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Pavlovian Conditioning of Sexual Interests in Human Males

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Pavlovian conditioning of the human male sexual response may be involved in the ontogenetic development of sexual interests and may be responsible for individual differences. We attempted to demonstrate Pavlovian conditioning of sexual interests in a nonclinical sample of adult males. Ten participants were exposed to 11 pairings of a slide of a moderately attractive, partially nude female adult (TARGET) and a highly arousing videotape depiction of heterosexual sexual interactions (US). Ten other participants were exposed to 11 presentations of the TARGET alone. Participants exposed to the TARGET-US contingency showed a 10% relative increase in sexual arousal to the TARGET; participants exposed to the TARGET-ALONE contingency showed an 11% relative decrease in sexual arousal to the TARGET. This group difference is interpreted as resulting from both conditioning and habituation.

KEY WORDS: Pavlovian conditioning; phallometry; sexual preferences; sexual arousal.

INTRODUCTION

One important issue in understanding the proximate origins of mating behaviors is how environmental contingencies shape, if at all, the development of sexual interests. It has been proposed that Pavlovian contingencies may be involved in this development (e.g., Laws and Marshall, 1990). Re-

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ports of the likely involvement of Pavlovian conditioning can be found in both the nonhuman and human literatures.

Nonhuman studies of Pavlovian conditioning have been concerned with various aspects of sexual behavior: Conditioning of sexual performance, such as reduction of ejaculatory latency in rats (Cutmore and Zamble, 1988; Zamble *et al.*, 1985a, 1985b, 1986); conditioning of preparatory sexual behavior, such as courtship display in Japanese quail (Domjan *et al.,* 1986; 1988), pigeons (Gilbertson, 1975; Rackham, 1971), and blue gouramis (Hollis *et al.,* 1989); conditioning of hormone circulation such as luteinizing hormone and testosterone in rats (Graham and Desjardin, 1980); and conditioning of ultrasonic vocalizations associated with sex in rats (Nyby *et al.,* 1983). Overall, these studies present convincing evidence that some initially neutral stimuli can become, by means of repeated association with a sexually arousing stimulus (such as a receptive female), learned releasers of sexual behaviors. Nonhuman studies, however, have not examined the modification of sexual *interests*.

Human studies have been particularly concerned with male sexual interest using the penile response as a dependent measure. The evidence that sexual arousal to an unconditional stimulus (US) can be transferred to an initially neutral or nonarousing stimulus (CS) by means of their repeated association without self-manipulation of the penis (i.e., not involving operant conditioning) is equivocal (for a review, see O'Donohue and Plaud, 1994). In studies in which an increase in sexual arousal to a sexual stimulus is reported (e.g., Barlow *et al.,* 1973; Beech *et al.*, 1971; Clément, 1989; De Gagné, 1988; Freund, 1960; Herman *et al.*, 1974a; Rachman, 1966; Rachman and Hodgson, 1968), the methodology employed and the nature of the information reported preclude the conclusion that Pavlovian conditioning was the cause of the increase. The absence of control conditions in some of these studies is particularly problematic, especially because it has been shown that simple exposure to a nonpreferred stimulus can sometimes produce changes in sexual arousal to that and other stimuli of the same category (Herman *et al.*, 1974b). Methodological problems also affect studies that have used a nonsexual CS, such as a green triangle (e.g., Barr and McConaghy, 1971, 1972; McConaghy, 1970, 1974).

Other factors have contributed to the equivocality. First, Pavlovian studies have used CSs that are biologically either relevant, such as a picture of a naked woman, or irrelevant, such as a picture of a green triangle, but no meaningful pattern of results has emerged. In the only study comparing these two types of CS (De Gagné, 1988), only the former produced increases in penile responses following conditioning but, again, control procedures were lacking. Furthermore, De Gagné's findings could not be replicated by Clément (1989).

Second, most of the studies were conducted in clinical settings with informed and motivated participants where the likelihood of voluntary control is high. It is now well known that many participants can voluntarily modify their penile response patterns when instructed to do so (e.g., Lalumière and Earls, 1992; Quinsey and Chaplin, 1988). Voluntary control may result in changes in observed patterns of arousal that may be falsely attributed to conditioning effects.

