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Habituation of Female Sexual Arousal to Slides and Film

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The habituation of genital and subjective sexual arousal in women was assessed. In a first experiment 32 women were randomly assigned to either a constant stimulus condition in which subjects were exposed to the same erotic slide on repeated trials within one session, or to a varied stimuli condition in which subjects were exposed to various erotic slides. A second experiment assessed habituation of sexual responses of 42 women to erotic film excerpts. In both experiments repeated erotic stimulation was followed by a novel erotic stimulus to study the effect of novel simulation to a sequence of uniform stimulation. In the first experiment a floor effect was found in response to the first three trials that prevented a valid interpretation of responding on subsequent trials. We conclude that slides yield too little sexual arousal in female subjects. In the second experiment only a slight decline in genital responding was observed. Women sustained considerable levels of genital arousal even after 21 trials of uniform stimulation. Facial EMG was used as a physiological marker of emotional experience. Zygomatic activity decreased over trials, suggesting decreasing positive affect as a result of uniform stimulation. Results are discussed in the context of selective attention, characteristics of the habituation stimulus, and novelty.

KEY WORDS: female sexual arousal; habituation; vaginal photoplethysmography; emotion; facial EMG.

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INTRODUCTION

In incentive models of sexual motivation, it has been predicted that "the hedonic quality of particular incentives is decreased by constant use or consummation and enhanced by abstinence from that particular incentive" (Singer and Toates, 1987, p. 485). This notion points to the possible role of habituation processes in the modulation of sexual motivation, since the incentive quality of the stimulus wears off with repeated exposure.

In the tradition of sexual motivation theories, Hardy (1964) proposed that as a result of habituation, a person seeks out sexual activities that continue to increase in intensity "in order to regain the prior level of gratification" (p. 10). In contrast, it has been suggested (e.g., O'Donohue and Plaud, 1991) that habituation may underlie low sexual desire disorders (American Psychiatric Association, 1987). Prevalence figures given by Bancroft (1989) suggest that low sexual desire is found most commonly in women. If a relationship between low sexual desire and habituation indeed exists, habituation of sexual arousal is expected to be found in women. Habituation has also been of interest in attempting to explain the Coolidge effect, which refers to a preference for novel sexual partners or a resumption of sexual behavior by a sexually satiated male animal when a new partner is presented (Dewsbury, 1981). On the basis of this phenomenon in male animals, sociobiologists argue that men will tend to habituate sexually (and therefore seek novel sexual partners) and women will not (and therefore remain monogamous), as such representing evolutionary sound reproductive strategies (e.g., Symons, 1979). However, to our knowledge, Coolidge effects have not been tested in female animals. Furthermore, it is as yet unknown whether the Coolidge effect is related to habituation or is a general response to novelty (cf. Singer and Toates, 1987).

Thompson and Spencer (1966) defined habituation as a systematic decrease in the magnitude of a response as a result of repeated stimulation, provided that the decrement is not attributable to neural adaptation or fatigue. Evidence for the occurrence of habituation of male sexual arousal within one session was found by O'Donohue and Geer (1985); repeated exposure to the same erotic slide produced a greater decline of both physiological and subjective arousal than exposure to different slides. O'Donohue and Plaud (1991) found both within- and between-session habituation of male sexual arousal to 2-min erotic audiotapes. Smith and Over (1987) tried to establish whether habituation as found by O'Donohue and Geer (1985) also applied to fantasy-induced sexual arousal. They found no decline in physiological or subjective arousal when men engaged in structured fantasy over repeated trials within a session. Response levels remained stable irrespective of whether the content of fantasy varied over trials or

whether the men engaged in the same fantasy on each trial. Unfortunately, whether fantasies in the habituation condition remained fixed over trials was not controlled, which may explain the lack of habituation.

Only one study has assessed habituation of female sexual arousal on a within-session basis (Meuwissen and Over, 1990). Decreasing levels of subjective sexual arousal and genital arousal in eight women were found after both repeated exposure to the same 1-min film excerpt and repeated structured fantasy. In the film and the fantasy condition presentation of two novel erotic stimuli led to recovery in physiological and subjective sexual arousal well above the level of the initial response. The results of this study, however, do not yield unequivocal proof of habituation of sexual arousal in women. First, in contrast to O'Donohue and Geer (1985) who used rigorous criteria upon which they considered habituation to have occurred, Meuwissen and Over (1990) used the percentage of decline in responding relative to the first three trials as the unit of measurement. That is, the increase in genital arousal during Trials 1–3 relative to the initial 2-min baseline was set at 100%. Their genital data showed that even after 18 trials subjects still responded up to 85%. Second, they did not include a condition in which subjects were shown different erotic stimuli, to control for physiological fatigue. Third, it is not sufficient to conclude that habituation has occurred on the basis of a significant trial effect. In our view a trend analysis is a more rigorous statistical test to establish whether habituation has occurred. When a significant negative linear trend is found, one can assume that the decline in responding is not coincidental, and that it will continue to decline when repeated exposure to a constant stimulus is maintained even longer. Particularly when small declines in responding are observed, such a criterion is valuable.

The present study was designed to assess the occurrence of habituation in female subjects. In a first experiment, female subjects were assigned randomly to either a constant stimulus condition in which they were exposed to the same erotic slide on repeated trials within a session, or to a varied stimuli condition, in which they were exposed to erotic slides that differed in content, but were about equal in stimulus intensity. This experiment provides a replication of the study of O'Donohue and Geer (1985) in male subjects. In the second experiment erotic film excerpts instead of slides were used. Dekker and Everaerd (1988) showed that female subjects were less sexually aroused by erotic slides than were men. They suggested that women were more distracted by specific details of the slides, since many of them evaluated the stimuli more critically than did the men. We propose that film stimuli will result in sexual arousal more prominently than slides and are, therefore, a more controlled way of ensuring high initial levels of sexual arousal. For both experiments we predicted a reduction in both

physiological and subjective sexual arousal in the constant stimulus condition. Relatively little decline in responding was expected to occur in the varied stimuli condition. In both studies the occurrence of habituation was assessed by performing trend analyses.

The effect of novel stimulation to a sequence of uniform stimulation was studied by changing the content of the visual stimulus on the last trial within the session. Recovery of response when a novel stimulus is presented is referred to as dishabituation.[3] In this respect both our experiments combined the methodology used in the O'Donohue and Geer (1985) and the Meuwissen and Over (1990) studies. If little or no habituation is observed, a significant increase in responding on the trial during which a new stimulus is introduced might indicate a novelty effect rather than evidence for habituation on preceding trials (e.g., Smith and Over, 1987).

