FINGER TEMPERATURE CHANGES IN MALES AND FEMALES IN RESPONSE TO VISUAL EROTIC STIMULATION

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Abstract

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Three groups of 10 male and 10 female students were shown 3½ minute-long neutral and sexually arousing films while their finger temperature was being recorded. Film segments pretested for their erotic value and rated equally arousing by males and females were assembled to produce two films varying in degree of eroticism. All subjects rated the films on two bipolar scales, unpleasant to pleasant, and not sexually arousing to highly sexually arousing. Results of the experiment provided evidence for a relationship between finger temperature and subjectively rated sexual arousal. The mean finger temperature of male and female subjects was significantly lower in response to both the highly and mildly erotic films than to a neutral film. The mean finger temperature of subjects led to believe that they would see an erotic film but who were actually shown a neutral film did not differ from their mean finger temperature in response to a neutral film. Analysis of the pattern of finger temperature change during film presentations revealed that finger temperature discriminated between the films in a manner consistent with their rated erotic value. Finger temperature of subjects viewing the highly erotic film decreased significantly as the film progressed, while that

of subjects viewing the erotic suggestion neutral film increased significantly from the beginning to the end of the film. Analysis of the subjective ratings suggested that subjects viewing the erotic films were experiencing sexual arousal that was not confounded with any negative emotional response.

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In a pioneering investigation more than 23 years ago, Kinsey and his associates (Kinsey, Pomeroy, Martin and Gebhard, 1953) collected a large fund of data concerning sex differences in response to psychosexual stimulation. They reported that sexual arousal in response to explicitly sexual stimuli was much rarer among women than among men. However, the procedures used by Kinsey et al. (1953) are inadequate in several respects. The data were collected in interview situations, increasing the likelihood that men and women would respond in accordance with the prevailing sexual stereotypes. The sexual stimuli being investigated could neither be defined precisely nor manipulated experimentally. Also, there is the possibility that the results reflected sex differences in the degree and type of experience with pictorial or narrative stimuli rather than sex differences in psychosexual arousability. In an effort to eliminate these problems, later investigators have exposed men and women to erotic visual and narrative stimuli and recorded their immediate and delayed responses to the stimuli with the use of verbal self-report and/or physiological measures. However, the use of these techniques involves additional difficulties which must be considered in studying the effects of erotic material. Five major problems can be distinguished which make research in this area difficult. These include measurement techniques of sexual arousal, specification of erotic stimuli, sex differences in preferred erotic stimuli, assessment of attitudinal effects of exposure to erotic material, and influences of non-sexual stimuli.

Measurement of sexual arousal

The most frequently used measures of sexual arousal are self-report verbal scales of varying length and design (e.g. Brady & Levitt, 1965; Gaughn & Gaynor, 1973; Sigusch, Schmidt, Reinfeld & Weidemann-Sutor, 1970). The validity of subjective ratings of sexual arousal are open to question however, because of their susceptibility to distortion by subjects. For example, subjective ratings of slides depicting sexual behaviors have been found to vary according to the social context in which the ratings are obtained (Amoroso & Brown, 1973; Amoroso, Brown, Pruesse, Ware & Pilky, 1972; Chapman, Chapman & Brelje, 1969). It has been suggested that subjective ratings concerning response to erotic stimuli can be a useful measure if they are sought in as unobtrusive a manner as possible (Amoroso & Brown, 1973), and are used in conjunction with other physiological measures (Mann, 1971).

Physiological measures of sexual arousal offer the obvious advantages of objectivity and continuous response tracking. Mann (1971) and Zuckerman (1971) reviewed studies employing physiological assessment as a means of establishing magnitude or direction of erotic interest in men and women. They reported that indirect measures such as galvanic skin response, pupillary dilation, blood volume and pressure, heart rate, respiratory rate, biochemical response, and evoked cortical response have tended to produce somewhat inconclusive results as indices of sexual arousal, and have had difficulty differentiating sexual arousal from other kinds of arousal. Penile erection

measures (e.g. Bancroft, Jones, & Pullan, 1966; Freund, 1963; Freund, Sedlacek & Knob, 1965; McConaghy, 1967) have proven to be the most sensitive indices of sexual arousal in the male. The most promising measure of female sexual arousal appears to be a device recording vaginal blood flow mounted on a diaphram ring (Geer, Morokoff & Greenwood, 1974; Heiman, 1975; Shapiro, Cohen, Dibanco & Rosen, 1968). Recording from the genitals, however, can create certain kinds of problems, e.g. sexual excitement or anxiety resulting simply from attaching the device. In addition, the penile plethysmograph is subject to distortions through movement artifacts (Lader, 1967), adaptation effects (Cairns, 1968), and voluntary control (Cairns, 1968; Laws & Rubin, 1969). Finally, because of the intrusiveness of the penile and vaginal photoplethysmograph devices, three important problems emerge. First, it is possible that subjects who would agree to use the apparatus are atypical in some respect (e.g. very liberal), thereby creating biases in the subject sample. Secondly, insertion or attachment of such devices would very likely contribute to making the experimental situation somewhat artificial and contrived (Amoroso & Brown, 1973). Finally, the direct genital measures would probably cause undue discomfort in a clinical population already experiencing anxiety concerning their sexual response. For these reasons it would appear desirable to find a less obtrusive measure of sexual arousal in men and women.

A simple physiological measure, finger temperature, has recently been employed as an index of sexual arousal. Finger tempera-

ture has the advantage of being a fairly unobtrusive measure which can be recorded continuously and identically in both males and females. It is not entirely surprising if skin temperature were related to sexual arousal. Masters and Johnson (1966) have reported that an increased flow of blood to the genitals is an integral part of the sexual response. In fact, the penile plethysmograph and vaginal photoplethysmograph (e.g. Heiman, 1975) rely on vasocongestion of the genitals which occurs with sexual arousal. The vascular engorgement of the genitals would require the diversion of blood from other parts of the body and if, as part of this alteration of blood flow, there occurred a vasoconstriction at the periphery, then a drop in skin temperature might be detected from tissues surrounding the genitals or in more peripheral areas such as the finger. Two of three studies employing this index found a significant decrease in finger temperature in response to the reading of erotic material and viewing an erotic film (Wenger, Averill & Smith, 1968; Corman, 1968). Wenger, Averill and Smith (1968) recorded autonomic activity from 16 male subjects as they read innocuous and sexually stimulating narrative material presented on slides. Finger temperature, recorded during the last 10 seconds of the presentation of three erotic and three control slides, decreased significantly in response to the erotic passages. Wenger et al. (1968) however, felt that the decrease reflected sexual arousal confounded by general activation. They pointed to a nonsignificant increase in finger temperature, occurring approximately 3 to 5 minutes after the onset of the stimulus material, as more indicative of pure sexual