Finally, and perhaps more importantly, investigators have not taken into account changes in responsivity when measuring penile responses to the CS. Changes in responsivity particularly affects the validity of pre–post comparisons of absolute responses to the CS and individual differences in responsivity affects the validity of between-group comparisons. Fortunately, new developments in the scoring of penile responses (Harris *et al.*, 1992) can help minimize this problem.

We investigated changes in sexual interest following Pavlovian pairings of sexual stimuli using a mixed design. We used scoring methods and a methodology that permitted evaluation of the effects of Pavlovian conditioning independently of changes related to repeated testing and individual differences in responsivity.

Outline

During the experimental phase, 10 participants were exposed to 11 pairings of a slide of a moderately attractive, partially nude female adult (TARGET) and a highly arousing videotape depiction of heterosexual sexual interactions (US), and 10 others were exposed to 11 presentations of the TARGET alone. Sexual interest was measured using relative penile circumference change, viewing time, and ratings of sexual attractiveness both before and after the experimental manipulation.

METHOD

Participants

Twenty heterosexual male participants ages 19 to 26 years ($\overline{X}$ = 21.6, SD = 2.0) were recruited from the Queen's University student community. Participants who were included in the experiment did not report any reasons that might affect overall penile responsivity (e.g., diabetes, recent use of alcohol). Participants received $20 for their participation. Two other participants refused to participate after the procedure was described to them.

Material and Stimuli

The experiment was conducted in a laboratory consisting of two separate rooms. The participant room contained a comfortable easy chair, a Kodak slide projector and a 1-m^2 viewing screen, another slide projector (Eiki, model 840) and a 25-cm^2 viewing screen, and a 30 $\times$ 40 cm television monitor (Quasar). Participants sat 3 m from the screens. The experimenter room contained a computer (Zenith Data Systems 486) and a videocassette recorder (Panasonic, Model AG-5200). Presentation of stimuli and recording of responses was carried out automatically by the computer. Communication between the two rooms was conducted using a two-way intercom.

Penile circumference changes were measured using mercury-in-rubber strain gauges (Parks Electronics Laboratories). Electrical conductance changes in these gauges, corresponding to changes in penile tumescence, were translated into voltage changes using a Parks Plethysmograph (Model 240) and were then registered and compiled by the computer program. Each gauge was calibrated using an aluminum cone (stepped in discrete increments of 1 mm) before each experimental session to insure voltage change linearity (Earls and Jackson, 1981). Skin conductance changes were measured but not recorded.

Participants controlled the rate of presentation and the time of illumination of the slides in Phases 1 and 5 (see below) through the use of a panel equipped with a button and a switch placed on the arm of the chair. Pressing a button advanced the slide, and flipping the switch illuminated the slide. Participants were not aware that viewing time was recorded. Viewing time has been found to relate to stimulus-person physical attractiveness (Landolt *et al.,* 1995) and to sexual gender and age preferences (Harris *et al.*, 1996; Quinsey *et al.,* 1993, 1996).

The stimuli used in this experiment consisted of 20 slides depicting semiclothed female adults, two neutral slides, and videotaped segments of an erotic film. Slides depicting persons presented a view of partially nude women in a variety of nonprovocative poses. The neutral slides depicted flowers and trees. The segments of an erotic heterosexual/lesbian film were used as the US. These segments have been previously used in similar studies and were found to generate a high level of arousal (Clément, 1989; De Gagné, 1988). These segments were edited from a commercially available x-rated film.

Procedure

Participants were tested individually. They were first contacted by phone and the general details of the experiment were explained (i.e., the

type of stimuli and the two physiological measures employed). Only participants who had previously been exposed to erotic material were invited to participate. Upon their arrival at the laboratory, participants were asked to fill out a consent form and a short biographic questionnaire. The general purpose of the experiment ("to investigate the effect of repeated exposure to sexual stimuli") and the functioning of the strain gauge and the skin conductance electrodes were explained. Participants were informed that the experiment consisted of three phases (although there were five), and the stimuli to be presented in each phase were described to them. Participants were then shown to the participant room and were assured of its complete privacy.

The electrodes serving to record skin conductance changes (not analyzed here) were then applied by the researcher. The functioning of the panel that controls slide presentation in Phase 1 was explained. Participants remained alone during each phase of the experiment.

