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AN EXPLORATORY STUDY OF PHYSIOLOGIC AND SUBJECTIVE REACTIONS EVOKED BY AVERSIVE AND NON-AVERSIVE SOUNDS

by
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FINAL REPORT
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Physiological and subjective responses to aversive and nonaversive sounds were studied in humans. Sixteen subjects, 19 to 43 years old, were exposed to sets of test sounds that varied in acoustic quality, familiarity, and information content. The sounds were presented in 20 test sessions. Physiological reactions to the sounds were assessed by measuring heart rate, blood pressure, gastrointestinal motility, galvanic skin response, and urinary 17-hydroxycorticosteroid and catecholamine concentrations. The sounds were rated subjectively as aversive or nonaversive. Sounds with screeching, grinding acoustic qualitiss which had unpleasant associations were consistently rated more aversive than sounds conveying smooth, rhythmic acoustic features having pleasant associations. Except for gastrointestinal motility, there were no significant differences in physiological responses to aversive and nonaversive sounds. Aversive sounds significantly increased gastrointestinal motility, whereas nonaversive sounds had only an insignificant effect. Subjective reactions were generally positively correlated with skin conductance and gastrointestinal motility and negatively correlated with heart rate. Most physiological reactions to the test sounds showed trends toward accommodation with repeated exposure. The authors conclude that the effects of aversive and nonaversive sounds upon humans are very complex, evoking subjective and physiological changes whose time courses may or may not parallel each other

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ABSTRACT

As an exploratory effort, this research sought to clarify different aspects of physiological and subjective response to moderate level sounds (nominally 80 dBA) which differed in acoustic quality, familiarity, and information content or meaning. Specific determinations were made of (a) physiological reactions evoked by the test sounds using heart rate, blood pressure, gastrointestinal motility, galvanic skin response, and biochemical indicators and concomitant subjective responses based on affective and semantic differential scale ratings, (b) tendencies toward accommodation and adaptation of these responses with repeated and sustained exposures of the test sounds, and (c) modification in the nature or strength of these responses through coupling the test sounds with biased contextual materials.

The results for 16 listener subjects indicated that sounds with screeching, grinding and other aversive acoustic qualities, though rated unpleasant, elicited no consistent differences in physiological reactions from those sounds which were less abrasive in nature and rated more favorably. Only gastrointestinal motility changes showed some differentiation between aversive and non-aversive sounds for initial exposures. Subjective ratings of the non-aversive sounds were found to correlate significantly with certain physiological measures, most notably gastrointestinal motility. Aversive quality sounds showed lesser covariation between subjective and physiological response measures. Most physiological reactions to the different test sounds revealed trends toward accommodation with repeated exposures. One exception was heart rate which showed a tendency toward greater suppression across repeated exposures.

Initial annoyance ratings toward sounds with aversive qualities were decreased when such sounds were accompanied by pictorial and narrative materials depicting a favorable or pleasant setting. Positive ratings to non-aversive sounds were also modified by coupling with unfavorable contextual materials. These

response modifications were found to be short lived. Semantic differential ratings for select aversive sounds conveyed meanings of extreme annoyance, strange, unimportant, large, taut, fluttering and dangerous. Ratings of the non-aversive sounds on the bipolar adjective scales were mostly in the mid-range, suggesting neutral impressions.

The overall findings indicated that the test sounds, though rated aversive and non-aversive in nature, evoke little differences in physiological response and bear uncertain relationships to subjective response. The time courses of the physiological and subjective reactions to the test sounds also lack clear correspondence.

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I. INTRODUCTION

Physiological and psychological reactions to sounds can be quite varied in nature, and much remains to be learned about these responses basic to predicting human tolerance and acceptance of such stimuli. These research needs have become more apparent with the growing problems of environmental noise pollution and demands for noise control. Indeed, rising noise levels from burgeoning industrial, transportation, construction, and recreational activities permeate modern society. Compounding this problem is overcrowding, especially in metropolitan areas, which denies adequate opportunities for quiet and gaining relief from such noise insults.

Over the years, Harris (1957), Burns (1969), Kryter (1970), Beranek (1971), and the Environmental Protection Agency (1971) have furnished fairly complete and updated reviews of information bearing on the degrading effects of excessive sound and noise exposure on man. Aural problems, namely, noise-induced hearing impairment and masking of the reception of wanted sounds, notably speech, have been extensively documented. While there are still some shortcomings, data in this area have been used to formulate exposure limits for conserving hearing or satisfying speech communication requirements.

Less detailed information exists in regard to extra-aural effects of sound and noise as defined by physiological and psychological changes which extend beyond or are apart from ear functions or speech reception processes per se. Perhaps the most dramatic example of such changes is the startle pattern typically consequent to the occurrence of an unexpected intense sound (e.g., car back-fire, explosion). Physiological changes triggered here include a sudden rise in blood pressure and drop in heart rate, gaps or breaks in the normal breathing pattern, cessation of digestive processes and sharp muscle contractions. Coupled to these physiological reactions are feelings of fear and alarm owing to the suddenness of the insult. With frequent repetitions of such sounds, these reactions tend to subside.

Longer lasting and more subtle physiological and psychological reactions also may occur for long-term exposures to intense continuous-type noise as found in heavy industry (Jansen, 1969; von Gierke, 1965; Anticaglia and Cohen, 1970). Available data suggest certain alterations in the cardiovascular and neurological functions of workers so exposed. Subjective reactions to this type of noise experience are somewhat unclear since most workers profess that "they don't even hear the noise". Nevertheless, a significant number express feelings of undue fatigue and irritability, and problems in inter-personal relationships both on-and-off-the-job for such workers have been reported. (cited in Kryter, 1970)

All of the above extra-auditory findings have been noted under acoustic conditions which hold obvious hazards to hearing or are clearly noxious to the observer. Of primary concern to this study was the characterization of physiological and psychological responses evoked by sounds occurring at levels posing no distinct harm. Such sound stimulation is more typical of everyday experience. Indeed, the intent of this research was to learn how assorted sounds differing in their acoustic quality (from abrasive to smooth), in familiarity (from well-recognized to unknown), and in meaning or association (from agitation to calm) could affect one's reactions both subjectively and physiologically. Specifically, this study addressed itself to the following questions:

1. Are there reliable physiological reactions to sounds which are offensive in nature due to acoustic or other qualities that may be distinguished from those produced by sounds which are pleasant?
2. What is the nature of the correlation between physiological reactions to these sounds and subjective affective ratings?
3. Are there parallel tendencies toward adaptation and accommodation for both physiological and subjective

reactions to these sounds with sustained or repeated exposures or are the time courses of these reactions different?

4. What effects do certain favorable or unfavorable contextual associations given to annoying and more pleasant sounds have on the physiological or subjective reactions evoked by the sounds?

This effort to find answers to these questions can be regarded as an exploratory one, searching for leads to more definitive research.

II. BACKGROUND

A. Review of Physiologic Reactions Evoked by Sound

The current literature references assorted effects of noise on extra-auditory physiological functions (Jansen, 1969; Environmental Protection Agency, 1971; Anthony and Ackerman, 1959; Kryter, 1970). However, these observations lack for systematic integration, there being only tentative agreement among researchers as to their stress significance. Reviews by Anticaglia and Cohen (1970), Nixon (1971), and Glass and Singer (1972) infer that intense noise conditions can cause stress as defined by certain changes in cardiovascular, neurologic, and glandular functions. Such changes are response manifestations of the sympathetic autonomic nervous system whose activation coincides with heightened emotional experience. Of interest here was whether these types of extra-auditory physiological changes could also be evoked by more moderate levels of sounds owing to their acoustic quality, familiarity and meaning. A summary of information bearing on the aforementioned physiological indicators as affected by sound follows:

1. Cardiovascular Response Measures

a. Heart Rate (HR) - In the foreign literature, Taccola, Straneo, and Bollio (1963) and Shatalov, Saitanov, Bradshaw, Glotova (1962) report that exposure to intense occupational-type noise increases the incidence of cardiovascular irregularities such as bradycardia (decrease in the cardiac rate) in workers. Thackray and Touchstone (1970) found that the first unexpected and the subsequent bursts of 115 dB random noise resulted in a heart rate response consisting of an initial significant acceleration during the first 5-sec. interval after stimulation followed by a rather abrupt deceleration. In a second study (Thackray, 1972) though, with repeated exposures to simulated sonic booms ranging in peak overpressure from 1 to 3.9

pounds per square foot (psf.), an overall suppression of heart rate was noted. The differences in the response patterns obtained in the two studies, however, were attributed to the probable differences in the loudness level of the stimuli employed. Compared with these findings, a definite heart rate acceleration in response to simulated sonic booms of .63 psf. to 2.5 psf. was obtained by Becker, Poza, and Kryter (1971), while the heart rate response to various nonimpulsive noises such as a vacuum cleaner, barking dog, motorcycle, and freeway traffic at levels between 62-85 Max dBA were not sufficiently consistent to indicate either acceleration or deceleration.

b. **Blood Pressure (BP)** - It has been shown by Lehmann (1956) and Jansen (1969) that moderate level noise exposure (70 dBA) causes vasoconstriction of the peripheral arteries. Furthermore, this response shows only limited adaptation with repeated exposures to the same sound. Linked with this vasoconstriction appear to be changes in arterial blood pressure as reported by Floss (1964) that seem to reflect a compensating action by the heart. Ponomarenko (1966) also notes a decrease in the systolic and an increase in the diastolic blood pressure in industrial workers exposed to high level noise.