arousal. Corman (1968) exposed 10 married male subjects to 50 neutral slides, 15 slides from Playboy centerfolds, and a 5 minute erotic motion picture. Finger temperature was recorded for five 30-second intervals during the film. Comparison with the control and Playboy slides showed a significant decrease in finger temperature to the erotic movie, and unlike the data of Wenger et al. (1968), there was no evidence of any increase in temperature during the last minutes of the movie. Recordings taken for 30 seconds approximately 16 minutes after the conclusion of the erotic movie revealed a slight increase in temperature, although it was still significantly lower than during presentation of the control and Playboy slides. In contrast to the experiments cited above, a study by Romano (1969) did not yield any significant differences in finger temperature in response to the viewing of control slides, a five minute erotic film (used in Corman, 1968), and an unpleasant film about concentration camps. It is impossible to evaluate this experiment, however, as no description was provided concerning the timing and duration of finger temperature recordings.

Specification of erotic stimuli

One critical aspect of experimental studies of sexual arousal is the specification of sexually arousing stimuli. It is obviously essential to assess to what degree stimuli used in experiments on sexual arousal are, in fact, sexually arousing. However, researchers have usually selected stimuli on the basis of intuitive judgements about their erotic value (Mann, 1971; Zukerman, 1971). One fairly extreme example of this can be seen in an experiment by Fisher and

Osofsky (1968). The stimulus situation designed to evaluate sexual responsiveness in women was a standard gynecological examination! It is possible, though by no means probable that the examinations produced sexual arousal, but no attempt was made to obtain self-ratings of the subjects' state of arousal while they were being examined. In another study, pictures of "ventral-ventral" coitus were rated by males as more arousing than nudes or portrayals of other forms of sexual contact (Brady & Levitt, 1965). These pictures were used in many subsequent experiments on sexual arousal (e.g. Byrne & Lamberth, 1971). Eight years later Gaughn and Gaynor (1973) replicated this study with males and females and obtained similar results. However, their most interesting findings were that most subjects did not rate the stimuli as very sexually arousing. This change may reflect habituation of the later sample to visual sexual stimuli as a result of the trend towards explicit portrayal of nudity and erotic activities in the media. More explicit and realistic stimuli, such as motion pictures of sexual behavior, may be required to elicit scalable responses. Erotic movies have produced considerably more sexual arousal in male subjects than either Playboy nudes (Corman, 1968), or slides depicting sexual activities (Sanford, 1974). Comparable studies using female subjects are not available.

Sex differences in preferred erotic stimuli

Early research on the effects of erotic visual stimuli typically employed male subjects (Byrne & Lamberth, 1971). However, investigations of sex differences in response to different kinds of

psychosexual stimulation have recently emerged (Byrne & Lamberth, 1971; Heiman, 1975; Jacobovitz, 1965; Schmidt & Sigusch, 1970; Schmidt & Sigusch, 1973; Sigusch, 1970; Sigusch et al., 1970). Although Kinsey et al. (1953) found that men indicated much greater interest in erotica and reported a greater degree of sexual arousal in response to such material than women, recent experimental investigations present contradictory evidence. The pattern appears to be that both men and women are equally capable of sexual arousal in response to some erotic material, but that sex differences in arousal may occur in relation to erotic themes or the modality of presentation. However, with few exceptions (e.g. Heiman, 1975), the studies investigating sex differences in response to psychosexual stimulation relied exclusively on retrospective verbal reports of sexual arousal. Since this approach involves pitfalls outlined earlier, the results of these experiments must be interpreted with caution. The use of physiological measures in conjunction with self-report data would appear to solve these problems. However, most investigations of physiological measures of sexual arousal have used only male subjects. In studies that include both sexes (Hess & Polt, 1960; Koegler & Kline, 1965; Levi, 1967; Speisman, Lazarus, Davison & Mordkoff, 1964), no attempts were made to take into account possible sex differences in arousal to the erotic stimuli. Since no external validation of the erotic stimuli as sexually arousing for both sexes was provided, the physiological evidence of sexual arousal from such experiments is difficult to interpret. Sex differences in physiological response patterns could reflect either sex

differences in psychosexual arousability or differences in the erotic value of the stimuli for males and females. Investigations of physiological correlates of sexual arousal in men and women must include controls for possible sex differences in preferred erotic stimuli.

Attitudinal differences during sexual arousal

An important aspect of subjects' responses to sexually arousing stimuli involves differences in attitudes about erotic material. Schmidt and Sigusch (1970) found that men and women tended to judge very sexually stimulating material (films) as unpleasant. Wallace and Wehmer (1972) assessed the sexual attitudes of a large group of male and female Detroit residents. Judges classified the subjects as sexual liberals or sexual conservatives. When the subjects were exposed to 60 slides showing various sexual themes, several differences between the two groups were found. Compared to the sexual liberal, the conservatives found the pictures to be more offensive, more arousing, less entertaining and less acceptable. For the liberals, the most arousing pictures were the most entertaining. For the conservatives, the most arousing pictures were also the most offensive. Unless attempts are made to assess these different correlates of sexual arousal by means of subjective measures, it would be difficult to determine the role of competing emotional responses such as anger, disgust, or anxiety on the physiological response to erotic stimuli.

