 15%. The average erection for all subjects during this period was 22% of maximum. During the second presentation of the new film (right panel, center section), when subjects were instructed not to inhibit their erection, all subjects produced a full erection. Again there were short latencies to both tumescence after the onset, and detumescence at end of the film. Average erection for all subjects during this period was 80% of maximum. When the new film was shown for the third time (left panel, last area enclosed by dotted lines), during which the subjects were again instructed to inhibit their penile erection, no subject produced a full erection. Two of the four subjects had smaller erections than during the first presentation of the film, none had larger erections. One subject reached a momentary peak of 75% of maximum, and one subject had no erection at all. The average erection for all subjects during this period was 11% of maximum.

Figure 2 shows the amount of penile erection produced by each of two subjects when they were shown a film nine times in succession. Subject 3 (upper section, Fig. 2) produced almost full erections (average, 80%) during every film presentation when he was instructed not to inhibit his erection (presentations No. 1, 3, 5, 7, and 9). There was very little decline in his erection under these conditions (compare presentation No. 1 to presentation No. 9). Erections always occurred soon after the onset of a film and declined rapidly after the end of the film. During the film presentations, when he was instructed to inhibit his erection (presentations No. 2, 4, 6, and 8), he produced almost no erection (average, 4%). There did not appear to be any change with time. Subject 4 (lower section, Fig. 2) also produced almost full erection (average, 83%) when instructed not to inhibit his erection. His pattern of responding under those instructions was very similar to that of S-3. However, the first time he was instructed to inhibit his erection he produced an average erection of 48% of maximum and reached a momentary peak of about 80%. The degree of erection under these instructions decreased over successive presentations and, the fourth time he was instructed to inhibit his erection (presentation No. 8), his average erection had decreased to 17% of maximum with a momentary peak of about 50%.

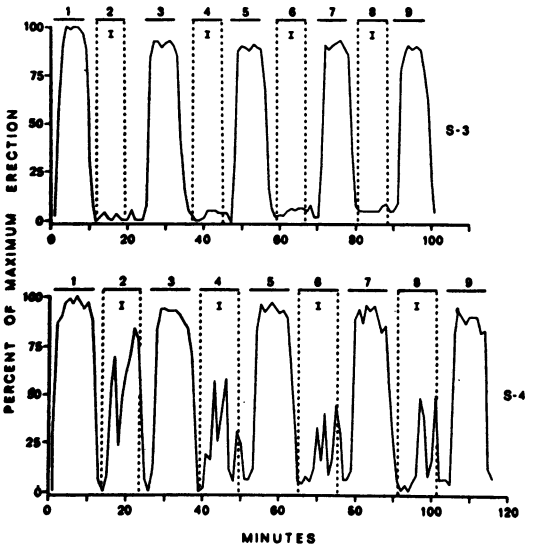

Fig. 2. Amount of penile erection elicited from two subjects by nine successive presentations of an erotic film (indicated by the numbered horizontal lines above each graph). Subjects were instructed to inhibit erection during the presentations enclosed by dotted lines, and not to inhibit erection during all other presentations.

Figure 3 shows the penile erections produced by each of the four subjects when they were instructed to develop an erection in the absence of an erotic film. All subjects produced partial erections (average of all subjects over entire session duration was 13% of maximum). Three of the four subjects had momentary peaks of about 30% of maximum, one (S-3) reached a peak of about 90%. The latency to any increase in penile size ranged from slightly less than 1 min (S-3) to 10 min (S-4). No sub-

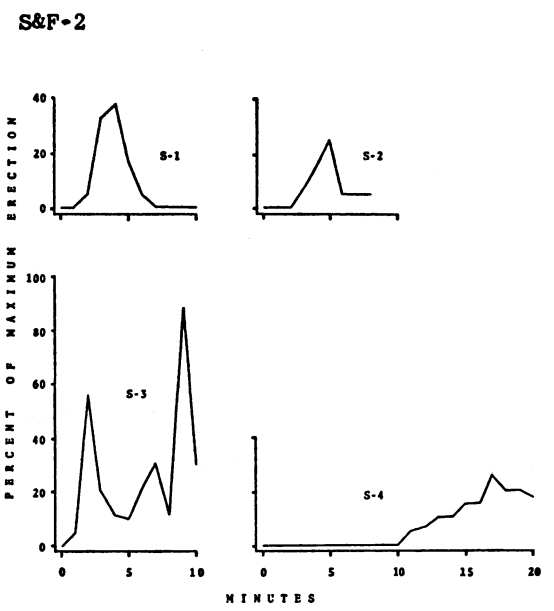

Fig. 3 Amount of penile erection obtained by each of four subjects when they were instructed to produce an erection in the absence of erotic stimuli.

ject was able to maintain any level of partial erection for more than a few minutes.

DISCUSSION

The response of penile erection was under the control of the experimental instructions. When told to inhibit penile erection, all subjects were able to do so. This lack of penile erection was probably not due to the subject looking away from the area of the film presentation because there was no difference in the accuracy of signal detection responses between experimental conditions. It was also not due to satiation for the film or to general fatigue. When instructed not to inhibit their erection to a film that they had seen as many as nine times in the same session, all subjects produced almost full erections; when instructed to inhibit their erection while viewing a film they had never seen before, no subject produced a full erection.