2. <u>Glandular Response Measures</u>

a. Galvanic Skin Response (GSR) - Measurement of electrodermal responses, i.e., the decrease in skin resistance occurring in response to emotional provoking stimuli (Darrow, 1937, 1934; Lindsley, 1958) has become an important aid to investigators of psychophysiologic phenomena. For example, Thackray and Touchstone (1972, 1970), Glass and Singer (1969), and Thompson and Spencer (1966) have all demonstrated a sharp drop in galvanic skin resistance measures as part of a "startle" response to a sudden burst of sound. GSR measures here then show rapid habituation with repeated exposures. In a recent study by Atherley, Gibbons and Powell (1970), subjective importance of some sounds, e.g., aircraft, alarm bell, typewriter and baby crying, was found to be significantly correlated with changes in skin resistance.

b. Gastrointestinal Motility (G.I. Motility) - The sudden, unexpected occurrence of noise at even moderate levels of intensity produces a complex bodily change that features increased gastrointestinal (G.I.) activity. For example, Davis, Garafolo, and Gault (1957) found a tone burst of 95 dB (SPL re .0002 Microbar) to produce a rise in amplitude of the gastrointestinal waveform reflecting a tonic contraction. In a study by Stern (1965), it was shown that a 500 Hz tone of 70 dBA caused more G.I. motility than lower levels of the same sound.

3. Biochemical Response Measures - Catecholamine and 17-Hydroxycorticosteroid (17-OHCS)

The catecholamines (epinephrine, norephinephrine, etc.) and 17-OHCS are a group of hormones secreted by the adrenal medulla and adrenal cortex, respectively. Principal reliance has been placed on increased secretion levels of 17-OHCS and catecholamines to indicate the degree of stress imposed upon the human organism. High level sound exposures, e.g., siren levels of 140 dB, have resulted in increased secretions of these hormones in animals reflecting apparent severe degrees of stress (Anthony and Ackerman, 1959). Under less intense noise conditions, however, there seems to be hormonal changes in the opposite direction. Under 75 dBA noise, Sakamoto (1959) showed that industrial workers excreted less than normal levels of urinary 17-Ketosteroids (17-Ks). Atherley, Gibbons, and Powell (1970) found a decrease in urinary 17-Ks when exposed to laboratory simulated aircraft noise at 95 dBA and typewriter noise at 70 dBA which were judged more important than white noise of 82 dBA which showed little change in 17-Ks relative to control measures. The authors attempted to explain these findings by suggesting that the lengthy exposure trials in this study, especially those containing aircraft and typewriter noises, caused the subjects to become quite tired. Under these conditions there can be diminished adrenal cortical activity.

B. Review of Subjective Reactions Evoked by Sound

Assorted subjective experiences, moods, feelings have been induced by sounds owing to their acoustic features (frequency, intensity, tempo, timbre, shrillness) or to their non-acoustic qualities (familiarity, pleasant o unpleasant associations). Cohen (1969) discussed the various ways in which individual attitudes and feelings are directly and indirectly influenced by certain sounds. Included as illustrations of the direct effects were (1) the chill-like feelings caused by chalk scraping on a blackboard or by some other abrasive type of sound, (2) moods ranging from calmness and contentment to excitement and elation evoked by musical sounds when tempo, rhythm, and melody are varied, (3) positive attitudes created in employees towards their work by introducing music into the industrial setting (Uhrbrock, 1961).

Concerning specific properties of the acoustic stimulus, it was noted that annoyance, reflected in negative feelings and attitudes, was aroused to a greater extent by some characteristics of the sound than others. Generally, annoyance grows with increased intensity (i.e., increased loudness), with higher frequencies (i.e., higher pitch) and with greater amount of variability in occurrence of the sound (i.e., the more intermittent and random, the more annoying).

Furthermore, sounds have indirectly influenced personal attitudes and feelings through the information being conveyed. Annoyance reactions evoked by many sounds have resulted not primarily because the sound is too loud or too shrill but because of the distress, alarm, or other unpleasant meanings which have been communicated. An example of this type of reaction is found in the annoyance elicited by the sound of an approaching aircraft because of the attached fear of a possible crash (Borsky, 1958; Parrack, 1957). Similarly, the fear connected with the siren of a patrol car or the clanging bells of a fire engine sometimes renders these sounds the most objectionable source of auditory annoyance next to television and radio were due not to the loudness of such communication, but rather to the references to other patients' conditions, operations and symptoms contained in them (Goodfriend and Cardinell, 1963). These pleasant or unpleasant associations along with such additional factors as the listener's unfamiliarity with the sound or the necessity or advantage identified with it weigh on the individual's judgment of acceptability.

In order to be able to quantify and compare these varied reactions evoked by the different acoustic qualities or non-acoustic features of sounds, two measurement techniques depending upon human judgments were considered in this study.

1. Subjective Rating Scale

Rating scale procedures represent merely an orderly description of the judgments people make every day as a matter of ordinary experience. In the extensive use of this method for estimating subjective reactions to sound, particularly with regard to relating the subjective response to the physical characterization of the sound event, several key facts about scaling these subjective judgments of sounds have emerged. Kryter (1970) has noted that the word "annoyance" is commonly used to signify one's reaction to sound that is based not only on the unwantedness and objectionableness of sounds, but also on the emotional content, unpleasant associations, or novelty which the sound may have for a particular individual. In scaling judgments of sounds where these aspects of the individual experience are important, annoying appears to be a more effective description than loud or noisy for anchoring the scale. In relation to the structure of the scale, Guilford (1954) and Conklin (1923) have suggested that for a bipolar scale the number of optimal divisions is nine, although others have used as many as twenty five (Bregman and Pearson, 1972) and as few as seven (Becker, Poza and Kryter, 1971).

Using the numerical form of rating scale, other studies have reported subjective ratings to some of the sounds used in this study. At moderate levels of exposure ranging from 62-85 Max dBA, mean ratings of unacceptability yielded the following rank-order of select typically annoying sounds: vacuum cleaner sound, freeway traffic sounds, barking dog, truck noise, and motorcycle noise (Becker, 1971).

2. Semantic Differential Measure of Meaning

Auditory experience has a richness and variety that far exceeds those aspects represented by just loudness or noisiness. Even a pure tone, the simplest type of sound, has attributes of loudness, pitch and volume. (Stevens and Davis, 1938). Complex tones, being mixtures of pure tones, vary in quality or timbre and seem to have, in addition to loudness, pitch and volume, qualities of brightness, roughness and fullness (Lichte, 1940). Everyday sounds and music grow in dimensionality and variety as they are extended in time, and their full richness emerges as they form a sequence spread over time.

Only a few studies of the richness and variety of auditory experience have been done. Solomon, (1957, 1958) using the semantic differential approach to the verbal description of objects, events and perceptions developed by Osgood (1957), allowed subjects to rate 20 different passive sonar sounds along 50 dimensions as defined by pairs of adjectives in opposition. The results suggested that people can meaningfully evaluate sounds on a magnitude dimension (heavy-light), on an aesthetic-evaluative dimension (good-bad, beautiful-ugly); a clarity dimension (clear-hazy); a security dimension (gentle-violent, safe-dangerous); a relaxation dimension (relaxed-tense); a familiarity dimension (familiar-strange); and a mood dimension (colorfulcolorless). These dimensions demonstrate the diversity of auditory experience and its description which is not limited to the attributes of loudness or noisiness.

Kerrick, Nagel, and Bennet (1969), in a study where 16 brief sounds (music, vehicle sounds, and artificial sounds) were judged on each of 15 bipolar scales, found two major dimensions. These were described by the words active, loud, familiar, noisy and by pleasant, acceptable, good and natural. As in Solomon's study (1957), loud and noisy descriptions were used as synonomous while acceptability was not necessarily equated with either of these.

C. Summary

This review characterizes a number of physiological changes and subjective impressions that can be induced by sound stimulation. The present study sought to measure and correlate such changes and also observe response variations with prolonged or recurrent exposures. The sounds utilized for this purpose, while of moderate level, varied greatly in acouetic quality, familiarity, and meaning so as to foster subjective experiences ranging from pleasant to unpleasant in nature. More detailed consideration is given of these test sounds and psychological and physiological response measures utilized in this study in succeeding sections.

III. METHODOLOGY

A. Experimental Design

Twenty test sessions over a period of four weeks served as the framework within which the data were collected from each subject. This period, as diagrammed in Figure 1, included an initial three sessions of baseline physiological determinations without any exposure to the test sounds followed by 16 sessions of such exposure. The twentieth session did not involve any exposure and served only for debriefing purposes.

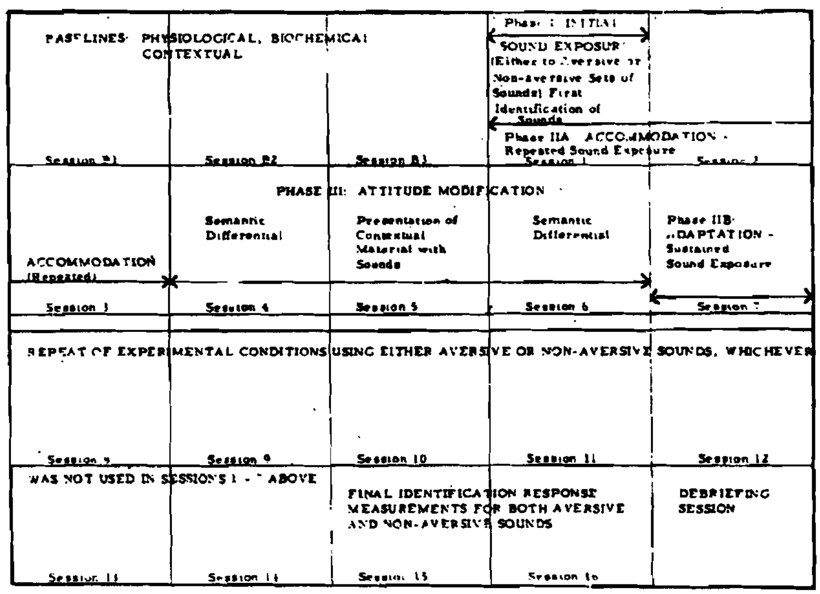

FIGURE 1. BLOCK DIAGRAM OF 20 TEST SESSION EXPERIMENTAL PLAN FOR EXPOSURE TO NON-AVERSIVE AND AVERSIVE SOUND

Sets of sounds, initially classified as aversive or non-aversive in nature, were presented during 14 test sessions, the non-aversive ones being assigned to half of the subjects during the first seven exposure sessions and the aversive ones for the last seven sessions. The other half of the subject group was exposed in the reverse order. This division of the test sounds and counterbalancing of the order of presentation was necessitated for several reasons, explained later. The two final test sessions remaining out of the total 16 exposure sessions were used for presenting all of the test sounds for the subjects' final judgment and identification.