Additional confounding variables in research on sexual arousal

Zuckerman (1971) has pointed out that the effect of the general experimental situation on subjects' sexual arousal has not

been considered in most experiments. The influences of uncontrolled stimuli could operate either by directly altering the subject's state of sexual arousal or by influencing the subject's self reports. The experiments that considered set factors (Barclay, 1970; Chapman et al. 1969; Martin, 1964), have found that even physiological responses such as GSR, pupil dilation, and urinary acid phosphatase secretion, may be influenced by sets induced by instructions, or the characteristics and behavior of the experimenter. For example, Barclay and his colleagues (Barclay, 1970; Barclay & Little, 1972) have provided evidence that an increase in the level of urinary acid phosphatase is associated with sexual arousal in male subjects. When Barclay (1970) informed some subjects about the purpose of the study, there was actually greater increase in acid phosphatase in the urine of waiting subjects than in that of the aroused subjects. Verbal self-report measures are also influenced by the demand characteristics of experimental situations. For example, Amoroso et al. (1972) found that subjects rated slides depicting sexual activity as more pornographic when physiological recordings were being taken than when no recordings were made.

Finger temperature as a measure of sexual arousal

The present experiment was designed to answer two basic questions. First, is experimentally induced sexual arousal in males and females accompanied by a decrease in finger temperature? All subjects in the previous studies using finger temperature as a measure of sexual arousal were males. There are no studies on finger temperature changes in women in response to psychosexual stimulation. And

secondly, do changes in finger temperature during sexual arousal bear any relation to the intensity of the arousal as rated by the subjects? The visual stimuli were pretested on males and females comparable to the subject sample in order to obtain independent ratings of the erotic value of the stimuli. Material judged equally arousing by both sexes served as the erotic stimuli in this experiment. This was done to decrease the variability due to possible sex differences in arousal to the erotic stimuli, thus permitting a more unambiguous interpretation of subsequent finger temperature changes in males and females. Three groups of males and females viewed neutral, mildly erotic, or highly erotic films. A control group was included to assess the effects of expectations of viewing erotic films. Finger temperature was recorded continuously for each subject prior to and during presentation of the films. There are no studies investigating the effects of sex of the experimenter on subjects' erotic responsiveness to sexual stimuli. In this study male subjects were run by a male experimenter, and females by a female experimenter. All subjects were asked to complete scales indicating their degree of sexual arousal to the films, and how pleasant or unpleasant they found them. The second scale was included to check for the presence of any negative emotional responses to the films, and to aid in evaluating possible inhibiting and/or disruptive effects of these emotions on the subjects' finger temperature responses to the erotic films. It was hypothesized that the finger temperature of the subjects would be significantly lower during the viewing of the highly erotic film than the neutral

film. A slight decrease in finger temperature to the mildly erotic film was also expected.

Method

Subjects

Sixty male and female students at Concordia University were used as subjects. All subjects were between the ages of 18 and 26. Ten males and 10 females were randomly assigned to each of three groups.

Apparatus

A one hour-long Scotch videotape, a Sony videotape recorder, and an Electrohome monitor were used to present the stimuli. Finger temperature was recorded from a thermistor attached to the subject's index finger and was monitored continuously by means of a Yellow Springs Telethermometer and a two-channel pen recorder. Room temperature was measured periodically using the same equipment and a thermistor suspended from the ceiling.

Stimuli

Forty-five videotaped segments of film depicting nude or partly clad men and women involved in various forms of explicit sexual behavior were rated by 106 male and 46 female students on a five-point ascending scale of sexual arousal. Eleven film segments, found to be the most sexually arousing by both the males and females were retransposed to another videotape in random order. Each segment varied in length from 10 to 20 seconds. There was a two-second interval between each segment and the total length of the film was 3½ minutes. The

mean rating by 106 males of the selected segments was 2.64 and for 46 females, 2.61. This film served as the highly erotic stimulus.

Two of the film segments rated least sexually arousing by the students were also retransposed to the second videotape. The mean rating of the two segments by males was 1.50 and by females, 1.40. Each segment was about 10 to 12 seconds in length and there was a two-second interval between each segment. The two segments were repeatedly presented for a total of 3½ minutes. This film was the mildly erotic stimulus.

Two 3½ minute films, consisting of a small black square moving at random on a blank screen, were also transposed to the videotape.

Students rated their responses to the films on 15 centimeter lines indicating continua of not sexually arousing to highly sexually arousing, and unpleasant to pleasant.

Procedure

Each subject was seated in a comfortable chair in a slightly darkened room which contained a television monitor on a table 5 feet in front of the chair. A thermistor was suspended from the ceiling permitting the sampling of room temperature which was conducted for three one-minute periods distributed during the experiment. Males were seen by a male experimenter and females by a female experimenter. (For convenience only the female pronoun will be employed). The experimenter explained that she was interested in the subject's reactions to several films. She also mentioned that certain body changes

occurring while the subject watched the films were also of experimental interest. A small electrode was then attached to the tip of the index finger of the subject's right hand, and the subject was reassured that no shock or painful procedures would be used. All subjects were told that there would be an initial period during which the equipment would be adjusted and they were simply to relax. The experimenter left the room and baseline recordings of finger temperature were taken for 10 to 15 minutes.

After the baseline recording of finger temperature was completed the experimenter returned and told the subject that the first film would last for 3½ minutes and would consist of a small black square moving at random on the screen. The experimenter then left the room and the film was shown. At the conclusion of the film the experimenter re-entered the room and asked the subject to rate his sexual arousal to the film, and how pleasant or unpleasant he found it. The subsequent experimental procedure differed according to the condition to which the subjects were assigned (highly erotic, mildly erotic; erotic suggestion neutral).

Subjects in the highly erotic group (10 males and 10 females), were told that the second film would depict men and women engaged in various forms of explicit sexual behavior. They were also informed that the experimental procedure required that they complete another set of ratings concerning the film. Subjects were given the option to discontinue at this point if they desired (only two female subjects withdrew). The experimenter then left the room and the 3½ minute

highly erotic film was shown. Subjects were then asked to complete the rating scales and the purpose of the experiment was discussed.

The procedure was identical for the mildly erotic group except that the second film shown consisted of repetitions of the two film segments previously rated as not very sexually arousing.

After rating the first film (small black square moving on the screen) the erotic suggestion neutral group was told that they would see another 3½ minute film similar to the one they had just seen, but with an important difference. They were told that if they carefully followed the movements of the square on the screen they would see a pattern resembling men and women engaged in various forms of explicit sexual behavior. They were then shown another film which consisted of a black square moving randomly on a blank screen.

