THE LONG-TERM HABITUATION OF SEXUAL AROUSAL IN HUMAN MALES: A CROSSOVER DESIGN

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Short-term and long-term habituation of sexual arousal was investigated in a crossover design. Nine subjects completed six sessions semweekly for 3 consecutive weeks. Sessions were scheduled at least 2 days but not more than 4 days apart. Each session consisted of 15 stimulus periods and 15 detumescence periods. Sexually explicit audio stimuli were administered. There were two conditions in the crossover design, which allowed each participant to serve as his own control. During one half of the sessions subjects were exposed to 15 different scripts (varied condition); during the remaining sessions subjects were exposed to the same script 45 times (15 trials for each of three sessions, the constant condition). The constant stimulus condition was the experimental habituation condition, whereas the varied stimuli served as a control for physiological fatigue. Scripts were randomly assigned to stimulus conditions. Subjects showed systematic decreases in penile responding within the second and third constant stimulus conditions, but no systematic decreases were noted in any of the varied stimulus conditions. Subjects evidenced significant long-term decreases in physiological responding only in the constant stimulus condition as well as short-term decreases in subjective report of arousal. Long-term habituation of sexual arousal may be related to molar behaviors such as promiscuity and the spread of sexually transmitted diseases, and may be tied to sociobiological accounts of long-term sexual behavior patterns in human males.

Habituation is a systematic decrease in the magnitude of a response upon repeated presentations of an eliciting stimulus when the decrement

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is not caused by fatigue or receptor adaptation (Thompson & Spencer, 1966). It is thought that habituation occurs in two distinct time courses (Leaton, 1976; Thompson & Spencer, 1966; Wagner, 1979). Some habituation effects are temporary and are retained for very short periods of time, whereas other habituation effects are thought to occur over a longer time. The longer term habituation effects are thought to occur when the following are observed: (a) short-term habituation; (b) spontaneous recovery, in which the highest magnitude of recovery systematically decreases over recovery trials; and (c) the number of trials to habituation decreases across habituation sessions (O'Donohue & Plaud, 1991).

Previous research by O'Donohue and Geer (1985) has demonstrated the existence of short-term habituation of sexual arousal in the human male. They found that the self-reports of arousal as well as the magnitude of penile tumescence systematically decreased across trials in which subjects were presented the same erotic slide. O'Donohue and Geer (1985) ruled out decrements caused by fatigue because subjects in a control group (who viewed varied stimuli) maintained relatively constant levels of both subjective and physiological arousal. O'Donohue and Geer's (1985) investigation of short-term habituation investigated intrasession habituation effects, but they did not investigate any long-term (intersession) habituation effects.

Several researchers have reported findings that support short-term habituation of sexual arousal in humans. For example, Koukounas and Over (1993) found that males' subjective arousal and penile tumescence decreased over the course of a session in which they either repeatedly viewed the same segment of an erotic film or repeatedly engaged in the same erotic fantasy. Similarly, Meuwissen and Over (1990) found that females habituated to a repeatedly presented erotic video as well as to a repeated erotic fantasy as measured by subjective arousal and average vaginal pulse amplitude. Smith and Over (1976) present the only study in which short-term habituation of sexual arousal was not found. The null results obtained by these researchers, however, may have been caused by a few major methodological flaws (as suggested by O'Donohue & Plaud, 1991). For instance, the stimuli used in the study were erotic fantasies, over which the researchers maintained no experimental control.

The investigation of short-term habituation of human sexual arousal provides an index of intrasession habituation, but does not provide information concerning intersession or long-term habituation. The study of long-term habituation of human sexual arousal allows one to simultaneously investigate the possibility of spontaneous recovery. Only one such investigation (O'Donohue & Plaud, 1991) exists to date.

O'Donohue and Plaud (1991) investigated the following aspects of male sexual arousal: (a) short-term habituation, (b) spontaneous recovery following habituation, and (c) long-term habituation. Sexual arousal was measured through self-report Likert ratings and penile
plethysmography. Subjects were exposed to 15 2-minute audio tapes depicting sexual intercourse with an attractive woman in each of 6 sessions. The researchers found that male sexual arousal habituated in the short term, replicating the earlier results of O'Donohue and Geer (1985). Additionally, the O'Donohue and Plaud (1991) study provided evidence for the spontaneous recovery of sexual arousal between sessions. Finally, the study provided some evidence of a long-term habituation process in male sexual arousal in that the number of trials to habituation and the magnitude of spontaneous recovery tended to decrease across sessions.