As illustrated in Figure 1, the experimental design consisted of three phases.

<u>Phase I</u>: Assessment of Initial Reactions to Aversive and Non-aversive Sounds and Correlation of Subjective and Physiological Measures

Determinations were to be made whether there were any reliable physiologic and/or subjective reactions to aversive-type sounds that might be distinguished from those produced by sounds of less aversiveness. For this purpose, physiologic reactions were monitored for subjects during the first session of exposure to aversive or non-aversive sounds and correlated with subjective judgments of the extent of annoyance evoked by the same sounds. Primary questions to be answered here were:

1. Are there any significant mean differences between physiological and subjective reactions evoked by the aversive sounds (AV) and non-aversive sounds (NA)?
2. Is there a significant correlation between physiological measures and subjective responses reflecting perceived

annoyance to aversive and non-aversive sound?

<u>Phase II</u>: Evaluation of (A) Accommodation and (B) Adaptation of Subjective and Physiological Responses After Repeated and Sustained Exposure to Aversive and Non-aversive Sounds

The objective of Phase II was to evaluate the effects that repeated or sustained exposures to aversive and non-aversive sound have on the physiologic and subjective reactions which were initially observed during Phase I. Accommodation was taken to mean a diminution of affective response, either physiological or subjective, over successive test sessions involving the same aversive or non-aversive sounds. Adaptation referred to similar response changes but with sustained exposure to the same sounds within a given test session. Particular sessions for these observations are shown in Figure 1.

<u>Phase III</u>: Modification of Responses Toward Aversive and Non-aversive Sounds by Pairings with Favorable and Unfavorable Contextual Materials

In this test phase, the different tests sounds were heard in the presence of verbal (narrative) or visual (pictorial) contextual materials which were chosen to convey positive and negative impressions. The objective was to determine if a positive contextual reference would reduce the initial unfavorable reactions given to aversive test sounds and a negative context offset more favorable responses given to non-aversive test sounds.

Another aspect of Phase III was to ascertain any changes in the perceived meanings of the test sounds due to the introduction of the contextual materials. The specific question posed was:

1. Are there any significant differences between physical

reactions and subjective responses to aversive and non-aversive sounds with coupling to favorable or unfavorable contextual references?

Particular sessions for these observations are shown in Figure 1.

B. Selection and Presentation of Test Sounds

1. Choice and Manner of Selection

The test sounds selected for use in this study were intentionally chosen so as to reflect broad differences in acoustic quality (e.g., soothing mood music, screeching file, low level humming of fan blower, scraping of fingernail across a chalkboard), familiarity (e.g., baby crying, electronic waveform sweep), and information content or meaning (e.g., vacuum cleaner, traffic and automobile crash, dog barking, rolling surf, electronically generated sound signals). This diversity sought to elicit listener experiences ranging from highly pleasant to extremely unpleasant for all types of sources of sound, i.e., household, industrial, electronic, human.

All of the test sounds were recorded at a professional sound studio and incorporated into master tapes. Prerecorded sound effects records served as the source of the vast majority of the 40 selected sounds. Others were obtained from electronic waveform generators and original, live production.

2. Classification

The test sounds as shown in Table I were initially divided into aversive and non-aversive categories based, in part, on a priori considerations and on the judgments of four recruited subjects who rated them on a nine-point sensitivity scale ranging from Very Pleasing (rating of 1) to Very Annoying (rating of 9). The operational definition of an aversive sound was one having an average subjective scale value of 5.01 or more. A non-aversive sound was one whose average rating was 5.00 or less.

TABLE I

CLASSIFICATION AND DESCRIPTION OF TEST SOUNDS
(listed in order of unpleasantness as judged by four subjects in pilot study)

Aversive

Sound	Class	Description
Waveform Sweep	Electronic	Square, sine, triangle waveforms Sweep 100 Hz to 1000 Hz tone at 1 sec intervals
Waveform Burst	Electronic	Sine, triangle, square waveforms Burst of 1500 Hz tone 5 times per second
Waveform Steady	Electronic	Triangle, square, sine waveforms Steady 1500 Hz tone
Power Saw	Industrial	Stripping metal
Filing	Industrial	Filing metal on tin can
Faucet Drip	Household	Slow, repeated dripping
Metal Sheerer	Industrial	Metal thumping metal
Plate Glass	Household	Smashing plate glass window randomly
Magic Marker Pen	Miscellaneous	Pen strokes on slick magazine cover
Traific	Urban	Traffic background, traffic jam, skid and crash, police siren (regular and warble)
Fingernail on Blackboard	Miscellaneous	Fingernail scraping across blackboard
High Speed Drill	Industrial	High frequency dentist drill
Riveting	Industrial	Rapid steady state hammering
Factory Whistle	Industrial	Steam whistle in short bursts
Key Cutting	Industrial	High pitch grind with motor in background
Clock Tick/Alarm	Household	Tick 1.00'/alarm .5' repeated twice
Stuck Record	Music	Scratched record stuck in groove
Hacksaw	Industrial	Continuous sawing of metal
Styrofoam	Miscellaneous	Wadding up styrofoam and rubbing wads together
Baby Crying	Human	Continuous crying of infant

TABLE I - (Cont'd)

Sound	Non-aversive Class	Description
Plastic in Cup	Miscellaneous	Twisting foam in a plastic cup
Angry Crowd	Human	Arguing and shouting adults
Dog Bark	Household	Coarse/sharp barking
Water Pump	Miscellaneous	Windmill pumping water
Velcro Strip	Miscellaneous	Pulling nylon velcro strips apart randomly
Space Sounds	Electronic	Sweep, warble, pulse, echoes
Piano Chords (Dissonant)	Music	Piano keys struck randomly
Rock N'Roll	Music	Acid Rock N-Roll with electric guitars and male vocalist
Vacuum Cleaner	Household	Start, run, stop sequence
Hammering	Industrial	Hammering nails into wood
Typewriter	Industrial	Continuous typing with spacing and bell ringing
Fan Blower	Industrial	Low level whirring of rushing air
Hand Drill	Industrial	Continuous running of drill at low speed
Tape Recorder	Industrial	Tape recorder motor idle
Mocking Bird	Nature	Two contented chirping birds
Surf (Seagulls)	Nature	Light steady rolling surf with wind and seagulls
Natural Night Sounds	Nature	Chirping crickets and small frogs
Babbling Brook	Nature	Slow running water over rocks
Mood Music	Music	Pleasant, soothing orchestral music
Piano Chords (Consonant)	Music	Simple melody of consonant chords

Common to many of the sounds termed aversive were acoustic qualities of screeching, grinding, piercing, scratching, and rattling. Such features justify the unpleasant ratings. Many in the non-aversive group had calm or smooth qualities. Others, however, conveyed certain features such that their inclusion in the non-aversive category seemed questionable. As will be noted later, subsequent judgments of these sounds based on the responses of the entire 16 subject group resulted in the need for reclassification (see Table III).

As already mentioned, the test sessions were divided and included sounds from either the aversive or non-aversive group (i.e., 7 successive days of presentation of non-aversive sounds, followed by 7 successive days of presentation of aversive sounds, or vice versa), as opposed to presenting such sounds in a randomized order in any one test session. This was felt necessary to overcome possible physiologic and psychologic "carry over" reactions from the "extreme and moderate" aversive sounds to the non-aversive ones. It was recognized too that the separation of the sounds by sets of sessions could also maximize the degree of hypothesized difference between reactions, both physiological and subjective, attributable to aversive and non-aversive sounds. Clear determinations of this nature were also essential for evaluation of response accommodation or adaptation with repeated or sustained exposure to the same sounds.

Sessions concerned with the evaluation of adaptation involved eight sounds, four aversive and four non-aversive, as originally classified (see Table I) and shown below.

Aversive	Non-Aversive
Filing	Surf (seagulls)
Clock Tick/Alarm	Rock'N Roll
Waveform Burst	Vacuum Cleaner*
Fingernail on chalkboard	Typewriter*

* Reclassified as aversive from judgments rendered by total subject group (see Table III).

Subsequent subjective evaluations, however, (see Table III) found two of the four non-aversive sounds, "typewriter" and "vacuum cleaner" to warrant reclassification as aversive ones. The evaluations for adaptation were thus based on six aversive and two non-aversive sounds. The eight sounds represented a variety of acoustic features, differences in familiarity and they offered a wide range of annoyance ratings.

Test sessions and conditions for determining contextual modifications of response utilized 9 sounds selected from each of the original aversive and non-aversive classifications. These were:

Aversive	Non-Aversive
Faucet Drip	Babbling Brook
Magic Marker Pen	Rock 'N Roll
Waveform Burst	Water Pump*
Power Saw	Vacuum Cleaner*
Clock Tick/Alarm	Typewriter*
Riveting	Hammering*
Hacksaw	Fan Blower*
High Speed Drill	Dog Barking*
Plate Glass Breaking	Velcro Strip*

Again, subsequent judgments by the subjects (see Table III) indicated that all but two of the sounds classified as non-aversive, were unpleasant enough to be placed in the aversive category. Hence, the evaluation of this phase of the study

*Reclassified as aversive from judgments rendered by total subject group (see (Table III).

involved 16 aversive and 2 non-aversive test sounds. The remaining sounds from each aversive and non-aversive groups were not coupled to any response-modifying materials and served as controls.