Overview of experimental design

Subjects were assigned to one of three groups and were run individually. A thermistor was attached to the subject's index finger and finger temperature was recorded continuously throughout the experiment. Baseline recordings were taken for 10 to 15 minutes and then all subjects were exposed to two 3½ minute films. The highly erotic group first viewed a neutral film (a black square moving on a blank screen). Next, they were informed that they were to see a film which depicted men and women engaged in various forms of explicit sexual behavior. Then they were shown the highly erotic film. The mildly erotic group viewed the same neutral film, received the same instructions, and were then exposed to the mildly erotic film.

Finally, the erotic suggestion neutral group was shown the same neutral film, were then informed that the second film would be a simulation of explicit sexual behavior, and were then shown another neutral film. It was hypothesized that this last condition would produce little, if any, sexual arousal, and would permit an assessment of the effect of instructions on the finger temperature response and self-report ratings of sexual arousal.

Results

The initial analysis of the data evaluated the overall effects of group (highly erotic, mildly erotic, erotic suggestion neutral), the subject's sex, and the treatment conditions (baseline, neutral film, treatment films) on finger temperature. Finger temperature was sampled every 3 seconds and a mean temperature was calculated for each subject under each condition. Table 1 presents the results of a three-factor, 3 x 2 x 3 mixed design analysis of variance (Bruning & Kintz, 1968) computed on these data. There was no significant main effect due to sex of the subjects, indicating no difference between males and females in the finger temperature response to the neutral and erotic films. Also, neither the third order Group x Sex x Condition interaction nor the Sex x Condition interaction were significant. There was, however, an unexpected Group x Sex interaction which proved to be significant, F (2, 54) = 3.91, $p < .05$. The mean finger temperatures for both sexes within each group are presented in Figure 1. In both the highly erotic and erotic suggestion neutral groups males had higher finger temperatures than females across all

Table 1

Analysis of variance: Finger temperature during baseline and two film conditions for the highly erotic, mildly erotic and erotic suggestion neutral groups

Source	SS	df	ms	F	p
Groups (G)	71.157	2	35.58	0.90	-
Sex (S)	1.115	1	1.12	0.28	-
G x S	308.164	2	154.08	3.91	<.05
$Error_b$	2125.81	54	39.37	-	-
Conditions (C)	63.564	2	31.78	38.93	<.001
G x C	11.373	4	2.84	3.48	<.01
S x C	0.478	2	0.24	0.29	-
G x S x C	0.293	4	0.73	0.90	-
$Error_w$	88.175	108	0.82	-	-

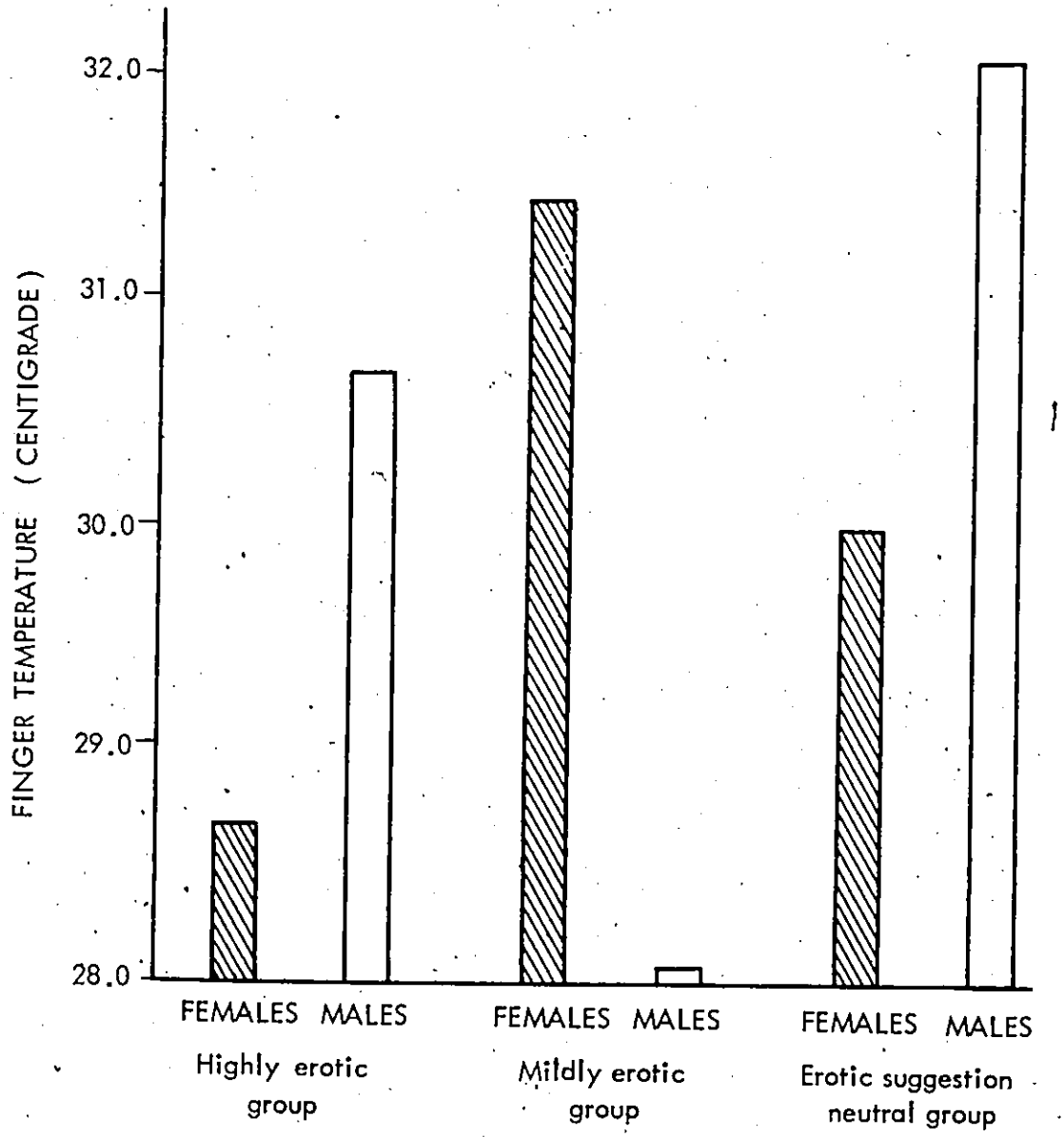

Fig. 1. Mean finger temperature (across baseline, neutral film and treatment film condition) of males and females in the three experimental groups.

conditions (baseline, neutral film, treatment films). However, this pattern was reversed for the mildly erotic group with the males showing a much lower finger temperature than the females. An inspection of the data from individual subjects revealed that in all groups there were subjects with initial finger temperatures that were extremely low, i.e. below 25°C. Although there were an equal number of male and female "low temperature subjects" in the highly erotic and erotic suggestion neutral groups (two and one respectively), there were no such subjects among the females in the mildly erotic group and four of these subjects among the males. Thus, it appears that an inordinately large number of "low temperature subjects" appeared among the males in the mildly erotic group, resulting in an unusually low mean finger temperature for this group.