EXPERIMENT 1

Method

Subjects

All 35 women who attended the introductory session in which all experimental procedures were explained agreed to participate. Due to technical problems the results of 3 subjects were eliminated. The remaining 32 women were between 18 and 30 years old ($\bar{X}$ = 21.31 years, SD = 2.74); 22 (69%) had sex with a steady partner, 29 (91%) had seen erotic pictures before participation. All subjects were undergraduate psychology students and received course credit for their participation.

The women were not tested during menstruation. Sixteen (53%) were tested in the first and second week after menstruation, another 14 were tested in the 2 weeks before menstruation. One woman menstruated too irregularly to give a reliable estimation. Twenty-two women (69%) used hormonal contraception (the pill), 4 (12.5%) used condoms, 2 used some other contraceptive means, and 4 women (12.5%) used no contraception at all.

[3]Strictly speaking, "dishabituation" refers only to recovery in response to the original habituation stimulus following either a novel stimulus or a certain time interval. The term "generalization" is often used to describe responding to a novel stimulus after repeated exposure to a habituation stimulus. However, many authors, as we do, refer to this phenomenon as "dishabituation."

Design

A 2 × 10 between-subjects repeated measures design was employed. The independent variables were Stimulus Variability (constant and varied stimuli) and Trials (10 trials). Subjects were randomly assigned to one of two conditions. Because the most substantial decrease in genital arousal in the O'Donohue and Geer (1985) study was found to occur during the first 10 slide presentations, in the constant stimulus condition subjects were exposed to 10 uniform presentations of a single slide. The 10 slide presentations were followed by a presentation of a new slide (dishabituation stimulus) to test for the effect of novelty subsequent to habituation. In the varied stimuli condition subjects were exposed to 11 presentations of different slides. Each slide was shown for 1 min with a 1-min interstimulus interval.

Stimulus Materials

The stimulus materials were 11 color slides. They depicted attractive heterosexual couples engaged in oral or genital sexual activity, or an attractive nude or seminude male or female model. The pictures were taken from sexually explicit magazines. O'Donohue and Geer (1985) found that such stimuli produced higher rates of habituation of physiological sexual arousal than stimuli of medium erotic intensity. On the basis of a pretest using a different set of female subjects the slide that received the highest rating of erotic intensity was selected as the habituation stimulus. For each subject the dishabituation stimulus that was presented next was selected randomly from the 10 remaining slides. In the varied stimuli condition subjects saw a series of 11 slides of high erotic intensity. The order of presentation was determined on a random basis.

Physiological Recordings

Genital responses were recorded on a WEKA OEM 821060 thermowriter (paper speed 100 mm/min) using a vaginal photoplethysmograph. Only the a-c component was used for analysis, since this measure is considered more sensitive and reactive than the d-c component (Geer *et al.*, 1974; Heiman, 1977; Osborn and Pollack, 1977; Hatch, 1979; Beck *et al.*, 1983; Korff and Geer, 1983). The a-c signal (time constant = 1 sec) was band-pass filtered (0.5–30 Hz). The genital device was allowed a 45-min warm-up period prior to insertion, and was put in place by the subject without the experimenter's help. Subjects had received careful instructions to

insert the probe with the light emitting diode facing the anterior aspect of the vaginal wall. The device was sterilized in a solution of Cidex-activated glutaraldehyde (Geer, 1980) before use.

Subjective Measurements

Subjective Sexual Arousal. Subjective sexual arousal was continuously assessed during trials. Subjects were instructed to move a lever that was so calibrated that its placement determined how many of 10 lights were illuminated. The lever in the most rearward position illuminated 1 light, signaling "no sexual arousal" and the lever in the most forward position illuminated all 10 lights, indicating "maximum sexual arousal." The lever was attached to either the right or left arm of the recliner chair, matching the subject's dominant hand. The corresponding bar with the 10 red light bulbs was placed beneath the television monitor so that subjects did not need to look away from the screen to monitor their level of sexual arousal. The women received careful instructions about the use of the lever and the extremes of this scale beforehand. They were told that each light between the two extremes indicated progressively more sexual arousal, and that they were to move the lever to indicate each increase or decrease in sexual arousal they might experience within one trial.

Emotional Experience. An additional measure of emotional experience was collected at the start and at the end of the experiment. Each woman was asked to assess on a 7-point Likert scale the degree to which she was experiencing 10 emotions (interest, surprise, disgust, distress, shame, contempt, guilt, anger, fear, and enjoyment) taken from the Differential Emotion Scale (Izard, 1972). This scale was abbreviated by giving only one description of each emotion. Another six sexual descriptors (sensual, horny, desire to make love, desire to masturbate, passionate, lascivious) were added to the scale. The extremes of these 7-point scales were *not at all* and *very strong*. The items were presented in random order.

Procedure

Subjects first took part in an introductory session in which all experimental procedures were explained in detail. They were shown the vaginal photoplethysmograph and were informed about the sterilizing procedures. Subjects were told that they would see slides of an explicit pornographic nature. They were asked not to discuss the experiment with anyone until they had received the debriefing which was sent to all subjects after the last subject was tested. Random spot-check during exit interview revealed

that subjects had complied with these instructions. Privacy, anonymity, and confidentiality were assured. It was stressed that they could withdraw from the experiment at any time, without penalty. At the end of this introductory session subjects were asked to make a tentative future appointment for the experimental session. Appointments were made so that subjects were not menstruating during the experimental session.

In the experimental session each woman was tested individually. On arrival at the laboratory, subjects read and signed an informed consent form. The experimenter then explained how to insert the genital device and how to use the mechanical lever.

Subjects inserted the probe in private. When they signaled (using a one-way intercom system) that the transducer had been placed, they rated their emotional experience by answering questions that were presented on the television monitor. They could answer by pressing one of seven buttons which corresponded with the seven answer categories that were shown beneath each question. During the 5-min adaptation period and a 3-min baseline period that followed, subjects listened to music. The erotic material was then presented. After presentation of the last slide subjects again rated their emotional experience.

At the end of the experiment subjects were asked to respond to a series of questions pertaining to their reactions to the slides, the degree to which they had understood and had complied with the instructions, their ability to concentrate, the degree to which they had engaged in sexual fantasy while watching the slides, their use of the genital device, and their expectancies concerning the objectives of the study.