3. Format and Conditions of Sound Presentation

Four basic tapes comprised of ten sounds each were reproduced from a master tape of test sounds using an Ampex 600 Recorder for playback and an Ampex AG-500 for recording. One tape format, namely,

Background	-	White Noise	-	90 seconds
		Test Sound	-	3 minutes
Background	-	White Noise	-	90 seconds
		Test Sound	-	3 minutes
Background	-	White Noise	-	90 seconds, etc..

served as the basic sound presentation sequence and as the point of reference for variations which were made in other test tapes to suit different phases of the experiment. This sequence of each three minute segment of test sound being preceded and followed by ninety seconds of electronic background white noise, had as its purpose to (a) mask stray test room noise, (b) reduce the "startle" reaction at the onset of the test sound, and (c) give the subject an opportunity to perform the subjective judgments as required.

All forty of the test sounds, regardless of classification (aversive or non-aversive) and experimental phase, were reproduced on an Ampex AG-500 Recorder, amplified, and presented through the experimenter's signal monitoring console to the individual subjects, listening binaurally with KOSS PRO/4AA headphones mounted in a spring headband. Each subject was seated comfortably throughout the testing in a sound attenuated room whose ambient level was nominally 30 dBA.

Regardless of sound classification and experimental phase, all the tests sounds were presented at a moderate level of audio intensity. That is, whether of a steady state or of a more impulsive nature, they were equated in overall recording level and had an audio range of approximately 78-82 dBA, while the white noise filler was maintained at a level of approximately 62 dBA. These levels were attained by precalibrating the earphone outputs for the test sounds via a KOSS 6cc cavity headphone coupler which was instrumented with a B&K 4133 Condenser Microphone. Sound level measurements were then taken with a GR-1551C sound level meter on the slow averaging-A scale (re 0.0002 microbar) for each recorded test sound.

Since particular aspects of the format and conditions of presentation of the sounds varied according to the particular phase of the experiment involved, these are separately discussed below.

a. <u>Phase I.</u> Assessment of Initial Reactions to Aversive and Non-aversive Sounds and Correlation of Subjective and Physiological Measures

Utilizing the basic tape format described previously (i.e., three minute segments of test sound preceded and followed by 90-second segments of white noise), either 20 different aversive sounds or 20 different non-aversive sounds were presented on the first test session of the seven designated for each of the two categories of test sounds. When the subjects had listened to ten of the twenty test sounds (a time lapse of 45 minutes) the test session was interrupted for a 15 minute rest pause, after which the remaining ten sounds were presented.

b. <u>Phase II.</u> Accommodation and Adaptation Processes After Repeated Exposure and Sustained Exposure to Aversive and Non-aversive Sounds

(1) Accommodation

Subjective and physiologic accommodation processes were evaluated by presenting either aversive or non-aversive sounds repeatedly over an exposure period of 3 test sessions. That is, each subject was exposed to 3 successive days of aversive sound and 3 successive days of non-aversive sound. All twenty test sounds of one group were presented in each of the three respective sessions and as before, two 45-minute periods were conducted in a session with a 15-minute rest pause between each period. The sound format was the same as the first test session with the exception that, in order to inject some variety into the exposure routine, two additional systematic randomizations of the ten sounds for each of the four test tapes were recorded for those presentations.

(2) Adaptation

Subjective and physiologic adaptation processes within a session were assessed for the eight selected aversive and non-aversive test sounds through presenting each sound to each subject for 30 minutes. Four different sounds were presented during each session. A five-minute period of silence was given between each sound and a 15-minute rest pause taken after the subjects had listened to two of the four sounds. The tape format for one of these sessions had the following appearance:

Background	-	White Noise	-	90 seconds
		Test Sound	-	30 minutes
		Silent Interval	-	5 minutes
Background	-	White Noise	-	90 seconds
		Test Sound	-	30 minutes, etc.

c. <u>Phase III.</u> Modification of Responses Toward Aversive and Non-aversive Sounds by Pairings with Favorable and Unfavorable Narrative and Pictorial Contextual Materials

The eighteen sounds, selected for response modification, were presented to the subjects in conjunction with accompanying verbal and visual information used to modify existing reactions. Verbal narratives of one to two minutes in length, depicting pleasant settings, were given just before the presentation of each aversive test sound. Seven to eight color slides, depicting scenes that produced a similar favorable "set" were then shown simultaneously with the three-minute segments of test sounds. For non-aversive sounds, the narrative and pictorial materials described an unfavorable or unpleasant situation (See Appendix D for description of contextual materials). The following breakdown illustrates the presentation format.

White Noise	-	90 seconds
Narration	-	1-2 minutes
Test Sound w/Visual	-	3 minutes
White Noise	-	90 seconds
Narration	-	1-2 minutes
Test Sound w/Visual	-	3 minutes
White Noise	-	90 seconds, etc.

The 55-minute exposure was repeated twice within the response modification session for both the 9 aversive and 9 non-aversive* sounds. The eleven remaining sounds in each group were not coupled with any contextual materials.

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* See comments on pp. 18-19.

C. **Subject Recruitment**

A sample of 24 subjects of both sexes ranging in age from 19 to 43 years, representative of an average community population, were recruited from newspaper advertising media, employment agencies, college placement services, and past employment applications files at Southwest Research Institute. The sample of 12 males and 12 females equally distributed in three age brackets (19 to 26 yrs., 27 to 34 yrs., 35 to 43 yrs.) were recruited at a rate of four subjects per month for six months. The selected subjects were paid $2.00 per hour for their participation, with an added bonus of $10.00 if they attended every session of the experiment.

Of these 24 subjects, 16 members constituted the sample upon which the major results reported in this study were based. A pilot study during which the test sounds were classified in the first grouping of 20 aversive and 20 non-aversive sounds required the use of the first four subjects. The data collected from these subjects and the next four were not included in the analysis because the experimental test conditions under which these eight subjects served varied in some important respects from those treatments given to the last sixteen subjects.

Subject selection was based on the following criteria:

(1) Between 19 years and 45 years of age

(2) A willingness to participate in all phases of the experimental series, including complete cooperation in submitting 24-hour urine samples and in being fitted with electrodes for physiologic monitoring

(3) An otologic medical examination revealing no abnormalities in ear structure or aural pathology

(4) Diversity in occupations so that the sample was not completely

composed of college students or housewives.

Pure-tone-air-conduction audiograms were performed on the left and right ears of each subject volunteer which included threshold determinations at frequencies of 125, 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000, 8000 Hz. Any potential subject that showed a hearing loss of 20 dB or more, averaged over 500, 1000, and 2000 Hz in either ear, was not accepted for the study. The testing for applicant screening was performed in accordance with approved audiometric procedures using a Beltone-9C calibrated pure-tone audiometer meeting the specifications of the American National Standards Institute (ANSI) (Se. 6-1969) and was conducted in the same sound attenuated test room used in the experimental sessions. Prior to initiation of individual hearing testing, the most recent significant noise exposures were noted so as to take into account possible elevations in hearing thresholds reflecting temporary losses in hearing sensitivity.

D. Test Procedures

1. Physiological Measurements

Physiologic reactions to aversive and non-aversive sound were evaluated by changes in heart rates, systolic and diastolic blood pressure levels, skin resistance, gastrointestinal contractions, 17-hydroxycorticosteroid levels, and catecholamine levels.

A variety of instrumentation was used in order to monitor and record the physiologic reactions of the subject. However, the majority of physiologic signals were monitored by the appropriate Beckman Input Couplers and displayed on an Offner Dynograph Type R, 8-channel strip chart recorder, at a paper speed of 0.2cm/sec. Critical epochs of the experimental sequence were indicated on the stripchart recording by means of a programmed event marker which was activated by a 1500 Hz identifying signal originating from the second channel of the dual channel Ampex AG-500 recorder. This marker was activated, for example, at the onset and termination of test sounds and also indicated passage of one-minute intervals of time. Physiologic parameters requiring electrodes for signal acquisition made use of Beckman silver/silver-chloride, shielded, biopotential skin electrodes. Baseline data were collected for all of the physiologic parameters under quite conditions before any exposure to the test sounds. These data were then compared to physiologic data collected under test conditions imposed by listening to daily sessions of aversive or non-aversive sounds.

Heart rate (HR), galvanic skin response (GSR), and gastrointestinal (GI) motility were monitored continuously throughout each test session. Both systolic and diastolic blood pressure were monitored at the beginning and at the end of each test session for 3 one-minute periods. Cumulative stress was evaluated by biochemical analyses of urine for significant amounts of 17-hydroxycorticosteroid (17-OHCS) and catecholamine (CATECH) secretion levels after exposure of five test sessions of non-aversive or aversive sound. It must be noted here that as a result of the subjective judgments rendered by the total subject group and the subsequent reclassification of 12 of the 20 non-aversive sounds as aversive (see Table III), the blood pressure and biochemical measurements were partially confounded. Since these measurements were obtained only at the beginning and end of test sessions or after a specified number of test sessions which were under the non-aversive sound conditions based on the original classification of the sounds (see Table I), they are in response to both non-aversive sounds (8 sounds) and aversive sounds (12 sounds). The remaining physiologic indicators (Heart Rate, G. I. Motility, GSR) were monitored continuously, however, and were linked to a specific sound by means of the event and timing markers. Hence, these measures were able to be separated and analyzed according to the reclassified test sounds.

a. Cardiovascular Response Measures

(i) Heart Rate - Continuous heart rate was measured from the R-wave component of the ECG by cardiotachometry using the standard Type II frontal plane ECG arrangement.