Table 1 also shows a significant main effect of condition F (2, 108) = 38.93, $p < .001$), and a significant Group x Condition interaction, F (4, 108) = 3.48, $p < .01$. There was however, no main effect of groups. The mean finger temperature for each group under each condition is presented in Figure 2. The interaction between group and condition is clearly seen in this figure. While all groups show progressively lower finger temperatures under succeeding conditions the decrease is greater in the two erotic film groups. A series of pairwise comparisons (Newman-Keuls test procedure (two-tailed), Mendenhall & Ramey, 1973) revealed that there was no significant difference in mean finger temperature between the neutral film and baseline condition in all three groups. However, the mean

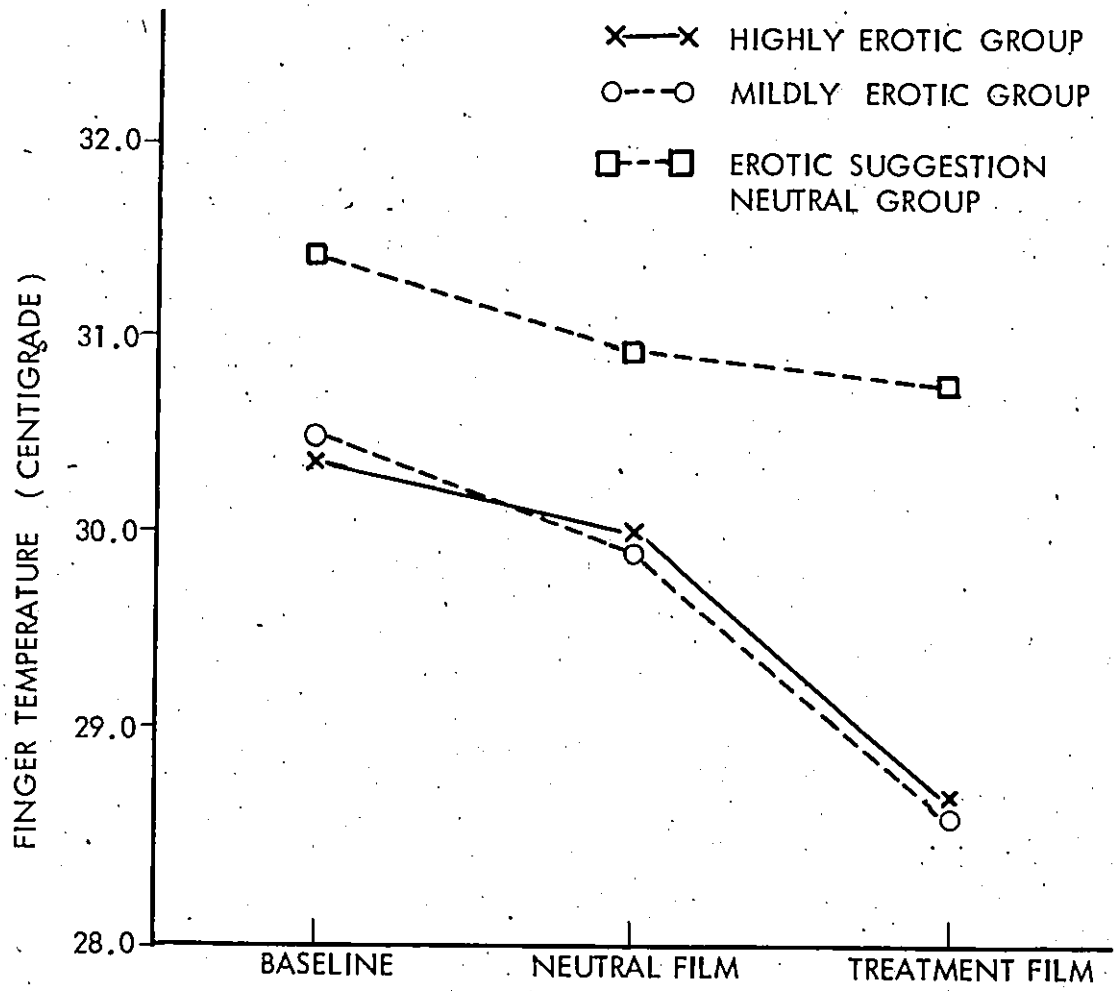

Fig. 2. A comparison of the highly erotic group, the mildly erotic group, and the erotic suggestion neutral group with respect to mean finger temperature response during baseline, neutral film, and treatment films.

finger temperature in both the highly erotic and mildly erotic groups was significantly lower during the treatment films than during the neutral film, $p < .05$. In the erotic suggestion neutral group, on the other hand, the mean finger temperatures during the neutral and treatment films did not differ significantly.