Data Reduction, Scoring, and Data Analysis

Vaginal pulse amplitude (VPA) was indexed by the difference between VPA during erotic stimulation and the initial 3-min baseline. VPA was hand-scored at 10-sec intervals across the baseline and subsequent trials. Each data point was recorded in millimeter pen deflection and averaged over 60 sec, resulting in one data point per trial (mean VPA). The continuous measure of subjective sexual arousal was quantified using an IBM AT personal computer and a Keithley system model 570 for Analogue/Digital conversion (sampling rate 10 Hz). Data were averaged every 60 sec, resulting in one data point per trial.

Habituation was assessed by performing trend analyses for mean VPA and mean subjective sexual arousal across the 10 trials on which there had been constant stimulation, with the overall level of significance for each dependent variable set at $\alpha = .05$ using the Bonferroni procedure. Novelty

effects were determined by comparing the mean level of response on Trial 11 (when there had been a change in stimulation) with the mean level of response on Trial 10.

The 16 emotions were considered to reflect positive and negative affect. Clusters of sexual feelings and negative emotional experience were confirmed by factor analysis.

The BMDP 4V program (Dixon, 1990) was used for all analyses. The Greenhouse–Geisser epsilon procedure was applied to all the repeated measures ANOVAs to protect against Type I errors, thus correcting for violation of the sphericity assumption in repeated measures designs (Vasey and Thayer, 1987). When required, post hoc contrast analyses (simple mean comparisons) were performed.

Results

Effects of Stimulus Variability

Genital Sexual Arousal. In the interstimulus intervals a return to baseline was observed in virtually all subjects. The mean VPA baseline score was unrelated to mean VPA difference scores across trials, $r(31) = .28$, p

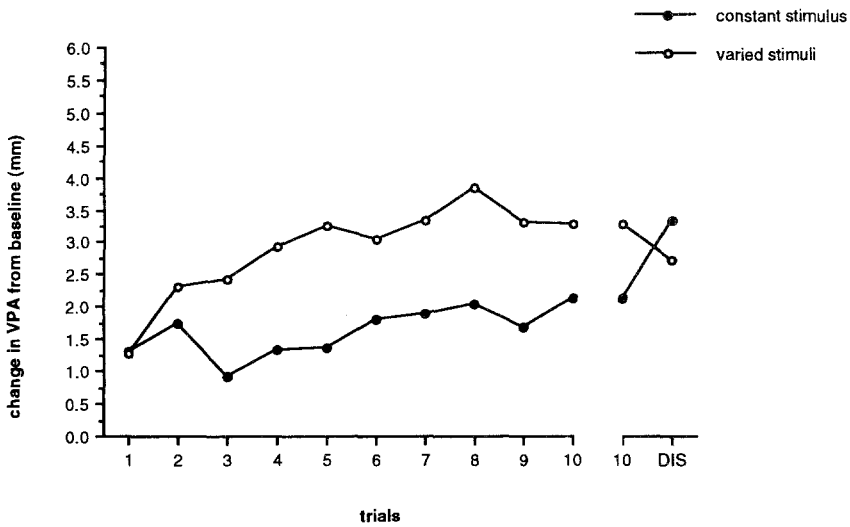

Fig. 1. Mean vaginal pulse amplitude (VPA) response for the constant stimulus condition and the varied stimuli condition on Trials 1–10 and the dishabituation stimulus (DIS).

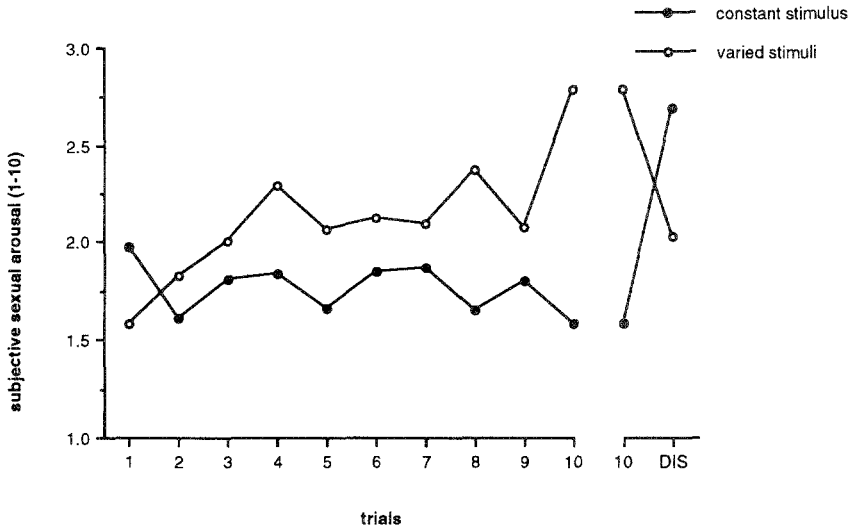

Fig. 2. Mean subjective sexual arousal as set by the lever for the constant stimulus condition and the varied stimuli condition on Trials 1–10 and the dishabituation stimulus (DIS).

> 0.10, justifying the use of VPA difference scores for analysis. A 2 × 10 (Stimulus Variability × Trials) repeated measures ANOVA, with stimulus variability as the between-group factor, yielded a significant trials main effect, $F(9, 270) = 5.53$, $p < 0.0001$, $\varepsilon = 0.58$, such that both conditions resulted in an increase in responding over trials (Fig. 1). The Stimulus Variability × Trials interaction was only marginally significant, $F(9, 270) = 1.93$, $p < 0.10$, $\varepsilon = 0.58$.

Trend analysis revealed that the increase in the constant stimulus condition was marginally significant ($p < 0.10$). There were no quadratic or cubic trends. The pattern of VPA in the varied stimuli condition contained a positive linear trend, $F(1, 15) = 16.08$, $p < 0.001$. A one-way ANOVA on Trial 10 with stimulus variability as the between-group factor indicated that VPA in this condition was not significantly higher than in the constant stimulus condition, $F(1, 30) = 0.88$, $p > 0.30$.

Although there was no evidence of habituation in the constant stimulus condition, contrasts between Trial 10 and Trial 11 (when novel erotic stimulation was introduced) showed an increase in VPA to the novel stimulus, $F(1, 15) = 10.07$, $p < 0.01$. These findings are consistent with what one would expect of the effect of novel stimulation after habituation has occurred. In the varied stimulus condition VPA on these two trials did not differ.