A recent review of the conditioning of human sexual arousal (O'Donohue & Plaud, 1994) suggests that, despite the importance that contemporary theorists of human sexuality place on the notion that sexual behavior is learned, scientific information about human learning and sexual arousal is still somewhat meager. For that reason, it is important that additional research be conducted to understand further the results of the relatively few studies in which researchers investigated the habituation of sexual arousal.

If it can be empirically demonstrated that human sexual behavior habituates in the long term, it becomes important to consider the possibility that habituation processes may have relevance to understanding the genesis and maintenance of sexual dysfunctions (Plaud & Holm, in press). O'Donohue and Plaud (1991) theorized that habituation processes may be implicated in more complex and molar human sexual behavior patterns. The current investigation was an attempt to add to the empirical data base in order to determine the parameters of both short-term and long-term habituation of sexual arousal in the human male. Although the clinical behavior therapy database claims that human sexual behavior is at least in part a function of classical and operant conditioning, as well as habituation, the actual empirical database at present is too preliminary to justify basing behavior therapy strategies on conditioning and habituation models of sexual functioning (cf. O'Donohue & Plaud, 1994, and Gaither, Rosenkranz, & Plaud, in press, for a discussion of this issue). The present study was designed to empirically demonstrate and cross-validate other studies that show the involvement of conditioning and habituation processes in the expression of human sexual behavior. If it could be shown that humans evidence long-term habituation processes, for example, it could be argued that such processes may influence sexual responsivity both in the short term as well as over long periods of time. In behavior therapy, strategies that include dishabituation procedures may be implemented to increase sexual arousal (e.g., varying sexual stimuli, sexual positions, and environmental stimuli).
Method

Subjects
Male subjects were obtained from undergraduate psychology courses at the University of North Dakota. Potential subjects read a consent form describing the experimental procedure. The consent form explained that the subject could receive 5 hours of psychology research credit and a $20 honorarium for completion of the study. An experimenter then contacted the potential subject to arrange an initial explanatory session. This session was designed to provide the potential subject with a basic description of the study, a tour of the laboratory, and a review of the consent form. Any questions which the potential subject had at that time were answered by the experimenter without divulging the specific hypotheses under investigation.

At the end of the explanatory session, the potential subject was given a consent form to take home. Following a 24-hour deliberation period, the experimenter contacted him to schedule a data collection session if he chose to participate. Potential subjects were informed that participation in the experiment required two appointments per week for 3 consecutive weeks. The appointments were arranged such that at least 2 days, but no more than 4 days, elapsed between sessions.

Sixteen potential subjects attended the initial explanatory session. Of those 16, 14 agreed to participate in the experiment when contacted by the experimenter after the initial explanatory session. One of the 14 subjects was unable to schedule semiweekly sessions and therefore was not able to participate, resulting in 13 subjects with whom data-collection procedures began.

During data collection, 3 subjects failed to attend scheduled sessions and were not able to reschedule within the required time frame (i.e., they were unable to reschedule within 4 days of their last attended session). These 3 subjects were asked to discontinue their participation and were compensated with extra credit for their time to that point. Data from 1 subject were discarded because of difficulties with data collection (the plethysmograph was not properly placed). Overall, 9 subjects completed all six experimental sessions.

Apparatus
Penile response was recorded by a plethysmograph manufactured by Parks Medical Electronics, Inc. (Model 240-A). Response was measured by a Type A mercury-in-rubber penile strain gauge, also obtained through Parks Medical Electronics. The plethysmograph was connected to a Coulbourn Instruments transducer rack for transformation from analog to digital recordings.

Stimuli
Erotic stimuli consisted of 45 audio scripts developed by the experimenters. Each script was approximately 2 minutes in length and
depicted sexual intercourse between an adult male and adult female. Scripts were recorded on standard audio tapes by a female medical student who was not connected in any other way with the experiment. Scripts were recorded individually, with one script per tape, and the tapes were labeled with script numbers (1-45).

**Procedure**

Each subject participated in six sessions semiweekly for three consecutive weeks. Sessions were scheduled at least 2 days but not more than 4 days apart. Each session consisted of 15 stimulus periods, lasting approximately 2 minutes each, separated by a detumescence period. The length of the detumescence period varied from trial to trial, depending upon how quickly the subject returned to baseline circumference. In each stimulus period, an audio script was played through headphones over a dual deck stereo system with a stereo integrated amplifier.