Although the overall group effect was not significant, inspection of Figure 2 reveals a rather large difference between the erotic suggestion neutral group and the highly and mildly erotic groups in each condition. In fact, Newman-Keuls comparisons showed that these differences were significant, $p < .05$. There is no obvious explanation for the higher finger temperature of the erotic suggestion neutral group. In an attempt to evaluate the possible effects of baseline differences between groups on the observed finger temperature changes in the neutral and treatment conditions, two statistical procedures were employed. First, a two-way, 3 x 2 analysis of covariance was computed to assess the effects of group and subject's sex on finger temperature during the neutral film. Subjects' scores during baseline served as the covariate. There were no significant main effects or second order interactions. When a similar analysis was computed for the treatment film, there were no significant effects due to sex of the subject, nor was the Group x Sex interaction significant. However, there was a significant group effect (F (2, 53) = 4.50, $p < .02$), indicating that the finger temperature of the erotic suggestion neutral group was higher than that of the two erotic groups during the treatment films. An additional attempt was made to deal

with the baseline differences in finger temperature between groups. Finger temperature changes during the neutral and treatment films were analyzed for subjects matched on mean finger temperature during baseline (resulting in an N of 30). Once again, although the finger temperature in all three groups tended to decrease from neutral to treatment condition, the decrease was greater for the two erotic groups. Pairwise comparisons of the mean finger temperatures for the three groups under the neutral and treatment conditions were computed, using the Wilcoxin's Matched-Pairs Signed-Ranks test (Downey & Heath, 1965). The results revealed that the groups did not differ significantly from each other with respect to mean finger temperature during the neutral film. Also, during the treatment condition, the mean finger temperature for the highly erotic and mildly erotic groups did not differ significantly. However, the mean finger temperatures for both the highly erotic and mildly erotic groups were significantly lower than that of the erotic suggestion neutral group during the treatment condition, $p < .05$. Therefore, when initial baseline differences were taken into account with the use of analysis of covariance, or eliminated with a matching procedure, the results substantiated those of the initial analysis of variance.

The analysis of the data to this point suggest that finger temperature is influenced by the viewing of erotic material. This can be seen even more clearly by examining the temporal pattern of finger temperature change during the viewing of the neutral and treatment films. A mean finger temperature was calculated for five time blocks

within the films, each block comprising 14 consecutive samples of finger temperature taken at 3-second intervals. The mean finger temperature for each block during the neutral and treatment films for all three groups is presented in Figure 3. A two-way, 3 x 5 mixed design analysis of variance, with repeated measures on one factor (Bruning & Kintz, 1968) was performed on the five blocks of the neutral film. The results of this analysis are presented in Table 2. Neither the Group x Block interaction nor the main effect due to groups was significant. The block effect approached significance however, indicating a tendency for the finger temperature of subjects in all groups to decrease as the neutral film progressed. The results of a similar analysis, carried out on the treatment films, are presented in Table 3.[1] There were no significant main effects due to groups or time blocks. A significant Group x Block interaction (F (8, 228) = 11.89, $p < .001$) suggested that subjects reacted differently to the neutral and erotic films during the treatment condition. Comparisons of subjects' finger temperature during the first time block with finger temperature during the last time block of each film revealed the following. The mean finger temperature for the highly erotic group was significantly lower during the last time block than during the first time block, $p < .05$. There was no significant difference in finger temperature at these particular time segments within the mildly erotic group. Subjects in the erotic suggestion neutral group showed a significantly higher finger temperature in the last time segment than in the first segment of the film, $p < .05$. In addition, the highly erotic and mildly erotic groups were compared with respect to the mean finger temperature during

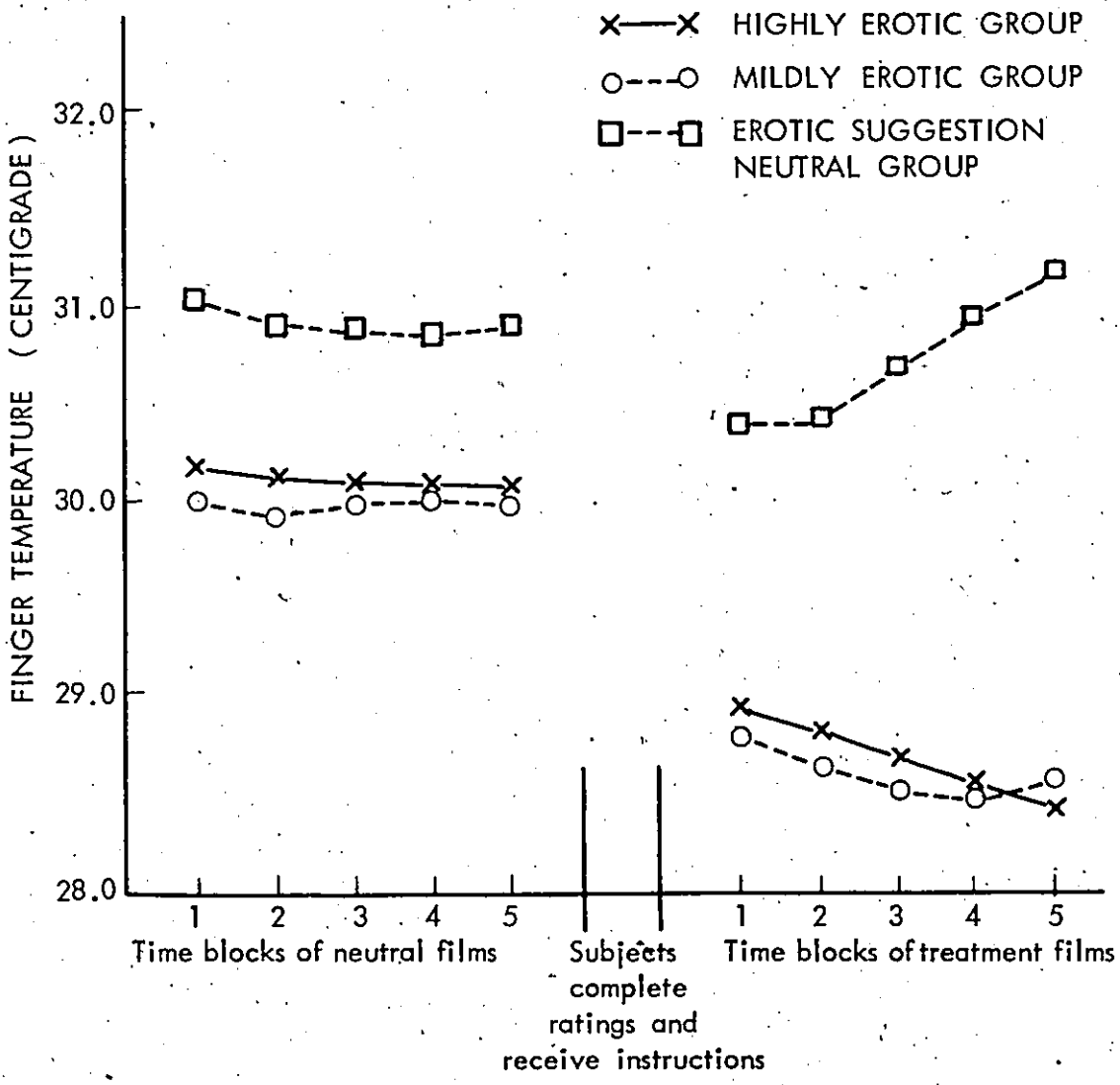

Fig. 3. Mean finger temperature of experimental groups for five consecutive time blocks of the neutral and treatment films.