Subjective Sexual Arousal. No main effects for stimulus variability and trials were found. The Stimulus Variability × Trials interaction was significant, $F(9, 270) = 2.64$, $p < 0.05$, $\varepsilon = 0.51$, indicating an increase in the varied stimuli condition and a slight decrease in the constant stimuli condition (Fig. 2).

The decline in the constant stimulus condition was not significant ($p > 0.40$). Also, no quadratic or cubic trends were found. A one-way ANOVA on Trial 10 indicated that subjective sexual arousal on Trial 10 was significantly lower in the constant stimulus condition than in the varied stimuli condition $F(1, 30) = 7.31$, $p < 0.02$. As with the VPA data, the introduction of novel stimulation in the former condition yielded a significant increase in subjective sexual arousal $F(1, 15) = 22.91$, $p < 0.001$.

The pattern of VPA in the varied stimuli condition contained a positive linear trend, $F(1, 15) = 11.05$, $p < 0.01$. There was a significant decline in subjective sexual arousal on Trial 11 with respect to Trial 10, $F(1, 15) = 5.31$, $p < 0.05$.

Emotional Experience. Principal component factor analysis with varimax rotation confirmed the structure of the emotion scales; 14 emotions were divided into 7 pleasurable emotions reflecting feelings of lust (consisting of all sexual emotions plus enjoyment; Cronbach's $\alpha = .91$), and 7 emotions relating to negative emotional experience (Cronbach's $\alpha = .86$). The factor solution explained 87.1% of the variance. Two of the 16 emotions did not contribute to the factor solution. Although in this factor analysis fewer subjects per item were used than is desirable, the solution was equivalent to the ones found in earlier experiments (Laan *et al.*, 1994; 1995).

The emotions contributing to the factor reflecting feelings of lust were averaged. A similar procedure was followed for the emotions contributing to the factor reflecting negative emotions. The two emotion factors were entered as dependent variables in a multivariate analysis. There were no differences in emotional experience on the pretest, therefore raw posttest scores were used for this analysis. A one-way MANOVA with stimulus variability as the between-subjects factor found no differences in emotional experience at posttest.

Discussion

The results of this first experiment indicate that there was no evidence of habituation of genital sexual arousal to repeated presentation of an erotic slide. In fact, genital responding increased in both the constant stimulus condition and the varied stimuli condition. Although the increase was significant only in the varied stimuli condition, there were no differences

between the two conditions on the 10th trial. The results for subjective sexual arousal were slightly different. Again in the varied stimuli condition a significant increase in responding was found, whereas responding in the constant stimulus condition declined somewhat. Trend analysis showed that this was not a significant decline.

A closer look at Fig. 1 shows that after three stimulus presentations in the constant stimulus condition a small decline in genital responding was established with respect to Trials 1 and 2. Nevertheless, the initial increase in responding was probably too low for habituation to occur. It seems reasonable to conclude that a floor effect was found, due to the low arousability of this type of visual stimulation.

It is possible, however, that we failed to find habituation of the genital response in this experiment because the specific slide that was used as a habituation stimulus was of low erotic intensity, despite the pretest ratings. For this reason we looked at the genital and subjective responses of subjects in the varied stimuli condition to this particular slide. Because slides in this condition were presented in a random order, order effects were presumed to be small. The slide used as the habituation stimulus in the constant stimulus condition appeared to yield the highest levels of genital arousal in the varied stimuli condition. For subjective sexual arousal only two slides received higher ratings that the habituation stimulus. We conclude that the findings in this experiment are not due to the specific slide used as the habituation stimulus. It is more likely that this type of visual stimulation in general yields too little sexual arousal.

From Trials 4 to 10 genital responding increased somewhat. Spontaneous reactions at exit interview revealed that subjects in the constant stimulus condition were feeling so bored that they started to engage in sexual fantasy, although no significant differences were found between the two groups when asked to respond to the question to what extent they had engaged in sexual fantasy ($p > 0.50$). Yet there was a significant difference between conditions in the extent to which subjects paid attention to the slides ($p < 0.001$). In the constant stimulus condition only four women (25%) indicated that they paid attention to the slides even after repeated stimulus presentations. Eight women indicated that they had been distracted now and then, and another 4 stated that they started to lose attention very quickly. In the varied stimulus condition however, 14 women (88%) said that they remained attentive to the slides all the time, whereas only 2 indicated to have been slightly distracted. Distraction itself does not result in increases in genital responding (e.g., Barlow, 1986). Given the fact that as of Trial 4 genital responses increased, it is plausible to conclude that subjects did engage in sexual fantasy.

The increase in genital arousal on Trial 11 in the constant stimulus condition (when a new slide was introduced) with respect to Trial 10 was significant and well above any previous response. It is clear that this finding cannot be taken as evidence for habituation on preceding trials. Instead, the increase should be interpreted as a strong novelty effect. This is corroborated by the subjective response on Trial 11 in the same condition.

EXPERIMENT 2

Given the finding of this first experiment we conducted a second experiment using erotic film excerpts. To make sure that decrements in levels of sexual arousal over trials were not due to decreasing levels of attention, even after repeated exposure to the same film excerpt, efforts were made to control attention. This was done by mounting dots into all visual stimuli, such that during each film excerpt three 1-sec dots appeared randomly over the screen. Subjects were required to press a button each time they noticed a dot. It was stressed that this was not a reaction time task, because a secondary reaction time task in itself could yield decreasing responses over time due to its distracting nature (Barlow, 1986). In addition, subjects were asked not to engage in sexual fantasy during interstimulus intervals. Because genital arousal was expected to be higher in this experiment, subjects were instructed to work on paper-and-pencil concentration tasks during these intervals to distract them from any sexual thoughts and to facilitate return to baseline between trials (cf. Laan *et al.,* 1994). We did not ask subjects not to engage in sexual fantasy during trials. A pilot study indicated that such an instruction was counterproductive. Research on thought suppression suggests that any attempt to stop thinking about something promotes preoccupation with the very thought that is unwanted (Wegner, 1989). In this pilot, subjects reported that it was very hard to comply to the instruction not to fantasize during trials, and that they were unsure whether any sexual thought was permitted. Most of them were highly aroused, even after up to 25 exposures to the same erotic film excerpt. The number of trials in this second experiment was extended from 10 to 21 trials. This was done because habituation was expected to occur at a slower rate due to the higher erotic intensity of the stimuli.