Two dependent variables were statistically analyzed, namely:

Average Heart Rate - arithmetic average of beats occurring per minute

Peak Heart Rate - maximum rate per minute

(ii) Blood Pressure - In this study, both systolic and diastolic blood pressure were monitored immediately before and after each session with an Arteriosonde Model 1261 featuring automatic cuff inflation and analogue readout in mm Hg. The dependent measures were:

Systolic Blood Pressure - mm Hg averaged for 3 one-minute periods

Diastolic Blood Pressure - mm Hg [illegible] one-mi[illegible]riods.

b. Glandular Response Measures

(i) Galvanic Skin Response (GSR) - GSR was monitored continuously to assess the effects of sound on basal skin resistance by analyzing short-term initial reactions and long term cumulative trends. Ten micro-amperes were passed through the middle segment of the middle finger of the non-preferred hand to the dorsal surface of the wrist on the same hand. The dependent measures consisted of:

Peak Amplitude - maximum amplitude in (mmhos) occurring within one minute

Frequency - number of response deflections per minute.

(ii) Gastrointestinal (G.I.) Motility - In an effort to assess the effects of the test sounds on visceral muscle motility in the intestinal tract, an electrogastrogram was continuously recorded from the upper left and lower right quadrants, separated by four inches, transversing the umbilicus of the abdominal region. The two dependent variables analyzed were:

Displacement - change in millivolts (mv.) between the end points of a one-minute baseline.

Peak Amplitude - maximum amplitude change (mv.) occurring within one minute from the two end points of a baseline.

c. Biochemical Response Measures

Because the level of activity of the adrenal cortex is a fundamental consideration in the question of whether noise level acts as a stressor, urine samples were collected during a 24-hour period before exposure to any test sounds (baseline), after exposure to non-aversive* sound and after exposure to aversive sound. Two dependent variables were measured:

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* This is a confounded category, (see pp. 25-26); 12 of these 20 sounds are more correctly categorized as aversive.

17 - Hydroxycorticosteroids - Urine collected over 24-hour period (mg/24 hrs.)

Catecholamines - Urine collected over 24-hour period (μg/24 hrs.)

2. Subjective Measurements

a. Rating Scale Measures of Sensitivity

Subjective assessment of the extent of annoyance was evaluated in this study for each exposure to sound during all testing sessions, using a specially prepared scale. An example section of the rating scale is shown below with the complete scale found in Appendix A.

SUBJECTIVE RATING SCALE

Instructions: Indicate how the sound affected you by placing an X mark in the blank space which best represents how you felt while listening to the sound. Be sure to mark only one space.

SOUND NUMBER 1

Very pleasing : _ : _ : _ : _ : _ : _ : _ : _ : _ : Very annoying
1 2 3 4 5 6 7 8 9

This scale revealed the extent to which a given sound elicited pleasant or annoying impressions. Each subject had the opportunity to rate all the test sounds, both aversive and non-aversive, at least 3 times in the total study. Those sounds specially selected for evaluation in Phase II (Adaptation) and Phase III (Response Modification by Contextual Influence) were presented even more often for rating. Subjects were instructed to make their judgments after they had listened to the three-minute segment of test sound, i.e., to perform all writing tasks during the white noise segment following the sound.

b. Source Recognition

In addition to the subjective rating given, the subjects had the opportunity on their initial exposure to both groups of test sounds and on the 15th and 16th test sessions (see Figure 1) to identify the sound or describe the sound source in their own words. This identification task, the form for which is found in Appendix B, was to ascertain the initial familiarity of the subjects with the sound and to note any improvement in recognition of the sounds with subsequent exposures.

c. Semantic Differential Measures of Meaning

Apart from the aforementioned responses, each subject also rated the test sounds on a set of adjective scales as derived from the semantic differential technique used in measuring meaning. The scales were derived, in part, from antonym word lists previously used in evaluating the meanings associated with noise, sounds, and music as noted by Osgood and Suci (1955), Solomon (1958), Jenkins and Russell (1958) and, in part, from a pilot study where descriptions of meanings were provided by subjects in response to the test sounds used in the main study.

All subjects rated the test sounds using the adjective scales, beginning with the 4th session in which the aversive or non-aversive sets of sounds were presented (see Figure 1). These scales were used primarily in conjunction with an attempt to modify existing responses toward aversive and non-aversive sounds. They were constructed on a nine-point differential with anchor words representing the extremes and five being the neutral point as shown below:

SOUND NUMBER 1

Attentive : : : : : : : : : : Distracting
1 2 3 4 5 6 7 8 9

A complete set of randomized scales were presented for each sound and the subject's task was to assess the connotative meaning of the sounds by rating each sound on the list of scales composed of subjective polar opposite adjectives such as those found in Table II. For example, the sound of

TABLE II. SUBJECTIVE POLAR OPPOSITE ADJECTIVES

Pleasing	-	Annoying	Feminine	-	Masculine
Solid	-	Hollow	Interesting	-	Boring
Steady	-	Fluttering	Resting	-	Busy
Leisure	-	Hurried	Slow	-	Fast
Quiet	-	Loud	Passive	-	Active
Simple	-	Complex	Ordinary	-	Unique
Narrow	-	Wide	Prompt	-	Delayed
Decelerate	-	Accelerate	Near	-	Far
Necessary	-	Unnecessary	Strong	-	Weak
Light	-	Heavy	Small	-	Large
Low	-	High	Gradual	-	Rapid
Soothing	-	Irritating	Smooth	-	Jumpy
Repeating	-	Random	Safe	-	Dangerous
Calming	-	Anxious	Familiar	-	Strange
Gentle	-	Violent	Still	-	Moving
Meaningful	-	Meaningless	Important	-	Unimportant
Stable	-	Changing	Shallow	-	Deep
Soft	-	Hard	Relaxing	-	Tensing
Free	-	Constrained	Compatible	-	Interfering
Sharp	-	Dull	Slack	-	Taut
Timely	-	Untimely	Quick	-	Sluggish
Full	-	Empty	Mild	-	Intense

a typewriter was rated on a list of scales such as "SLOW-FAST", "SMOOTH-JUMPY", "FREE-CONSTRAINED" or "SOFT-HARD". In this way, a complete profile description of a sound was obtained based on scale ratings which designated its polarity or tendency toward extreme meanings. The actual rating sheet used in the scaling is shown in Appendix C.

3. Response Modification

Following the initial reaction and accommodation phases of the experiment, an attempt was made to modify existing responses to the aversive and non-aversive sounds. The measurement techniques used for evaluating this phase included the semantic differential scales, the overall pleasing-annoying rating scales earlier described and the physiologic response measures monitored during other phases of the experiment.

The first of the three sessions scheduled for the Response Modification Phase (see Figure 1) was begun with an explanation on the use of the semantic differential scales and required judgment (see Appendix C). Then all 20 test sounds in one grouping (i.e., either aversive or non-aversive) were presented to the subjects and these were rated on the semantic differential scales. In the second session of this phase, the subjects were exposed to the nine selected sounds along with the respective contextual materials. A bias was produced before each sound was heard by verbal narratives. Then as the subjects listened to the test sounds, color slides were shown on a rear projection screen with a Kodak Carousel 800 projector located outside the subject testing room. The slides moved along in rapid sequence about every 20-25 seconds reinforcing the theme developed by the "set" producing narration. These narrative and visual materials are described in script form in Appendix D. During this session, physiologic responses were monitored and subjects rated the sounds on the overall annoyance rating scale. On the third and final session of this phase, ratings were again obtained on the semantic differential scale for the same 20 test sounds presented.

Thus, it was possible to obtain measurements reflecting responses to certain aversive and non-aversive sounds either during the session or on sessions preceding and following that in which the sounds were paired with response modifying materials. In addition, similar measurements were available for other non-aversive and aversive sounds which were not so paired. To summarize, the semantic differential measurements were made for all of the test sounds of a set on test sessions before and after the respective contextual materials were coupled with the 9 selected aversive and 9 selected non-aversive* test sounds. Since the overall annoyance scale was one of the 45 scales on the semantic differential, the pleasantness or annoyance judgments of the sounds were provided before, during and after response modification. Physiological reactions were recorded only during the presentation of the response modifying contextual materials. But in order to eliminate the effects of possible variable confounding and to establish control conditions, these physiologic responses were compared with those recorded at three other instances:

(1) Under general baseline conditions

(2) While presenting the narrative pictorial conditioning materials without and before exposure to any test sounds, i.e., contextual material baseline

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* See comments on pp. 18-19.

(3) While presenting the sounds alone without any contextual materials, i.e., initial reaction.

As already noted, nine non-aversive sounds were selected and coupled with narrative and pictorial information developed to produce an unfavorable bias toward the non-aversive sounds. In contrast, a favorable bias was created for nine aversive sounds by linking verbal material and colored slides reflecting a pleasing and useful context. This exposure to narrative and pictorial material in conjunction with the test sounds sought to produce either an unfavorable or a favorable set which would make aversive sounds less aversive and non-aversive sounds aversive. However, subsequent subjective judgments (see Table III) found all but two of the nine selected non-aversive sounds to be aversive. It was necessary then to reclassify the data obtained in the manner described above in the following way:

Aversive Sound with Favorable Narrative/Pictorial Material	-	9 test sounds
Aversive Sound with Unfavorable Narrative/Pictorial Material	-	7 test sounds
Non-aversive Sound with Unfavorable Narrative/Pictorial Material	-	2 test sounds.

IV. RESULTS

A. **Phase I.** **Assessment of Initial Subjective and Physiologic Reactions to the Tests Sounds and Their Correlation**

1. **Subjective Initial Reaction**

Ratings from very pleasing (rank of 1) to very annoying (rank of 9) to the 40 test sounds are averaged for the 16 listeners in Table III.