Table 2

Analysis of variance: Finger temperature during five time blocks of the neutral film

Source	SS	df	ms	F	p
Groups (G)	57.685	2	28.84	0.38	-
$Error_b$	4339.99	57	76.14	-	-
Blocks (B)	0.778	4	0.19	2.39	-
G x B	0.354	8	0.44	0.55	-
$Error_w$	18.514	228	0.81	-	-

Table 3

Analysis of variance: Finger temperature during five time blocks of the highly erotic, mildly erotic, and erotic suggestion neutral films

Source	SS	df	ms	F	p
Groups (G)	288.912	2	144.46	2.19	-
$Error_b$	3764.07	57	66.04	-	-
Blocks (B)	0.509	4	0.13	0.96	-
G x B	12.582	8	1.57	11.89	<.001
$Error_b$	30.151	228	0.13	-	-

the first time segment of the treatment film. There was no significant difference between the two groups for this time segment. The analysis of temperature change under the treatment film condition presents the following pattern. Beginning at equivalent levels, the finger temperature of subjects viewing a highly erotic film decreased significantly over 3½ minutes, while the temperature of subjects viewing a mildly erotic film did not. By contrast, finger temperature of subjects viewing the erotic suggestion neutral film increased significantly from the beginning to the end of the film.

After viewing each film all subjects were asked to rate them on two bipolar rating scales, unpleasant to pleasant and not sexually arousing to highly sexually arousing. A three-way, 3 x 2 x 2 mixed analysis of variance was computed to assess the effects of group, the subject's sex, and the film (neutral film vs. treatment films) on the subjective ratings. The results of the analysis on the pleasantness ratings are presented in Table 4. Neither the sex of the subject nor the subject's group had any significant effect on the pleasantness ratings. Also, there were no significant second or third order interactions. However, the analysis revealed a significant film effect, indicating that the subjects rated the treatment films significantly more pleasant than the neutral film, F (1, 54) = 8.26, $p < .01$. The mean pleasantness ratings of the neutral and treatment films for the three groups are presented in Table 5. Several pairwise comparisons, using the method of Newman-Keuls, were computed. As expected the groups did not differ from each other in their pleasantness ratings of the neutral film. In addition, there were no significant dif-

Table 4

Analysis of variance: Pleasantness ratings for experimental groups of neutral, and treatment films

Source	SS	df	ms	F	p
Groups (G)	30.815	2	15.41	1.20	-
Sex (S)	15.265	1	15.26	1.19	-
G x S	32.398	2	16.20	1.26	-
$Error_b$	694.896	54	12.87	-	-
Films (F)	68.101	1	68.10	8.26	<.01
G x F	29.630	2	14.82	1.80	-
S x F	3.201	1	3.20	0.39	-
G x S x F	0.921	2	0.46	0.56	-
$Error_w$	455.06	54	8.25	-	-

Table 5

Mean pleasantness ratings for neutral and treatment films

Group	Neutral film	Treatment film
Highly erotic group	5.92	8.75
Mildly erotic group	5.91	7.16
Erotic suggestion neutral group	5.89	6.33

Note. Film ratings may range from 0 (unpleasant) to 15 (pleasant).

ferences in the pleasantness ratings between the highly erotic and mildly erotic films, and the mildly erotic and erotic suggestion neutral films. However, the highly erotic film was rated significantly more pleasant than the erotic suggestion neutral film, $p < .05$. When the pleasantness ratings of the neutral and treatment films were compared within all three groups, only the group viewing the highly erotic treatment film rated it significantly more pleasant than the neutral film, $p < .05$. Subjects in the mildly erotic and erotic suggestion neutral groups did not rate the treatment film significantly different from the neutral film.

Table 6 presents the results of the analysis on the ratings of sexual arousal. Again, there was no significant main effect due to the subject's sex. The Group x Sex, Sex x Film, and Group x Sex x Film interactions were all nonsignificant. Significant differences in the subjects' ratings of sexual arousal occurred as a function of group (F (2, 54) = 7.75, $p < .01$), and the film shown, F (1, 54) = 141.72, $p < .001$. Several comparisons were computed with the method of Newman-Keuls to further examine a significant Group x Film interaction, F (2, 54) = 27.12, $p < .001$. The mean ratings of sexual arousal to the neutral and treatment films for all three groups are presented in Table 7. The first set of comparisons revealed that, as expected, the groups did not differ significantly in their ratings of sexual arousal to the neutral film. However, in response to the treatment films, the mean arousal rating of the highly erotic group differed significantly from the mean ratings of the mildly erotic and erotic suggestion

Table 6

Analysis of variance: Sexual arousal ratings for experimental groups of neutral and treatment films

Source	SS	df	ms	F	p
Groups (G)	179.690	2	89.85	7.75	<.001
Sex (S)	0.954	1	0.95	0.82	-
G x S	30.537	2	15.27	1.32	-
$Error_b$	625.873	54	11.59	-	-
Films (F)	667.880	1	667.88	141.72	<.001
G x F	225.645	2	127.82	27.12	<.001
S x F	1.564	1	1.56	0.33	-
G x S x F	17.186	2	8.59	1.82	-
$Error_w$	254.489	54	4.71	-	-

Table 7

Mean ratings of sexual arousal for neutral and treatment films

Group	Neutral film	Treatment film
Highly erotic group	0.69	8.96
Mildly erotic group	1.13	5.90
Erotic suggestion neutral group	1.28	2.40

Note. Film ratings may range from 0 (not sexually arousing) to 15 (highly sexually arousing).

neutral groups, $p < .05$. Also, the erotic suggestion neutral and mildly erotic groups were significantly different from each other, $p < .05$. Subjects in the highly erotic group rated the treatment film significantly more sexually arousing than the neutral film, $p < .05$. Subjects viewing the mildly erotic film rated it significantly more sexually arousing than the neutral film as well, $p < .05$. However, there was no significant difference between the ratings of sexual arousal for the erotic suggestion neutral film and the neutral film.