A final goal of this second experiment was to explore facial (corrugator and zygomatic) EMG activity concurrent with differential genital responding. Research has shown facial EMG to differentiate between positive and negative affective states. Across studies, increases in corrugator site muscle activity correlated with negative affect, while increased zygomatic activity appears to vary as a function of positive affect (e.g., Cacioppo *et al.,* 1986).

Sullivan and Brender (1986) examined facial (corrugator and zygomatic) EMG during sexual arousal in female subjects. They found increased m. corrugator activity when subjects listened to unpleasant (sexual and nonsexual) audiotape narratives, relative to activity at this site during pleasant audiotape narratives. Unfortunately, no measure of genital sexual arousal was included in this study. In our experiment zygomatic activity in the constant stimulus condition was expected to decrease as a function of decreasing positive affect, whereas corrugator activity in the same condition was expected to increase as a function of increasing negative affect. Additionally, this study explored whether EMG activity can be conceptualized as indicative of approach- and avoidance-action tendencies (Frijda, 1986), by correlating EMG activity with an Action Tendency Questionnaire developed at our laboratory. In doing so, an attempt was made to develop an unobtrusive measure of behavioral components in emotion research. Finally, research in our laboratory indicated that violent sexual film excerpts co-occurred with increased m. trapezius activity (van Moorst, 1992). This increased activity was conceptualized as an index for defense behavior. This muscle group was included in the EMG measures.

Method

Subjects

Forty-six healthy women participated in this second study. The data of 4 women were eliminated because of technical or procedural failure. The remaining 42 women were between 18 and 37 years old ($\bar{X}$ = 20.54 years, SD = 3.16); 23 (55%) had sex with a steady partner; 37 (88%) had seen erotic films before participation. All subjects were undergraduate psychology students and received course credit for their participation.

Twenty subjects (48%) were tested in the first and second week after menstruation, another 20 were tested in the 2 weeks before menstruation; 2 women menstruated too irregularly to give a reliable estimation. Twenty-seven women (66%) used hormonal contraception (the pill), 4 (10%) used condoms, 2 (5%) used some other contraceptive means, and 8 (19%) used no contraception at all.

Design

A 2 × 7 between-subjects repeated measures design was employed, with Stimulus Variability (constant and varied stimuli) as the between-

subjects factor and Trials (7 blocks of 3 trials) as the within-subjects factor. In the constant stimulus condition, subjects were exposed to 21 uniform presentations of a 1-min film excerpt. In the varied stimuli condition subjects were exposed to 21 1-min film excerpts that differed in content but were about equal in stimulus intensity. In each condition the 21 trials were followed by two 1-min dishabituation stimuli to test for the effect of novelty subsequent to habituation. These two stimuli were the same for both conditions.

Stimulus Materials

All film excerpts used in this study were taken from so-called "women-made" videotapes described in Laan *et al.* (1994). The stimulus in the constant stimulus condition depicted a heterosexual couple engaged in cunnilingus. To assure that our findings were not limited to a particular excerpt, two cunnilingus scenes were used. Women in this condition were assigned randomly to one of the two film excerpts. Scenes were selected on the basis of earlier research, in which cunnilingus scenes were rated as high in intensity and evoked high levels of genital arousal (Laan *et al.*, 1990).

In the varied stimuli condition subjects saw 21 different film excerpts selected from three different categories of erotic stimuli. They saw cunnilingus scenes, intercourse scenes, and scenes that depicted manual stimulation of female genitals. The film excerpts used in the constant stimulus condition were incorporated in the cunnilingus category. Three random orders of the 21 excerpts were created, and subjects were assigned randomly to one of these three orders.

Two themes were used as dishabituation stimuli to rule out the possibility that an effect was unique to a specific theme. Half of the subjects saw a cunnilingus scene followed by an intercourse scene, the other half saw the two scenes in reverse order. All erotic film excerpts were presented with sound.

Physiological Recordings

Genital responses and EMG were recorded on a WEKA OEM 821060 thermowriter (paper speed 100 mm/min). The a-c signal (time constant = 1 sec) was band-pass filtered (0.5–30 Hz) and digitized (20 Hz) using a personal computer (IBM AT) and a Keithley system model 570 for Analogue/Digital conversion. In this experiment depth of the probe and orientation of the light-emitting diode were controlled by a device that was

attached to the photoplethysmograph by the experimenter before each session. This consisted of a 9 × 2 cm acrylic plate with a hole in the center that allowed for the photoplethysmograph to be pulled through and fixed to the cable at a distance 5 cm from the center of the phototransistor. Subjects were instructed to insert the photoplethysmograph so that the plate would touch their labia. Both the photoplethysmograph and the placement device were sterilized in a solution of Cidex-activated glutaraldehyde before use.

Bipolar EMG recordings of two facial muscles (corrugator supercilii and zygomaticus major) were made by means of Ag-AgCl pellet electrodes (2.5 mm detection surface). Electrode placement was done according to recommendations given by Fridlund and Cacioppo (1986). Bipolar EMG recording of the m. trapezius region of the nondominant side of the body was made using 7.5 mm Ag-AgCl pellet electrodes. EMGs were recorded using a Myotron 120 contour-following integrator with the time constant set at 1 sec. Integrating EMGs were band-pass filtered (0.5–30 Hz) and sampled at a rate of 25 Hz. Interelectrode impedances were maintained at less than 10 kΩ.

A software program developed at our department timed the administration of erotic stimuli, employed a trigger signal to initiate sampling of the physiological measures, and marked change-over between stimuli and interstimulus intervals.

Subjective Measurements

Subjective Sexual Arousal. As in Experiment 1, subjective sexual arousal was continuously assessed during trials. This time subjects were instructed to move the lever to indicate to what extent they were experiencing genital sensations during each trial. The lever in the most rearward position signaled "no genital sensations" and the lever in the most forward position indicated "complete wetness of the vagina."

Emotional Experience. This questionnaire was identical to the one used in Experiment 1.

Action Tendency Questionnaire (ATQ). This questionnaire assessed the tendency to execute overt behavior, without necessarily doing so (Frijda, 1986). Subjects were asked to assess on 5-point Likert scales the degree to which 25 statements were applicable to them. The extremes of these 5-point scales were *does not apply to me* and *strongly applies to me.* The questionnaire was used to establish differences in action tendencies resulting from the experimental manipulations and to correlate them with EMG activity.