TABLE III. SOUND SOURCES RANK-ORDERED SUBJECTIVELY FROM PLEASING TO ANNOYING

	Sound Source	Scale Value	Sound Source	Scale Value	
	Mood Music	1.63	Metal Shearer	6.88	
	Babbling Brook	2.44	Dog Bark	6.94	
	Surf (Seagulls)	2.56	Key Cutting	7.00	
Non-Aversive	Piano Chords	2.69	Riveting	7.13	
	Mocking Bird	2.88	Plate Glass	7.31	
	Rock N'Roll	4.25	Power Saw	7.38	
	Space Sounds	4.69	Baby Crying	7.44	
	Crickets	4.94	Clock Tick/Alarm	7.44	
	Tape Recorder	5.13	Traffic	7.50	
	Typewriter	5.56	Waveform Burst	7.50	Aversive
	Water Pump	5.56	Angry Crowd	7.56	
	Factory Whistle	5.69	Velcro Strip	7.63	
	Dissonant Chords	6.00	High Speed Drill	7.81	
	Stuck Record	6.06	Waveform Sweep	7.81	
Aversive	Fan Blower	6.13	Magic Marker Pen	8.19	
	Hand Drill	6.31	Waveform Steady	8.19	
	Hammering	6.31	Plastic in Cup	8.31	
	Hacksaw	6.44	Fingernail	8.38	
	Faucet Drip	6.56	Styrofoam	8.44	
	Vacuum Cleaner	6.88	Filing	8.75	

An inspection of these data reveal that only 8 test sounds were perceived on the average as having a pleasing quality, i.e., a rating of less than 5.00. These sounds were predominately those of nature and music. Sounds that fell in the mid-range, i.e., between the marginal pleasant and annoying ratings, 5.00 to 6.00, are more of a familiar mechanical-type noise, e.g., motors, typewriter, etc. A filing sound received the most extreme rating of annoyance with a number of other test sounds, either laboratory generated noise of low familiarity, or scraping, piercing sounds also ranked high in annoyance. As the frequency distribution of subject's ratings to the test sounds in Figure 2 reveals, there is a definite negative skewness with the bulk of the scores at the annoying end of the scale.

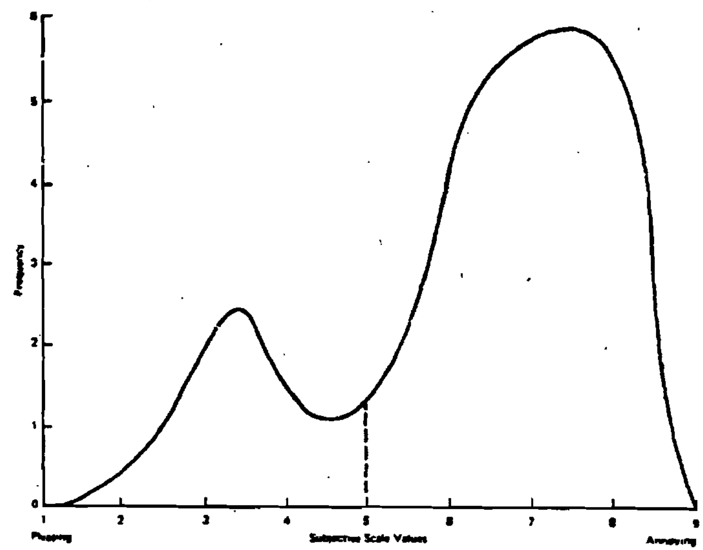


FIGURE 2. FREQUENCY DISTRIBUTION OF SUBJECTIVE JUDGMENTS TOWARD SOUND

The average of the ratings for the 8 sounds to be considered as non-aversive (ratings of 5.00 or below in Table III) was 3.26; the remaining 32 sounds rated in excess of 5.00, referred to as aversive, had an average rating of 7.08.

Degree of familiarity was assessed by determining if the listeners could actually identify the sources of the different test sounds. These judgments were solicited in the initial presentation session for the different sounds and during the last two sessions of testing for a given subject. (See Figure 1). A subject's answer here was considered correct if it showed recognition of the origin of the sound as opposed to describing its features. For example, the expressions "electronic" or "radio signals" were acceptable for identifying all sounds which had been produced by waveform generators regardless of the particular sounds actually generated. Sounds which involved pastoral themes were considered correct if "nature" was mentioned. However, appliances and machinery required more than a "motor running" descriptor. The subjects were instructed to be as specific as possible.

Again, a number of test sounds ranked high in annoyance had the lowest familiarity content, e.g., rubbing styrofoam wads together, fingernail on blackboard, plastic in cup, Magic Marker pen. Also familiarity did not improve, that is, scores did not increase between the first and last efforts at identification. Sound sources that were identified by 75% or less of the subjects are shown in Table IV. A cricket sound was the only one in the non-aversive category (rating below 5.00) which was not identified by more than 75% of the subjects.

TABLE IV. PERCENT OF SUBJECTS CORRECTLY IDENTIFYING SOUND* SOURCES ON INITIAL AND FINAL EXPOSURE SESSIONS

Initial Exposure	Final Exposure
More than 50% but no greater than 75% of subjects	
Filing	Riveting
Riveting	Velcro Strip
Steady Waveform	Filing
Velcro Strip	Steady Waveform
Water Pump	Burst Waveform
Burst Waveform	Sweep Waveform
	Crickets
More than 25% but no greater than 50% of subjects	
Crickets	Fan Blower
Sweep Waveform	
Key Cutting	
Hand Drill	
25% of subjects or less	
Fan Blower	Hand Drill
Fingernail on Blackboard	Fingernail on Blackboard
Magic Marker Pen	Tape Recorder
Tape Recorder	Plastic in Cup
Plastic in Cup	Key Cutting
Styrofoam	Styrofoam
Metal Shearer	Magic Marker Pen
	Metal Shearer

*All other test sounds not listed here were correctly identified by more than 75% of the subjects during the initial and final exposure sessions.

2. Physiologic Initial Reaction

Initial physiologic reactions upon exposure to non-aversive and aversive sounds were compared with baseline controls and established before exposure to any of the test sounds. The subjects' mean reponses to 32 aversive and 8 non-aversive sounds as well as mean baseline values were computed.

After a randomized block factorial analysis of variance had been performed to test for overall accommodation trends to be explained in Phase II, means associated with baseline and initial physiologic reaction were tested for significance using Duncan's Multiple Range Test. As reported in Table V, average

TABLE V. MEAN COMPARISONS BETWEEN BASELINE AND INITIAL PHYSIOLOGICAL REACTIONS TO AVERSIVE AND NON-AVERSIVE SOUNDS

Response Measure	Dependent Measure	Deviation of Physiologic Measure from Baseline Values — Sound Condition: Aversive	Non-Aversive
Heart Rate	Average (bpm)	-.14	-.57
	Peak (bpm)	-.36	-.04
G.I. Motility	Displacement (mv)	+.238*	+.087
	Peak (mv)	+.118	+.016
GSR	Peak (mmhos)	+1.02	+1.12
	Frequency (dpm)	+0.68	+1.01*

* significant at $p < .05$

and peak heart rate initial reaction means did not significantly differ from mean baseline rates for either aversive or non-aversive test sounds. However, increases in G.I. Motility displacement in response to the first exposure of the aversive sounds relative to baseline measures were found significant at the 5% level. There were no significant changes in peak amplitude of G.I. Motility under these conditions. In addition, significant increases at the 5% level were found between the first test session and baseline for non-aversive sound conditions as measured by GSR deflection frequency. No significant differences were evidenced in peak skin conductance upon initial exposure to either aversive or non-aversive sounds.

Changes in systolic blood pressure, as shown in Figure 3, were noted at the beginning and at the end of the session involving initial exposure to aversive test sounds While these changes proved significantly different from baseline readings taken in earlier sessions, they were not different from each other. Similar findings occurred for diastolic blood pressure measurements.

As has already been mentioned, the blood pressure measurements obtained under non-aversive sound conditions are partially confounded since 12 of the original 20 non-aversive sounds which were presented on the sessions when these blood pressure measurements were made were reclassified as aversive on the basis of the judgments of the total subject group. (See Table III.) Hence, the results reported here and elsewhere in this document for the blood pressure response to non-aversive sounds must be qualified by this observation. As illustrated in Figure 4, diastolic blood pressure was significantly higher after exposure to non-aversive* sounds than before exposure. However,

* This is a confounded category, (see pp. 25-26); 12 of these 20 sounds are more correctly categorized as aversive.