There were two conditions in the single-subject crossover design, which allowed the subject to serve as his own control. The order of conditions (constant or varied) was randomly determined such that one half of the subjects were exposed to the varied condition first followed by the constant condition. The remaining subjects were exposed to the constant condition prior to the varied condition. All three of the constant condition and varied condition sessions occurred consecutively (i.e., a subject in the constant condition participated in all three constant condition sessions before exposure to the varied condition sessions).

During the constant condition, one script served as the stimulus for all 45 trials. In the varied condition, subjects were exposed to 15 different scripts during each session. These scripts were randomly chosen (with replacement), with the exceptions that the same script was not presented more than once within a given session and the script that served as the constant condition stimulus was not used during the varied sessions. Thus, the constant stimulus condition was the experimental habituation condition, whereas the varied stimuli served as a control for physiological fatigue.

Upon arriving at the first data-collection session, the subject was greeted by the experimenter and shown to the subject room, which contained only a reclining chair, a pair of stereo headphones, and a Likert scale mounted on a wall 4 feet from the chair. The experimenter then explained the procedures used for calibrating the plethysmograph, answered any questions, and then left the room.

Communication was maintained between the subject and the experimenter via a voice-activated intercom system which connected the subject room and the control room. Once the calibration process was completed, the subject was instructed to place the strain gauge on his penis, place the headphones on his head, and inform the experimenter that he was ready to begin. The experimenter then instructed him to relax for 5 minutes before beginning the first audiotaped stimulus.
After the relaxation period ended, the experimenter began the first stimulus period, which lasted approximately 2 minutes. After the script ended, the subject was asked to rate how sexually aroused he had felt using the 10-point Likert scale (0 = not at all aroused, 9 = extremely aroused). A detumescence period of at least 2 minutes followed. Once the subject's penile circumference had returned to baseline (i.e., he had detumesced) the next stimulus period was begun. The same procedures were followed for the remaining 14 stimulus periods.

The same procedures were followed for all six data-collection sessions. At the end of the final session the subject was debriefed by the researcher. He was provided with the hypotheses under investigation, and any questions were answered at that time.

Results

Data Reduction

Physiological data were collected via CODAS software and stored individually for each session, totaling six sessions per subject (three sessions for each condition). Next, the maximum circumference achieved during each stimulus period (each 2-min trial) was obtained for each subject. Five blocks of trials per session were then formed taking the maximum circumference (in centimeters) of three subsequent trials. Therefore, Block 1 is the highest maximum penile circumference recorded for Trials 1 through 3. Next, individual subjects' baseline circumference measurements were obtained for each session. Baseline circumference was defined as the minimum circumference recorded for a given subject in a given session.

Change in circumference (change score) was calculated by subtracting the baseline circumference from the block maximum circumference. Consistent with prior research (e.g., Koukounas & Over, 1993; O'Donohue & Geer, 1985), data were collapsed across subjects for further analyses, even though the study could be conceptualized as a single-subject design because each subject served as his own experimental control.

Subjective reports of arousal consisted of the Likert rating (0-9) for each trial. Subjective reports were then grouped into blocks of trials, as previously described for the physiological arousal. Again, data were collapsed across subjects for further analyses.

Overall Analysis

Three research questions were investigated in the current study. First, do subjects show intrasession habituation to the erotic stimuli in either the constant or varied conditions? Second, do subjects show spontaneous recovery of arousal between sessions? Finally, do subjects show a decrease in maximal responding in either the constant or varied stimuli conditions? These issues are addressed next, with separate analyses for the physiological and subjective report data.
Separate 2 (condition) x 3 (session) x 5 (block) repeated-measures ANOVAs were conducted on the physiological and subjective report data to determine whether subjects responded differentially in the constant and varied conditions. For the physiological arousal data, there were significant main effects for condition, $F(1, 8) = 5.25$, $p = .05$, and session, $F(1, 8) = 3.58$, $p = .05$, as well as a significant condition by session interaction, $F(2, 16) = 3.64$, $p < .05$. Tukey post-hoc analyses of this interaction indicated that there was a significant difference between Sessions 1 and 3 only in the constant stimulus condition ($p < .01$). Figure 1 displays the mean change scores for each session by condition. The interaction between condition and session is clearly indicated, and it can be seen that although the mean change score decreased across sessions in the constant, but not the varied stimulus condition. For the subjective report data, only the main effect for condition was significant,
$F(1, 8) = 19.44, p < .003,$ with higher scores in the varied condition ($M = 3.98, SD = 2.01$) than in the constant condition ($M = 1.18, SD = 1.40$).