The questionnaire was administered after the 21st trial, directly prior the dishabituation stimuli.

Procedure

The procedure was similar to the one in Experiment 1. To reduce subject awareness of the experimental hypotheses with regard to the EMG recordings, subjects were told in the introductory session that the facial electrodes measured natural, involuntary physiological reactions evoked by complex visual stimuli such as film (Cacioppo *et al.,* 1986). Subjects worked on paper-and-pencil concentration tasks during a 1.5-min interstimulus interval to distract them from any sexual thoughts and to facilitate a return to baseline between trials. This produced a return to baseline in most subjects. Between the 21st trial and the presentation of the dishabituation stimuli, subjects filled out the ATQ.

Data Reduction, Scoring, and Data Analysis

The VPA data were entered into a computer program developed at our laboratory, that enabled off-line graphical inspection of the a-c channel. Artifacts in the a-c channel are caused by movements of the lower part of the body or by voluntary or involuntary contractions of the pelvic muscles. Spectral analysis revealed that artifacts do not occur in a distinctly different frequency band but they can be readily detected by the eye in that they show an extreme increase in amplitude. After these artifacts were deleted peak-to-trough amplitude was calculated for each remaining pulse and averaged over 60 sec, resulting in one data point per trial (mean VPA). Mean VPA was transformed into millimeter pen deflection change from baseline to enable direct comparison with levels of genital arousal found in Experiment 1. Trials were grouped into blocks of three trials (Trials 1–3, 4–6, etc.) for all analyses.

For the integrated EMGs peak-to-trough amplitude was calculated and averaged over 60 sec, resulting in one data point per trial, reflecting mean activity for each of the three muscle groups per trial.

The 25 items of the ATQ were considered to measure the tendency to exert approach behavior and avoidance behavior, and behavior indicating feelings of helplessness. The questionnaire also contained items that reflect control over the situation and items that measured attention and interest in the situation. The subscales were partially confirmed by factor analysis.

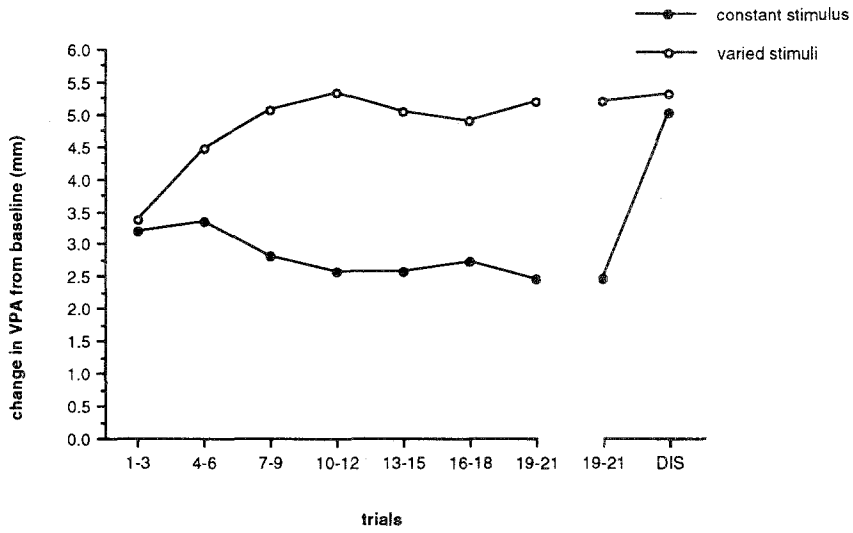

Fig. 3. Mean vaginal pulse amplitude (VPA) response for the constant stimulus condition and the varied stimuli condition on Trials 1–21 and the dishabituation stimuli (DIS).

Results

Responses at exit interview indicated that subjects had been comfortable during the experimental setting despite the inserted genital device and the attached electrodes. None of the women were aware of the fact that activity in the facial muscles can be increased voluntarily. Consequently, none of them indicated to have done so.

To determine whether there were differences between conditions in the number of times subjects pressed a button, a 2 × 7 (Stimulus Variability × Trial Block) repeated measures ANOVA was computed. There was a main effect of stimulus variability, $F(1, 40) = 8.35$, $p < 0.007$, and a main effect of trial blocks, $F(6, 240) = 23.63$, $p < 0.001$, indicating that subjects in the constant stimulus condition pressed a button after seeing a dot more often ($\overline{X} = 2.77$ times) than subjects in the varied stimuli condition ($\overline{X} = 2.49$ times), and that there was a slight variation over trials in both groups. A Stimulus Variability × Trial Blocks interaction, $F(6, 240) = 6.08$, $p < 0.001$, indicated that the difference between groups occurred predominantly during the first trial block. Subjects in the constant stimulus condition may have learned to detect the dots at a faster rate.

Effects of Stimulus Variability

Genital Sexual Arousal. The mean VPA baseline score was unrelated to mean VPA difference scores across trials, $r(41) = .17$, $p > 0.25$. A 2 × 7 (Stimulus Variability × Trial Blocks) repeated measures ANOVA revealed a marginally significant stimulus variability main effect, $F(1, 40) = 3.82$, $p < 0.06$, indicating that mean VPA was higher in the varied stimuli condition. The Stimulus Variability × Trial Blocks interaction was significant, $F(6, 240) = 5.38$, $p < 0.002$, $\varepsilon = 0.50$, such that the constant stimulus condition resulted in less responding over trial blocks (Fig. 3).

Trend analysis showed that the decline in the constant stimulus condition was not significant ($p > 0.15$). In addition, no quadratic or cubic trends were found. VPA in the varied stimuli condition contained a cubic trend, $F(1, 19) = 8.19$, $p \leq 0.016$. The one-way ANOVA on Trials 19–21 indicated that VPA in the varied stimuli condition was significantly higher on Trials 19–21 than in the constant stimulus condition, $F(1, 40) = 7.13$, $p < 0.02$. Contrasts in the constant stimulus condition between Trials 19–21 and Trials 22–23 showed a significant increase to the novel stimuli, $F(1, 31) = 30.18$, $p < 0.0001$. In the varied stimuli condition such a difference was not revealed.