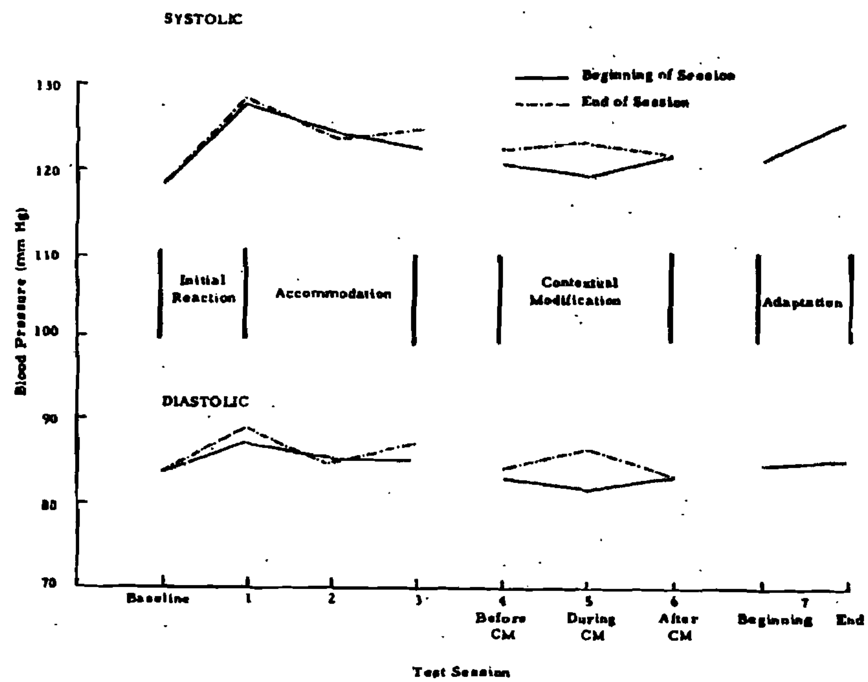


FIGURE 3. DIFFERENCE IN MEAN BLOOD PRESSURE RESPONSE TO AVERSIVE SOUNDS IN DIFFERENT PHASES OF THE TESTING

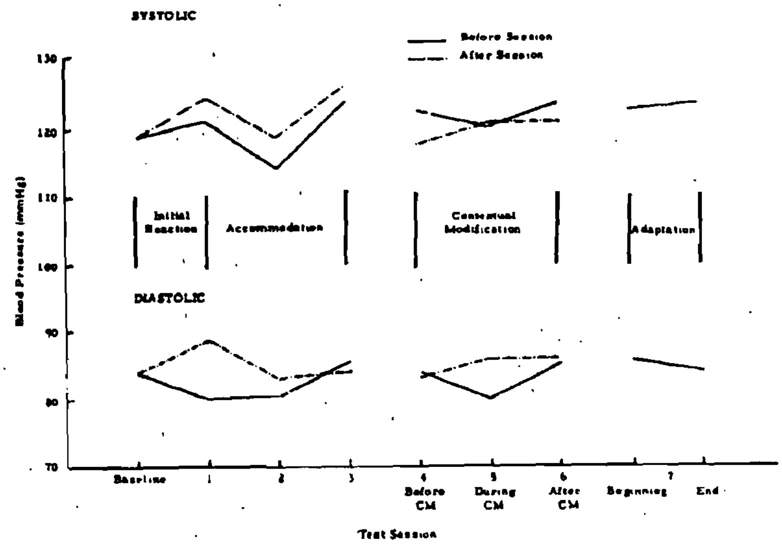
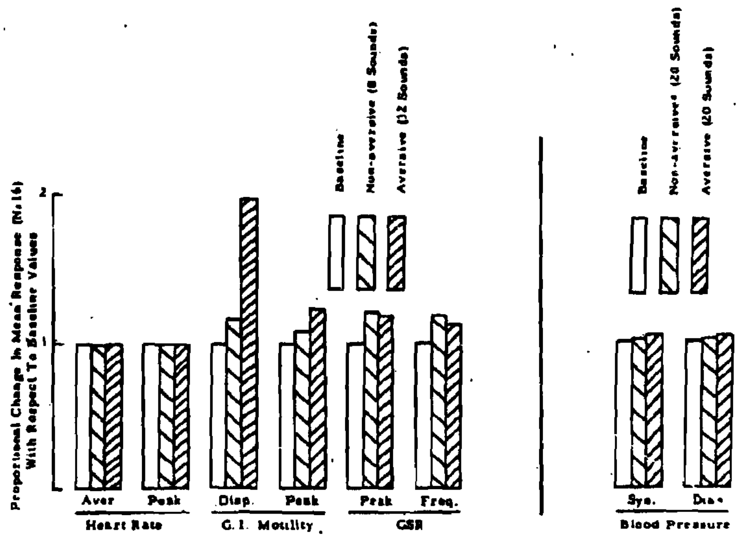


FIGURE 4. DIFFERENCES IN MEAN BLOOD PRESSURE RESPONSE TO THE NON-AVERSIVE SOUNDS IN DIFFERENT PHASES OF THE TESTING

neither of these measures were significantly different from the mean baseline diastolic blood pressure.

All mean initial physiological reactions to aversive and non-aversive sounds are summarized as proportional changes with respect to baseline values in Figure 5.



* This is a confounded category. See pp 25-26); 12 of these 20 sounds are more correctly categorized as aversive

FIGURE 5. SUMMARY OF MEAN INITIAL PHYSIOLOGICAL REACTIONS TO THE TWO TYPES OF TEST SOUNDS

Relative to the question of distinctiveness of physiologic response to aversive and non-aversive sounds, only one measure appeared to reliably evidence this characteristic. The increased displacement of the gastrointestinal waveform from baseline was statistically significant in response to the aversive sounds, while the increase noted upon exposure to non-aversive sounds was not. It is noteworthy that the difference between the reactions to the two types of sound was not one of direction but one of magnitude or degree. In general, this was the pattern of

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response for the majority of physiological variables measured.

3. Correlation

Separate correlation coefficients for the initial and final exposure periods were calculated between each physiological measure, and subjective ratings averaged for all subjects for sounds judged aversive (32 sounds with ratings of more than 5.00), judged non-aversive (8 sounds with ratings of 5.00 or less), and for all test sounds (combined). As noted in Table VI, significant correlations with subjective ratings were demonstrated with G.I. Motility measures (both peak and displacement) for the initial exposure sessions, higher motility values corresponding with higher annoyance values irrespective of the groupings of the test sounds. A greater correspondence is seen between the subjective ratings and

TABLE VI. CORRELATION BETWEEN SUBJECTIVE AND PHYSIOLOGIC REACTIONS TO THE TEST SOUNDS

Exposure	Sound	G.I. Motility		GSR		Heart Rate	
Period	Condition	Peak	Displace	Peak	Freq.	Peak	Average
Initial	Combine	.50**	.60**	[illegible]	.09	.25	-.10
	Aversive	.41**	[illegible]	.15	.04	.10	-.20
	Non-aversive	.76**	.94**	[illegible]	[illegible]	.50	-.62*
Final	Combine	.21	.25	[illegible]		-.27	-.32*
	Aversive	.31*	.11	[illegible]		-.42*	-.45**
	Non-aversive	.40	.28	.56		-.52	-.26

Combine - df 39, r= .257, $p < .05$*; r= .358 $p < .01$**

Aversive - df 31, r= .296, " ; r= .409 "

Non-aversive - df 7, r= .582, ; r= .750 "

physiological measures for the non-aversive sounds as compared with the aversive sounds in the first exposure session. All such correlations for the non-aversive sounds are diminished in the final session with none attaining statistical significance.

Correlations between subjective ratings and physiological data differ between the initial and final sessions for exposures to the aversive test sounds. Differences here are not clear. There is a decreasing degree of correspondence between G.I. Motility readings and subjective annoyance ratings between the first and last sessions on the one hand, and on the other, a generally increasing covariation between subjective annoyance and heart rate and GSR (frequency) measures. The change in correlation could be reflecting differential adaptation or accommodation processes for the subjective responses relative to the physiological indicators. Evidence that subjective measures showed variations over time different from that of the physiological measures is summarized in Phase II results. Significant negative correlations between subjective ratings and heart rate response to the test sounds in Table VI indicate that increased annoyance is associated with a slower heart rate.

Correlations between each physiological response measure and subjective ratings to the test sounds by individual subject were also computed. As shown in Table VII, only G.I. Motility displacement indicated a trend toward a positive relationship with subjective ratings, i.e., increasing displacement with increasing annoyance. G.I. Motility peak, which showed significant correspondence with subjective ratings for averaged group data, does not show this covariation when each subject is treated separately.

TABLE VII. CORRELATION BETWEEN SUBJECTIVE REACTION TO ALL FORTY TEST SOUNDS AND PHYSIOLOGICAL MEASURES ON INITIAL TEST SESSION FOR INDIVIDUAL SUBJECTS

Experimental Subject No.	Average Heart Rate	Peak Heart Rate	G.I. Motility Disp.	G.I. Motility Peak	GSR Peak	GSR Frequency
1	-.007	+.037	-.088	+.050	[illegible]	-.106
2	+.223	-.102	+.269*	-.229	+.084	-.311
3	-.317*	-.256*	+.011	+.016	+.397*	-.037
4	+.254	+.156	+.028	-.154	-.361**	[illegible]
5	+.313*	+.324*	-.197	-.383**	+.502**	+.49[illegible]
6	-.179	-.406**	-.127	-.366**	-.455**	-.344*
7	+.200	+.056	-.100	-.065	+.134	-.112
8	-.660**	-.639**	+.059	-.070	-.376**	-.457
9	-.325**	-.541**	+.605**	+.603**	-.065	-.125
10	-.268*	+.087	+.317*	+.336**	-.108	-.225
11	-.373**	-.365**	+.272*	+.230	-.009	-.451
12	+.383**	+.154	-.176	+.404**	+.497	+.292
13	-.417**	+.254	+.028	-.097	-.383**	-.289
14	-.700**	-.732**	+.060*	+.392**	+.219	+.213
15	-.001	-.214	+.037	+.187	-.047	-.356
16	-.197	-.308*	-.218	-.357*	-.533**	[illegible]

df=39 r= .257, $p < .05$*
r= .358, $p < .01$**

4. Biochemical Response Measures

Hormonal secretions from the adrenal gland (17-OCHS and catecholamines) were averaged for the 16 subjects after 5 consecutive sessions of exposure to non-aversive or aversive test sounds. As already noted, the biochemical results for the non-aversive sound treatment are partially confounded because of the reclassification as aversive of 12 of the 20 original non-aversive sounds (see Tables I and III) which were presented during the exposure interval from which these measures were taken.

	17-OHCS (mg / 24 hrs)	Catecholamine (μg / 24 hrs)
Baseline (No Sound)	7.41	50.03
Non-aversive	7.74	51.13
Aversive	8.26	54.96

Despite differences suggesting increased secretions for aversive sound stimulation, a repeated measures analysis of variance revealed no significant differences between these means. Masking of treatment effects probably resulted from the sizeable inter-subject variability that occurred for these measures with the catecholamine response levels of the subjects ranging from 6 - 147 μg/24 hrs and 17-OHCS levels from 2.4 - 22.1 mg/24 hrs. Adult normal ranges for these biochemical measures are considered to be 0-140 μg/24 hrs for the catecholamines and 0-10 mg/24 hrs for the 17-OHCS. The mean values obtained were well within these ranges as were individual results with the exception of 2 subjects in the case of the catecholamines and 4 subjects for the 17-OHCS. It is entirely possible that these individual occurrences could have been due to factors totally apart from the laboratory testing.