Phase 1: Slide Selection. The researcher left the room and participants were asked to advance the slide-tray on the EIKI projector containing the 20 slides (ordered randomly for each participant). For each slide, participants provided a verbal rating of sexual attractiveness of the stimulus-person on a scale of 0 to 10. One of the slides rated 5 (or another median value) by each participant was selected by the researcher and served as the TARGET stimulus for that participant. Six other slides were selected based on participants' ratings: Two stimulus-persons rated as the least attractive, two stimulus-persons rated as moderately attractive (adjacent to the TARGET), and two stimulus-persons rated as the most attractive. These slides were used as test slides in the pre- and posttest phases (Phases 2 and 4). Viewing time was recorded during this phase.

Phase 2: Pretest. The researcher placed a new slide tray on the EIKI projector containing two copies of the TARGET, two neutral slides, and the six other slides selected in Phase I, and left the room. Participants were then asked via the intercom to fit the strain gauge to their penis. The researcher asked participants to relax and wait for the presentation of the stimuli. The researcher then assessed the baseline for that participant and calibrated the recording device. The 10 slides were presented for 45 sec each. The order of slide presentation was randomized for each participant, except that the two copies of the TARGET were always presented first, and slides of the same categories (other than the TARGET) were never adjacent. Each slide presentation was followed by a return to the baseline. The minimum interstimulus interval was 30 sec. Penile circumference was recorded during this phase.

Phase 3: TARGET-US Group. Ten participants were then exposed to 11 presentations of the TARGET (for 10, 15, 20, 25, or 30 sec) followed

by the US (40 sec). The TARGET was presented on the 1 m^2 viewing screen using the Kodak projector, and the US was presented on the television monitor placed below. The presentation time of the two stimuli overlapped by 5 sec. The TARGET was always presented for 30 sec in Trials 1, 6, and 11, following a return to the baseline. In other trials, the TARGET presentation time varied randomly from 10 to 30 sec and the interatrial interval varied randomly from 30 to 60 sec (average of 45); return to the baseline was not required in these trials.

Phase 3: TARGET-ALONE Group. Ten other participants were exposed to 11 presentations of the TARGET alone. Each participant in this group received a TARGET sequence that matched the sequence for a participant in the conditioning group, except that in Trials 1, 6, and 11 the TARGET was presented after return to the baseline.

Phase 4: Posttest. The 10 test slides were again presented for 45 sec each using the EIKI projector. The order of slide presentation was again randomized for each participant except that the two copies of the TARGET were always presented first. Each slide presentation was followed by a return to the baseline. The minimum interstimulus interval was 30 sec. A 5-mm segment of the video was presented at the end of this phase. Penile circumference changes were recorded during this phase.

Phase 5: Participants' Ratings and Viewing Time. After this, participants were asked to remove the strain gauge. The researcher then entered the room and put in the slide tray containing the 20 original slides on the EIKI projector (randomized again for each participant). Participants were then asked to advance and provide a verbal rating of sexual attractiveness of the 20 stimulus-persons (including the TARGET). During this phase viewing time was recorded.

The whole session took about 2 hr. Afterwards, participants were asked what they thought the experiment was about, whether they knew that viewing time was being recorded (only one reported having discovered it), and what they knew about conditioning. Participants were then debriefed, thanked, and paid.

RESULTS

Data Manipulation

All participants showed penile responses to the sexual stimuli exceeding responses to the neutral stimuli, and all participants but two showed maximal responses (near full or full erection) to the video.

Penile circumference responses were obtained for each slide presentation in Phases 2 and 4 by subtracting the baseline response (prior to the presentation of each slide) from the maximum response during the stimulus presentation plus 30 sec following the stimulus offset. These responses were standardized (to a mean of 50 and a standard deviation of 10) for each participant and for both phases separately. An average response for each of the five stimulus categories (TARGET, neutral, low attractiveness, moderate attractiveness, and high attractiveness) was then calculated for each participant and for both phases separately. These averages were used in the analysis of variance described below.

Viewing time and ratings of sexual attractiveness obtained in Phases 1 and 5 were standardized (also to a mean of 50 and a standard deviation of 10) for each participant and for both phases separately. An average response for each of the four stimulus categories (TARGET, low attractiveness, moderate attractiveness, and high attractiveness) was then calculated for each participant and for both phases.