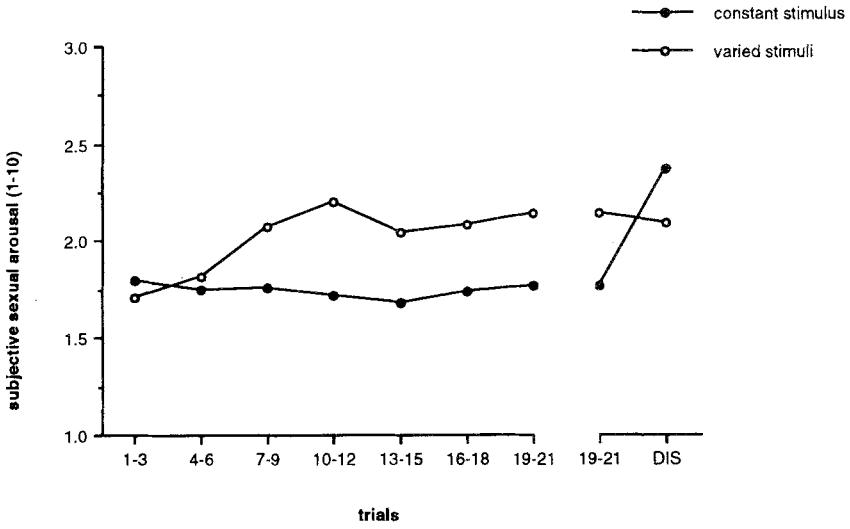

Fig. 4. Mean subjective sexual arousal as set by the lever for the constant stimulus condition and the varied stimuli condition on Trials 1–21 and the dishabituation stimuli (DIS).

Subjective Sexual Arousal. Main effects for Stimulus Variability and Trial Blocks were not significant. The Stimulus Variability × Trial Blocks interaction was marginally significant, $F(6, 240) = 2.65$, $p < 0.07$, $\varepsilon = 0.40$ (Fig. 4).

The slight decline in the constant stimulus condition was not significant ($p > 0.80$). There were no quadratic or cubic trends. There were no linear, quadratic, or cubic trends in the varied stimuli condition. Again there was a significant increase in subjective response in the constant stimulus condition to the novel stimuli, $F(1, 31) = 14.64$, $p < 0.0001$. In the varied stimuli condition there was no difference in subjective sexual arousal between Trials 19–21 and Trials 22–23. Subjective sexual arousal on Trials 19–21 in the varied stimuli condition did not differ significantly from subjective arousal on this trial block in the constant stimulus condition.

EMG. Due to technical failure or impedances greater than 10 kΩ EMG data of 5 women could not be used. A 2 × 7 × 3 (Stimulus Variability × Trial Blocks × Muscle Groups) repeated measures MANOVA found no significant main and interaction effects. However, for the zygomaticus muscle the Stimulus Variability × Trial Blocks univariate test approached significance, $F(6, 192) = 2.26$, $p = 0.11$, $\varepsilon = 0.33$. Trend analysis revealed a marginally significant quadratic trend in the constant stimulus condition,

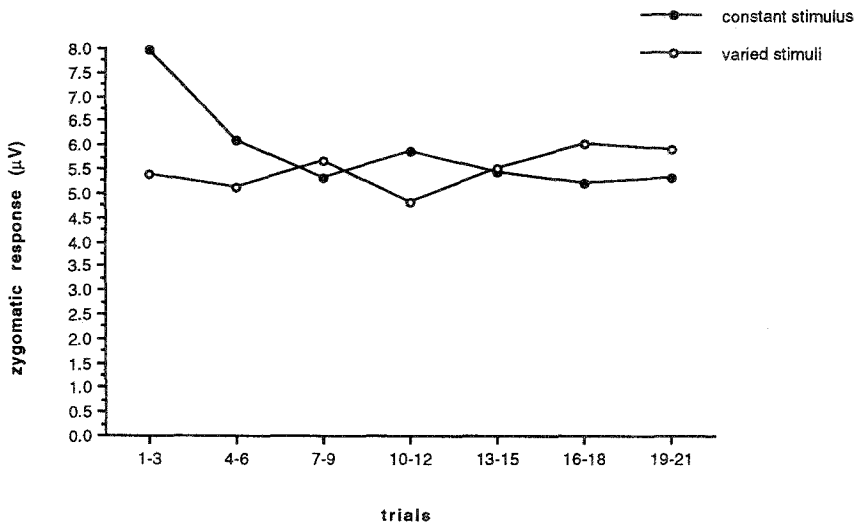

Fig. 5. Mean zygomatic activity for the constant stimulus condition and the varied stimuli condition on Trials 1–21.

$F(1, 21) = 3.54$, $p = 0.07$, indicating that zygomaticus activity decreased over time. In the varied stimuli condition no trends were found (Fig. 5).

Emotional Experience. As in the first experiment, there were no differences in emotional experience on the pretest. A one-way MANOVA found no differences in emotional experience at posttest.

Action Tendencies. Exploratory principal component factor analysis with varimax rotation on the 25 items of the ATQ revealed 5 subscales. Four items reflected approach behavior (e.g., "I wanted to enjoy something or someone," Cronbach's $\alpha = .87$), 8 items indicated tension and avoidance behavior (e.g., "I turned away or at least wanted to"; Cronbach's $\alpha = .75$). Two items reflected a need for protection (e.g., "I wanted to protect myself from something, I did not want to be bothered"; Cronbach's $\alpha = .81$), and 4 items indicated attention (e.g., "I wanted to closely follow what happened"; Cronbach's $\alpha = .76$). The factor solution explained 78% of the variance. A fifth factor contained 3 items that were related to helplessness, but since the reliability of this factor was low (Cronbach's $\alpha = .15$), it was not used in further analyses. Four items did not contribute to the factor solution. Although this factor solution seems satisfactory, the unfavorable subject–item ratio warrants further investigation of this questionnaire.

Items contributing to each of the described factors were averaged, thus creating four subscales. The four subscales were entered as dependent variables in a multivariate analysis. No significant differences were found.