All the subjects reported that, when instructed to inhibit their erections, they thought about things that required some concentration, *e.g.*, the lyrics to popular songs, verses of poetry, multiplication tables, or the immediate detection of the signal lights. Development of erection without the aid of an erotic film was apparently accomplished by the subjects' thinking about sexually exciting things or events ("fantasizing"). They all indicated that they attempted to relax in the chair as much as possible and concentrate on sexual thoughts. All were able to develop partial erections using this procedure. There was, however, a distinct difference between these "fantasy" erections and the film-elicited erections. The latter were characterized by short latencies to the maximum level (full erection) and a generally smooth and regular response recording. The "fantasy" erections, on the other hand, had long latencies, low peak levels (partial erection), and showed some variability throughout the period when the instructions were in effect.

The fact that subjects can develop or inhibit erection in accord with instructions indicates that there is voluntary control over the erection response. The main prerequisite would seem to be sufficient motivation on the part of the subject. How he was motivated to respond would be governed by the consequences of either inhibiting or developing an erection. Any consequence would be determined by the combination of the erotic stimuli and the environment in which they appear. Voluntary development of erection would be most likely to occur in an environment where erotic stimuli sufficient to produce erection were present and favorable consequences, *e.g.*, sexual intercourse, would follow the response. Conversely, if intense erotic stimuli were present, but development of erection would result in unfavorable consequences, *e.g.*, social embarrassment, then the individual would be likely to attempt to inhibit the response.

There is some evidence to show that individuals will attempt to control their sexual responding under strong motivational conditions. Freund (1963, 1965, 1967) used changes in penile volume in response to still photographs to diagnose sexual pathology. He indicated that some of his subjects apparently attempted to produce a penile erection in order to influence the diagnosis they desired for themselves. Some of these subjects had denied having had homosexual activities, while others desired evidence of homosexuality in order to avoid military service. Since the diagnosis would have an important influence on their future, these subjects were no doubt highly motivated to produce the "correct" response. Freund noted rapid oscillations in the response tracings of some of these subjects

which he interpreted as attempts at response faking. These irregularities were excluded before the recordings were evaluated because his prediagnosis or prior information on the subjects indicated that they should not produce volume changes at the points where they were seen. The oscillations that Freund observed may represent one type of voluntary movement, *e.g.*, flexion of penile muscles, or he may have been recording some "fantasy" erections. Perhaps more interesting is the fact that Freund (1963, 1965, 1967) reported that in some of his subjects the recorded changes in penile size were insufficient to permit a diagnostic judgment. This report raises the important issue of the extent to which subjects could influence diagnosis by inhibition of erection. Diagnosis of sexual deviation is generally based on the development of erection in the presence of deviant stimuli. The most efficient way for a subject to influence a diagnostic judgment would not be to produce an erection to "normal" stimuli, but rather, to inhibit erection to "deviant" stimuli. Regardless of whether he produced an erection in the presence of "normal" stimuli, he could not be diagnosed as deviant unless he produced an erection in the presence of "deviant" stimuli.

Since penile erection is a prerequisite for the consummation of most male sexual acts, voluntary control of penile erection could be used to change the probability of occurrence of a particular sexual act. All subjects in the present study reported that they controlled their erections by concentrating on mental stimuli, suggesting that patients with sexual problems might be able to learn to control their erections if they were trained to concentrate on specific thoughts at appropriate times. For example, the training could be directed toward concentrating on sexual stimuli to produce an erection in order to accomplish coition, or it could be directed toward concentrating on asexual stimuli to prevent a deviant sexual contact. In either case, the voluntary control exerted by the untrained normal subjects in the present study was extensive and enduring enough to warrant further study for its clinical application.

REFERENCES

Bancroft, J. H. J., Jones, H. G., and Pullan, B. R. A simple transducer for measuring penile erection, with comments on its use in the treatment of sexual disorders. *Behavior Research and Therapy*, 1966, **4**, 239-242.

Freund, K. A laboratory method for diagnosing predominance of homo- or hetero-erotic interest in the male. *Behavior Research and Therapy*, 1963, **1**, 85-93.

Freund, K. Diagnosing heterosexual pedophilia by means of a test for sexual interest. *Behavior Research and Therapy*, 1965, **3**, 229-234.

Freund, K. Diagnosing homo- or heterosexuality and erotic age preference by means of a psychophysiological test. *Behavior Research and Therapy*, 1967, **5**, 209-228.

Houssay, B. S. *Human physiology*. New York: McGraw-Hill, 1955.

Kuhn, R. A. Functional capacity of the isolated human spinal cord. *Brain*, 1950, **73**, 1-51.

Kuntz, A. *The autonomic nervous system*. 4th ed.; Philadelphia: Lea and Febiger, 1953.

McConaghy, N. Penile volume change to moving pictures of male and female nudes in heterosexual and homosexual males. *Behavior Research and Therapy*, 1967, **5**, 43-48.

Marks, I. M. and Gelder. M. G. Transvestism and fetishism: clinical and psychological changes during faradic aversion. *British Journal of Psychiatry*, 1967, **113**, 711-729.

Masters, W. H. and Johnson, Virginia E. *Human sexual response*. Boston: Little-Brown, 1966.

Wade, O. L. Movements of the thoracic cage and diaphragm in respiration. *Journal of Physiology*, 1954, **124**, 193-212.

Whitney, P. J. The measurement of changes in human limb volume by means of a mercury-in-rubber strain gauge. *Journal of Physiology*, 1949, **109**, 5.

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