The data derived from the subjects' ratings of sexual arousal, when combined with the finger temperature findings, suggest the following. During the viewing of the film which subjects rated as the most erotic, their finger temperature decreased significantly. Although the mildly erotic film was rated significantly more arousing than the neutral film, it was given only an intermediate rating of sexual arousal. The finger temperature of subjects viewing this film, while significantly lower than recordings taken during baseline and presentation of the neutral film, did not decrease significantly as the film progressed. Rather, it tended to level off fairly rapidly. It will be recalled however, that there was no significant difference in overall mean finger temperature between the groups viewing either the highly or mildly erotic film. The subjects rated the erotic suggestion neutral film as not very sexually arousing and not significantly different from the neutral film with respect to sexual arousal. After an initial decrease, the finger temperature of these subjects increased significantly during the presentation of the erotic suggestion

neutral film.

Discussion

The results of this study provide evidence for a relationship between finger temperature changes and sexual arousal induced by erotic films. The finger temperature of male and female subjects was significantly lower in response to viewing two films varying in degree of eroticism than a neutral film. Comparison of subjects' finger temperature during the highly and mildly erotic film conditions with temperature during the erotic suggestion neutral condition revealed that decreases in finger temperature were due to the effects of the erotic films rather than subjects' expectations and attentional factors, only. In addition, the analysis of the different course of finger temperature changes during the treatment films showed that finger temperature discriminated between the highly and mildly erotic films in a manner consistent with their rated erotic value. It is interesting that this physiological measure appears to have been sufficiently sensitive to reflect a small difference in subjects' ratings of sexual arousal evoked by the two erotic films. The finger temperature of subjects in the erotic suggestion neutral group who viewed a film devoid of any sexual content was also of interest. The pattern of changes was quite different from the two erotic film groups. Finger temperature of subjects in this suggestion condition actually increased significantly from the beginning to the end of the film. It appears that, after scrutinizing the movements of the black square presented in this film, subjects soon became aware that there were

no hidden sexual images. After an initial decrease, relative to finger temperature during the neutral film, suggesting an anticipatory effect, finger temperature rapidly increased to baseline level.

A perplexing finding of the present experiment concerns the temperature differences between the erotic suggestion neutral and the two erotic film groups in the baseline and neutral film conditions. There is no obvious explanation of this result. Since the mean finger temperature of the erotic suggestion neutral group is always higher than the means for the other two groups it would be difficult to attribute the absence of a temperature decrease under the erotic suggestion neutral film condition to a floor effect. Similarly, it seems unlikely that the temperature decrease observed under the two erotic film conditions represent the return of initially high temperature values back to baseline. In addition, procedures (covariance analysis and matching) designed to control for baseline differences between the groups, confirmed the original findings.

Some discussion is also warranted on the finger temperature decreases which appeared to have occurred between film presentations. It will be recalled that during this interval subjects filled out rating forms and were told that they would view explicit sexual material. Although it was not possible to analyze the finger temperature decreases occurring in this period in a systematic manner, it is possible that these decreases reflect subjects' anticipatory responses. Exposing the subjects to one or more additional sessions of viewing the visual material (as in Heiman, 1975), would have the

advantage of clarifying the subjects' expectations about the kind of film they will be shown and stabilizing their anticipatory reactions.

One final problem, the significant Group x Sex interaction, requires comment. This interaction seemed to reflect the unequal distribution of "low temperature subjects" across males and females in the three groups. The incidence of subjects with low finger temperature requires further study.

This experiment marks the first attempt to use finger temperature as a measure of sexual arousal in women. It will be recalled that the erotic stimuli used in this experiment were pretested and selected to be equally sexually arousing to both males and females. The material was again judged sexually arousing to an equal degree by males and females in the present experiment and generated equivalent decreases in finger temperature in both sexes.

The pleasantness ratings, which subjects were also required to provide, were used to determine the presence of strong emotional reactions in addition to sexual arousal to the erotic stimuli. The highly erotic, mildly erotic, and erotic suggestion neutral films were rated by subjects as significantly more pleasant than the neutral film. Unlike the results of Schmidt and Sigusch (1970), who found that subjects rated very sexually stimulating material as unpleasant, the film rated as most erotic in this experiment was also rated as the most pleasant. The pleasantness ratings suggest that on the whole the response of sexual arousal to the films was not confounded with any negative emotional responses.

This experiment does not shed any light on the physiological mechanisms underlying the observed finger temperature changes. Masters and Johnson (1966) and Kinsey et al. (1953) reported that peripheral vasodilation occurs over much of the body during sexual arousal. Therefore, Wenger et al. (1968) and Corman (1968) expected subjects' finger temperature to increase in response to the viewing of sexually arousing material. However, in both of these studies and in the present experiment, finger temperature decreased significantly in response to subjectively reported sexual arousal, indicating the occurrence of peripheral vasoconstriction. The subsequent increase in peripheral blood flow, reported by Masters and Johnson (1966) and Kinsey et al. (1953), may be characteristic of later, more advanced stages of sexual arousal. Studies which compare temperature at peripheral as well as central sites on the body in response to psychosexual stimulation could help to resolve these discrepancies.

Although the results of this study provide support for the use of finger temperature as a measure of sexual arousal in males and females, further validation studies are in order. Finger temperature might be recorded in conjunction with penile plethysmograph and vaginal photoplethysmograph measures in experimental situations designed to produce sexual arousal. Malmo (1975) has recently reported finger temperature decreases in response to several strong emotions, other than sexual arousal, in humans. Thus, the capacity of finger temperature to differentiate sexual arousal from other intense affective states must be investigated as well. Unlike penis and vagina

based measures, finger temperature is quite unobtrusive. The fact that it appears to reflect different levels of sexual arousal as well, suggests that it may be a valuable physiological measure in investigations of human sexual arousal.

Footnotes

[1]This analysis of variance was also computed to include an assessment of the effects of subject's sex on finger temperature change during the five time blocks of the treatment film. The inclusion of this variable did not alter the results of the analysis nor any conclusions based on the original analysis of variance. The only significant effect related to sex of the subject, also found in the overall analysis, was the Group x Sex interaction.

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