Pearson product-moment correlations were computed between physiological data (change scores) and the subjective reports for each block of trials within each session. Overall, 30 correlations were calculated (5 blocks x 6 sessions). None of the correlations was significant at the .05 level. In only one other study of the habituation of sexual arousal did researchers report correlational analyses between the physiological and subjective report data (O'Donohue & Geer, 1985). In that study, the only significant correlation was for the first block of trials.

**Intrasession Habituation**

Figure 2 displays the mean penile circumference change score for each of the three sessions in the constant stimulus condition. Intrasession habituation was established through visual inspection of the change scores and a series of ANOVAs.

Repeated-measures ANOVAs were conducted within each session to determine whether significant differences in physiological arousal existed between blocks of trials. In the constant condition, the ANOVAs for Sessions 1 and 2 revealed no significant differences between blocks of trials. The ANOVA conducted on Session 3 of the constant condition, however, revealed significant differences between blocks of trials, $F(4, 32) = 2.87, p = .04$. Tukey post-hoc testing on Session 3 data indicated that there was a significant difference between Block 1 and Block 5 ($p < .01$) in the constant stimulus condition, further evidence intrasession habituation from the beginning to the end of the trials in the constant stimulus condition only. Visual inspection of Figure 2 shows that, for all three sessions of the constant condition, physiological arousal decreased across blocks of trials. The ANOVAs conducted across blocks of trials for each session in the varied condition revealed no significant differences in physiological arousal.

ANOVA were also conducted on the subjective reports to determine whether there were significant differences between blocks of trials within each session. For the constant condition, significant differences between blocks of trials were found for Sessions 1 and 3, $F(4, 32) = 3.6, p = .02$ and $F(4, 32) = 2.99, p = .03$, respectively. No significant difference was found for Session 2, $F(4, 32) = .96, p > .05$. For the varied condition, no significant differences between blocks of trials were found for any session. Thus, intrasession habituation rather than fatigue appears to be responsible for the decrease in subjective reports of arousal across blocks of trials.

**Spontaneous Recovery**

Spontaneous recovery was defined as a significant increase in arousal between the last block of trials (Block 5) of one session and the first block of trials (Block 1) of the subsequent session within a condition. Paired-samples $t$ tests found no significant differences for the
Constant Stimulus Condition

Figure 2. Intrasession or short-term habituation during the constant stimulus condition: physiological arousal (change scores in centimeters) across all blocks of each of the three constant stimulus sessions.

Physiological data or the subjective report data, although visual inspection of Figure 2 shows a trend that would be consistent with an interpretation of spontaneous recovery.

Intersession Habituation

Intersession habituation was determined through an examination of differences between the first block of trials for each session, conducted separately for each condition. Intersession habituation was defined as a significant decrease across sessions in the constant condition, but no significant decrease across sessions in the varied condition. Figure 3 displays the mean change in penile circumference for the first block of trials for each session by condition. An examination of Figure 3 reveals a
Results of this study support the hypothesis that for human males sexual arousal habituates both in the short term and in the long term. Analyses performed on physiological responding clearly show that subjects showed systematic decreases in penile responding within the second and third constant stimulus conditions, whereas no systematic decrease in physiological arousal for the constant condition, but not for the varied condition. A repeated-measures ANOVA again revealed a significant condition by session interaction, $F(2, 16) = 5.27$, $p < .02$. Tukey post-hoc testing revealed that there were significant differences between Sessions 1 and 3 in the constant stimulus condition only ($p < .01$). No significant differences were found for the subjective report data.

Discussion

Results of this study support the hypothesis that for human males sexual arousal habituates both in the short term and in the long term. Analyses performed on physiological responding clearly show that subjects showed systematic decreases in penile responding within the second and third constant stimulus conditions, whereas no systematic
decreases were noted in any of the varied stimulus conditions. Further, data analysis revealed significant long-term decreases in physiological responding only in the constant stimulus condition. The condition by session interaction provides clear evidence of intersession habituation for the constant stimulus condition, further supported by the intrasession habituation in the third session in the constant stimulus condition, as shown in Figures 2 and 3.

Although no statistically significant differences were found for spontaneous recovery, when the data are analyzed visually, as shown in Figure 2, the figure shows responding patterns consistent with a general pattern of spontaneous recovery from Session 2 to Session 3. Lack of spontaneous recovery was shown for physiological responding between Session 1 and Session 2. Visual inspection of the subjective report data in Figure 2 indicates a pattern of responding consistent with spontaneous recovery in both Sessions 2 and 3, especially when the constant and varied stimulus conditions are contrasted in Figure 2.