Correlations between EMGs, Emotional Experience, and Subscales of the Action Tendency Questionnaire

M. zygomaticus major activity was expected to be related to the approach factor of the ATQ, whereas m. corrugator supercilii activity was expected to be related to the avoidance factor of the same questionnaire. However, most correlations between factors of the ATQ and muscle groups proved to be low and statistically nonsignificant. Only corrugator activity was significantly related to the approach factor of the ATQ, $r(36) = -.33$, $p < 0.05$, and trapezius activity was related to the protection factor of the ATQ, $r(37) = .40$, $p < 0.01$. Significant correlations were found between factors of the ATQ and the two factors measuring emotional experience. The feelings-of-lust factor was significantly related to the approach factor, $r(41) = .66$, $p < 0.005$, and the attention factor, $r(41) = -.39$, $p < 0.01$, of the ATQ. The negative emotions factor was significantly related to the tension and avoidance factor, $r(41) = .56$, $p < 0.005$, and the protection factor, $r(41) = .34$, $p < 0.05$, of the ATQ. Given the high explained variance of the factor solution of the ATQ, the high reliabilities of the individual fac-

tors, and the high correlations of factors of the ATQ with the two factors measuring emotional experience, we tentatively conclude that these data contribute to the concurrent validity of the ATQ.

DISCUSSION

Neither of the experiments support the claim that female sexual arousal decreases with repeated stimulation. Although in the second experiment genital responding in the constant stimulus condition decreased somewhat, we cannot reliably conclude that habituation has occurred. In fact, it is striking that even after 21 trials subjects still showed considerable genital arousal; subjective sexual arousal showed even less decline. The lack of decline in subjective arousal may be due to a floor effect. Mean subjective arousal was not greater than 2 on a 1–10 scale on any of the trials. In Experiment 1 subjects started out with slightly higher ratings of subjective sexual arousal. For this reason it is notable that genital responses were considerably higher in Experiment 2 (see Fig. 3) than in Experiment 1 (see Fig. 1). The latter finding suggests that erotic films are indeed stronger sexual stimuli than erotic slides, at least as far as genital arousal is concerned. It is not possible, however, to assess the differential effects of slides and film on the course of habituation of the genital response. After all, in the first experiment a floor effect was found in response to the first three slides.

Perhaps in Experiment 2 the intensity of the habituation stimulus was too high for habituation to occur, although this explanation is not corroborated by subjective reports. In retrospect, the majority of women in both conditions indicated that they had not engaged in sexual fantasy during stimulus presentations, nor during interstimulus intervals. The stimuli may have been too complex, or the stimulus presentation or interstimulus interval may have been too long (cf. van Olst, 1971; Thompson and Spencer, 1966). Of any visual stimulus, whether slides or film, it is difficult to ensure that stimulus intensity and stimulus complexity remain equal over time, particularly at a relatively long stimulus duration of 1 min. At exit interview subjects were asked if, over trials, they had changed their way of looking at the stimuli. Only 4 women in the constant stimulus condition (18%) indicated that they did not feel they had changed their way of looking at the habituation stimulus, whereas 85% in the varied stimuli condition (17 subjects) said this. Overall, most women in the constant stimulus condition reported that after a certain number of trials they had begun to pay more attention to both context-related details and sexual details. By doing this, subjects may have succeeded in keeping the stimulus interesting and sexually arousing.

The above finding suggests that habituation is mediated by attentional factors. Similarly, the very instruction to report subjective sexual arousal by using the lever may have served as a cue to retain a high level of attention during each repeated exposure to the same stimulus. The instruction to press a button each time a dot appeared on the screen may have contributed to this as well. The results regarding the task to press a button each time a dot was seen on the screen at least indicate that subjects in the constant stimulus condition did not look away from the screen during stimulus presentations. As noted earlier, this task did not guarantee that subjects had remained equally involved in looking at the stimulus over trials, nor that the stimulus continued to be similar in that they had paid attention to the same details over time. The importance of attentional factors in the process of habituation is corroborated by a recent study of habituation of male sexual arousal by Koukounas and Over (1993). They found that over trials, attention to the film stimuli had shifted from a participant perspective to a spectator perspective. When the effects associated with this change in absorption were partialled out, the habituation effects of genital arousal disappeared. They pointed out, however, that the absorption and subjective sexual arousal ratings may not have been independent. In fact, absorption may simply have been a proxy measure of subjective sexual arousal, with the former decreasing simultaneously with the latter.

This experiment is the first habituation study of sexual arousal to include a physiological marker for emotional experience, with promising results. As predicted, zygomatic activity decreased in the constant stimulus condition, with the largest decline in the first three trial blocks, indicating that positive affect decreased. The pattern of correlations between EMG activity and factors of the ATQ suggest that EMG activity may indeed be an indicator of approach- and avoidance action tendencies (Frijda, 1986). Koukounas and Over (1993) proposed that the startle response may serve as a physiological marker of emotional state during repeated erotic stimulation. Future studies have yet to reveal which marker is a more appropriate physiological measure of affect in habituation studies.

Despite the lack of habituation of both genital and subjective sexual arousal, in both experiments responses to the novel stimuli were well above any previous response (see also Meuwissen and Over, 1990). Clearly, in our experiments these increases cannot be interpreted as a dishabituation effect. Instead, this may suggest that responses to novel stimuli (the Coolidge effect) are unrelated to habituation, at least in women.

As noted earlier, in the constant stimulus condition women sustained considerable levels of genital arousal even after 21 trials. Meuwissen and Over (1990) also found that after 18 trials genital responses of their female

subjects were still strong. The genital response patterns of the women in these experiments suggest a highly automatized response mechanism. A detail that strengthened this impression was that most responses returned to the initial baseline level during interstimulus intervals. Nevertheless, subjects showed an increase in response each time the habituation stimulus was presented. Laan *et al.* (1993) suggested that to a certain degree, genital arousal may emerge fairly automatically, i.e., without conscious cognitive processing. The findings of the studies reported here may serve as further evidence for this.

When comparing the above-mentioned results with the findings of O'Donohue and Geer (1985), it is tempting to speculate that men habituate faster and to a greater degree than women. However, it seems very likely that attentional processes, such as the degree of involvement in the erotic stimulus, mediate the effect of habituation. It is also possible that women elaborate on sexual stimuli to a greater extent than do men, resulting in less habituation because stimulus intensity and stimulus complexity do not remain equal over time. If it is true that women not only elaborate more on erotic stimulus materials that do men but also do this more critically (e.g., Dekker and Everaerd, 1988), the findings of this study are even more interesting because apparently such critical evaluations and elaborations do not inhibit genital responses. However, given the different methodologies used in the studies discussed here, the problems in comparing genital responses of men and women directly, and possible differences within and between sexes with regard to responses to specific types of stimulus materials, it is too early to infer that male sexual arousal habituates and female sexual arousal does not.

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