An index of pre–post change was calculated for each dependent measure to provide an alternative scoring method to investigate the effects of conditioning. This index was calculated by dividing the average posttest standardized response to the TARGET, by the average posttest standardized response to the other sexual test slides, and then by dividing this ratio by the equivalent ratio calculated at pretest:

$$\frac{\dfrac{\text{TARGET}_{\text{POST}}}{(\text{LOW}_{\text{POST}} + \text{MED}_{\text{POST}} + \text{HIGH}_{\text{POST}})/3}}{\dfrac{\text{TARGET}_{\text{PRE}}}{(\text{LOW}_{\text{PRE}} + \text{MED}_{\text{PRE}} + \text{HIGH}_{\text{PRE}})/3}}$$

Because the responses were standardized and slide attractiveness was ordinal and symmetric, absence of change due to conditioning or habituation should, approximately, produce a ratio of 1:1, hence an index of change of 1. This index thus allows us to estimate the average pre–post response change to the TARGET relative to the average pre–post response change to the other sexual stimuli, thereby eliminating the contaminating effects of within-subject changes in responsivity. Because this study is concerned with *relative* change in stimulus saliency, raw responses were not analyzed.

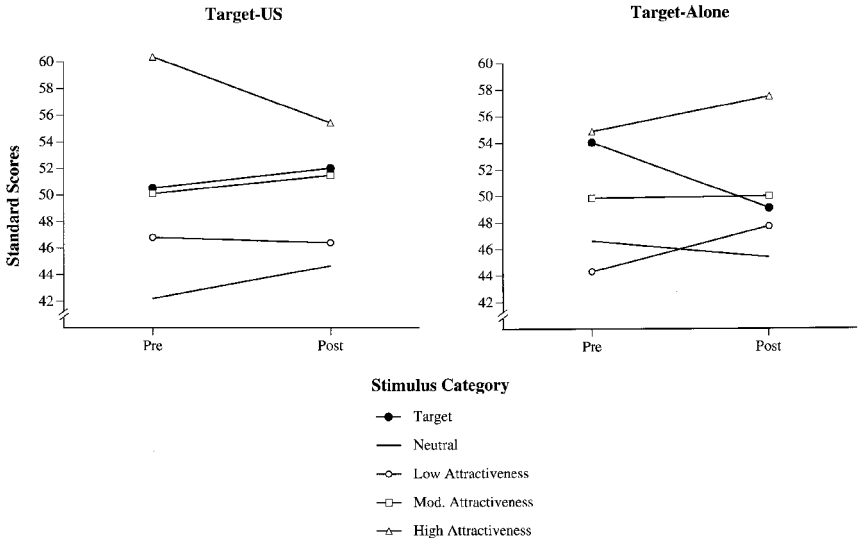

Fig. 1. Mean standardized responses as a function of stimulus category and group membership at pretest and posttest.

Penile Responses

Comparisons of penile responses for the five stimulus categories in Phases 2 (pretest) and 4 (posttest) are presented in Fig. 1. It can be seen that responses to the TARGET increased in the TARGET-US group and decreased in the TARGET-ALONE group. Responses to the highly attractive stimulus category showed the reversed pattern. A 2 (Group) by 2 (Pre–Post Test) by 5 (Stimulus Category) analysis of variance with repeated measures on the latter two factors was conducted. The presence of conditioning effects would be revealed by a three-way interaction.

There was a main effect of Stimulus Category, $F(4, 72) = 23.29$, $p < .001$. Because of the scoring procedure, there was no difference between the two groups and between the pretest and posttest. No significant two-way interactions were detected and the predicted three-way interaction approached significance, $F(4, 72) = 1.78$, $p > .13$. The power to detect the three-way interaction was .52 and the effect size (partial eta^2) was .09.

The average index of change (in percentage) for the TARGET-US group was +9.8% (95% confidence limits of −9.78 to 29.46%) and −10.9% (−22.85 to 1.14%) for the TARGET-ALONE group. The mean difference was significant, $t(18) = 1.76$, $p < 0.05$, one-tailed.