Interestingly, short-term but not long-term habituation of subjective report of arousal was also found. This finding coupled with the lack of correlational significance between results of correlational analyses supports a desynchronous model of physiological and subjective sexual responding. Even though subjects may not verbally report significant long-term decrements in sexual arousal, systematic physiological decreases seem to be occurring anyway.

O'Donohue and Plaud (1991) suggested that short-term habituation may be responsible for the Coolidge effect (Dewsbury, 1981) in which sexual arousal returns to a sated male as a function of the reintroduction of a novel female. Given the results of the present study, as well as the earlier study by O'Donohue and Plaud (1991) which have both demonstrated the presence of short-term as well as long-term habituation processes, a compelling data base of physiological data now suggests that habituation processes may play a significant role in long-term patterns of sexual arousal and sexual behavior.

Habituation processes may also have relevance to understanding, at least in part, the etiology of selected sexual dysfunctions (Plaud & Holm, in press). The DSM-IV (American Psychiatric Association, 1994) lists several major sexual dysfunctions characterized primarily by disturbance in sexual desire and changes in psychophysiology associated with the sexual response cycle. Dysfunctions such as sexual desire disorders and sexual arousal disorders could also have as a functional basis long-term habituation of sexual arousal. Given the complex influences of both biological and behavioral processes in the genesis and maintenance of sexual dysfunction for both males and females, it is clear that behavioral approaches add significantly to our understanding of the causes and modification of maladaptive sexual behavior (Plaud & Holm, in press). Consideration of the habituation parameters of human sexual arousal in the context of interpersonal and other social contingencies related to sexual responding could lead to innovative techniques such as
dishabituation procedures to treat certain clinical presentations of sexual dysfunction.

The present results also have direct implication for behavioral research concerned with patterns of sexual behavior over the long term. Sexual promiscuity, relationship problems, and the spread of sexually transmitted diseases represent a few examples of behavioral repertoires that could be significantly influenced, and perhaps in some cases even caused, by long-term habituation of sexual arousal. Colloquial phrases such as the "honeymoon effect" and "7-year itch" also implicate the possibility that short- and long-term habituation processes may have significant involvement in these molar behavioral processes. If long-term habituation is involved in sexual functioning, then one reason why males wander from long-term, stable monogamous relationships may have to do with low levels of sexual attraction and arousal toward their partners, a finding consistent with the prevalence of infidelity in human relationships. Lack of long-term desire in monogamous interpersonal relationships may therefore be a function in part of reduced physical attractiveness, decreases in marital intimacy, boring sexual routine, extramarital affairs, situational disturbances, and marital maladjustment (Munjack & Oziel, 1980; Plaud & Holm, in press; Wincze & Carey, 1991). Long-term habituation of sexual arousal may be a common behavioral denominator to all these sexual and relationship factors. The present results support this conclusion and provide data that warrant further investigation of the possible role of habituation processes in human relationships.

Given the popularity of evolutionary and sociobiological accounts of sexual responding (e.g., Symons, 1987), we emphasize that habituation, a behavioral process, may underlie much of the observed molar patterns of sexual behavior. The present data empirically support the conclusion that behavioral habituation processes have implication not only for short-term patterns of physiological arousal, but also long-term patterns. Moreover, this pattern appears to be a consistent one: With repeated exposure to a constant sexually explicit stimulus sexual arousal systematically decreased within a set of trials (for both physiological responding and subjective report) and continued to decrease across successive weeks (for physiological responding). When varied sexually explicit stimuli were presented, this effect was not seen either in the short term or the long term. Given this observed pattern of results, therefore, it is strongly suggestive that habituation of sexual arousal may have direct implication for both short- and long-term patterns of sexual behavior.

Further research in this area could continue to empirically probe the parameters and potential limitations of long-term habituation processes. Also, future research could address whether dishabituation procedures could be introduced to interrupt the patterns of sexual arousal habituation found in this study. Finally, at this stage of the research it is critically important to study whether such long-term habituation
processes are also shown for female subjects. Presently there is no published study that effectively demonstrates whether long-term habituation processes also occur in females. At best, therefore, our behavioral investigation of habituation is incomplete given this lack of basic information. However, results of the present study of male sexual arousal have important implication for understanding behavioral processes in sexual responding, and may contribute significantly to bio-behavioral models of molar patterns of sexual responding, both in the short term and in the long term.

References