Ratings of Attractiveness

This analysis compares ratings of attractiveness collected in Phases 1 and 5. The average pre–post test correlation (within-subject, Pearson *r*) for the TARGET-US group was .58 and .66 for the TARGET-ALONE group. The index of change for the TARGET-US group was −12.89% and −9.15% for the TARGET-ALONE group. The difference was not significant.

Viewing Time

This analysis compares viewing times collected in Phases 1 and 5. The average pre–post test correlation (within-subject) was .13 for both groups. The index of change for the TARGET-US group was 13.63% and 11.17% for the TARGET-ALONE group. The difference was not significant. A correlation between viewing time and ratings of attractiveness was calculated for each participant and for each phase separately; the average correlation for all participants varied from .20 (pretest, TARGET-ALONE group) to .31 (posttest, TARGET-US group).

DISCUSSION

Participants ' penile responses were affected by stimulus category: Stimuli rated as more attractive produced larger responses than stimuli rated as less attractive. Hence, the principal dependent measure used in this experiment was reliably related to participants' ratings of stimulus attractiveness.

Participants exposed to the TARGET-US contingency showed an increase in penile responses to the TARGET stimulus relative to their responses to the other test stimuli, whereas participants exposed to the TARGET-ALONE contingency showed the reverse pattern. This effect was significant using the index of change and approached significance using the analysis of variance. The group difference on the index of change, interestingly, was symmetrical about zero. Ratings of attractiveness and viewing time did not seem to be differentially affected by the experimental manipulation.

Most of the difference between the two groups seems to be due to a change in response to the TARGET and to the slide category representing the most attractive stimulus-persons. The eliciting power of the most attractive stimuli decreased from pretest to posttest under the TARGET-US contingency while it increased under the TARGET-ALONE contingency.

One interpretation of this finding is that the TARGET-US contingency produced inhibition to stimuli that were not associated with the US. It is not clear why this inhibition would particularly affect the most attractive stimuli. In contrast, the TARGET-ALONE contingency produced inhibition only to the stimulus that was presented repeatedly. This inhibition may have been the result of habituation.

There is a small but consistent literature on the habituation of the penile response. In general, participants who have been repeatedly exposed to the same stimuli tend to show smaller penile responses over time (Freund *et al.,* 1974; O'Donohue and Geer, 1985; O'Donohue and Plaud, 1991). In contrast, participants who have been repeatedly exposed to variations within a stimulus category tend not to show such habituation (Julien and Over, 1984; O'Donohue and Geer, 1985, Rosen, 1973), and sometimes show increased arousal.

The findings on habituation are consistent with the Coolidge effect in which male sexual interest is maintained by stimulus variety. The Coolidge effect has been interpreted in the context of sex differences in biological requirements in minimal parental investment and associated sex differences in reproductive life histories (e.g., Daly and Wilson, 1983; Trivers, 1985). The relevance of the Coolidge effect to the ontogenetic development of sexual interests has not been fully explored however. Quinsey *et al.* (1993) hypothesized that the development of sexual preferences may involve the gradual elimination of some categories of persons and activities. The nonhuman literature certainly supports this idea in the case of males (e.g., Daly and Wilson, 1983).

CONCLUSION

The group difference obtained in this study is due to a relative increase in arousal to the TARGET stimulus when paired with an arousing sexual stimulus, and a relative decrease in arousal to the TARGET when presented alone. This translates to a 21% difference in relative arousal, a nonnegligible effect. If our interpretation of the findings is correct, any attempts to increase sexual interest using Pavlovian conditioning will be hindered by the well-documented male tendency to habituate to stimuli presented repeatedly.

We believe that researchers should continue to examine the possibility that conditioning and habituation effects are involved in the development of sexual interests. This research is badly needed to inform treatment of pedophilic and sadistic sexual interests. The research on Pavlovian conditioning remains sparse and a large number of factors have not been inves-

tigated. For instance, the effect of conditioning may be stronger around the time of puberty (cf. Storms, 1981). New assessment techniques, such as viewing time, could be used to study the development of sexual interest in young people. Also, new theoretical advances in understanding of the (phylogenetic) design of the sexual preferences system (cf. Quinsey and Lalumiere, 1995) may help in designing more productive ontogenetic (developmental) models.

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