B **Phase II.** Evaluation of Accommodation and Adaptation Processes for Repeated and Sustained Exposure to Test Sounds

1. Accommodation

A series of repeated measures, randomized-block factorial analysis of variance were conducted on all subjective and physiologic data whose treatment means are illustrated in Figures 6-9. These means were plotted against test sessions in which the subjects were exposed to a sound in one of the two categories, aversive or non-aversive, only once per session. The aversive and non-aversive sound groups were determined by the averages of the subjective scale values given to each sound source on the initial exposure session, i.e., those rated 5.00 or below were non-aversive and those rated above 5.00 were aversive. This resulted in 8 sounds in the non-aversive group and 32 sounds in the aversive group (see Table III).

Figure 6 shows that the mean subjective ratings for

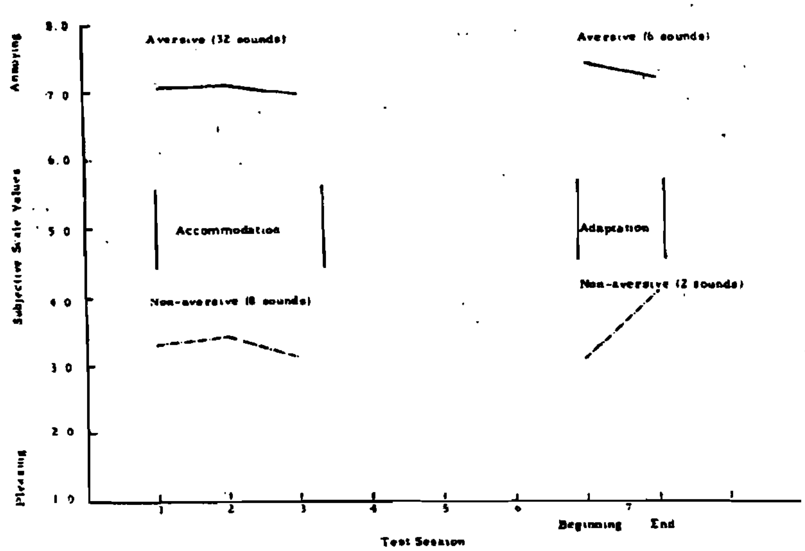

FIGURE 6 MEAN SUBJECTIVE RATINGS TO AVERSIVE AND NON-AVERSIVE SOUNDS FOR ACCOMMODATION AND ADAPTATION PHASE OF TESTING

aversive and non-aversive test sounds reveal no systematic changes across repeated exposure sessions. That is, initial subjective reactions to the test sounds whether pleasant or unpleasant, did not significantly change with subsequent repeated exposure to the same sounds.

Analysis of variance performed on the physiological parameters did reveal effects across repeated test sessions that were significant for G.I. Motility displacement ($F = 3.4$ $p < .05$) and GSR measures of peak amplitude ($F = 3.16$ $p < .05$) and deflection frequency ($F = 7.39$ $p < .01$). The results of Duncan's Multiple Range Test for significant means are summarized in Table VIII. The G.I. Motility responses, which increased significantly relative to baseline response during the initial and second exposures to aversive sounds, decreased in Session 3 to a value not significantly different

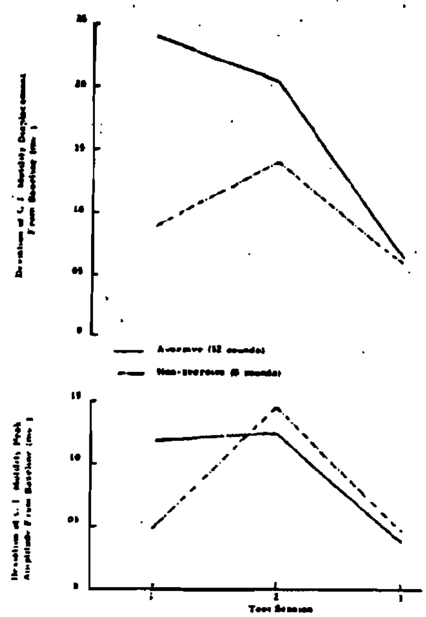

FIGURE 7. INITIAL AND SUBSEQUENT MEAN G.I. MOTILITY REACTIONS TO TEST SOUNDS OVER REPEATED EXPOSURE SESSIONS

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TABLE VIII. MEAN DIFFERENCES REFLECTING ACCOMMODATION IN G.I. MOTILITY AND GSR RESPONSES OVER REPEATED TEST SESSIONS FOR AVERSIVE AND NON-AVERSIVE TEST SOUNDS

Response Measure	Sound Condition	Test Session Means (N=16) Baseline (B)	1	2	3	Mean Comparison	Significance Level
G. I. Motility-Displacement (mv)	Aversive	.255	.493	.459	.327	B & 1 B & 2 B & 3 All others	$p < .05$ $p < .05$ N.S N.S.
GSR-Deflection Frequency (dpm)	Non-aversive	2.37	3.88	2.44	3.28	B & 1 B & 2,3 1 & 2 2 & 3	$p < .05$ N.S $p < .01$ $p < .05$
GSR-Deflection Frequency (dpm)	Aversive	2.87	3.55	2.61	3.62	B & 1,2,3 1 & 2 2 & 3.	N.S $p < .05$ $p < .05$
GSR-Peak Conductance (mmhos)	Non-aversive	2.71	3.83	1.83	7.14	B & 1,2,3 2 & 3	N.S $p < .05$
HR-Average (bpm)	Aversive	78.24	78.10	77.37	76.33	All	N.S
HR-Average (bpm)	Non-aversive	78.24	77.67	77.63	76.94	All	N.S.
HR-Peak (bpm)	Aversive	88.91	88.85	88.73	88.0	All	N.S.
HR-Peak (bpm)	Non-aversive	88.91	88.87	87.62	87.26	All	N.S.

from baseline. This return back to a baseline level suggested accommodation in the G.I. Motility response to the aversive test sounds.

Mean comparisons for GSR peak conductance and deflection frequency between the different test sessions show significant differences but do not reveal an orderly progression reflective of either accommodation or sensitization.

While statistically insignificant, Figure 9 suggests a trend of decreasing heart rate across exposure sessions for both sets of test sounds. These results hardly warrant the assertion that accommodation was occurring, indeed the opposite; but since none of the heart rate values represented significant deviations from baseline, conclusions as to sensitization cannot be made.

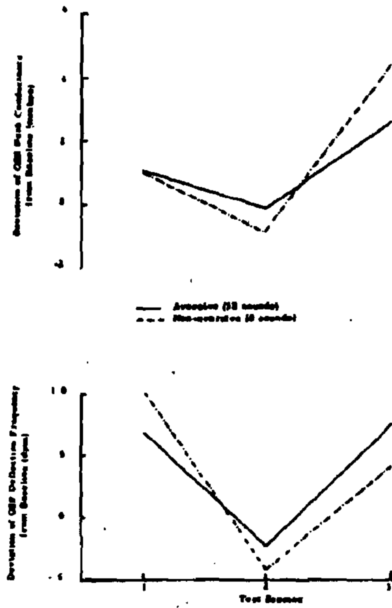

FIGURE 8. INITIAL AND SUBSEQUENT MEAN GSR RESPONSES TO TEST SOUNDS OVER REPEATED EXPOSURE SESSIONS

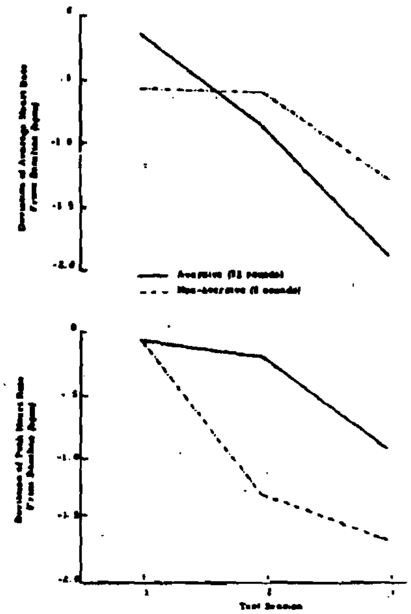

FIGURE 9. INITIAL AND SUBSEQUENT MEAN HEART RATE RESPONSE TO TEST SOUNDS OVER REPEATED EXPOSURE SESSIONS

Differences between mean systolic and diastolic blood pressure at the beginning and the end of repeated exposure sessions are plotted in the accommodation portions of Figures 3 and 4. The t-ratios computed between these differences showed a significant rise ($t = 3.59$, $p < .01$) in systolic blood pressure relative to baseline at the end of the initial aversive sound exposure session. This change is limited, however, by the fact that an equally significant increase ($t = 3.34$, $p < .01$) was obtained before the session started. Over the repeated aversive test sessions, systolic measures taken both at the beginning and end of the sessions showed lower values than those obtained initially and none of these were significantly different from baseline responses. Diastolic blood pressure showed no significant changes throughout the repeated aversive sound test sessions.

Under non-aversive* sound conditions, no significant differences were noted in the mean systolic fluctuations about baseline levels; and while the comparison between the diastolic blood pressure at the beginning and end of the initial session showed a significant difference ($t = 3.48$, $p < .01$), neither these responses nor those obtained in the following two sessions were different from baseline. As a result of the minimal changes in blood pressure, relative to baseline, for aversive and non-aversive* test sounds, no substantial evidence was found to indicate these response measures were being altered in any systematic way across the test sessions.

2. Adaptation

In the adaptation portion of Figure 6 are shown the average differences in subjective ratings given prior to and at the end of 30 minute exposures to 6 select aversive and 2 non-aversive sounds as noted earlier (see pp. 25, 26). Significant differences ($t = 5.08$ $p < .01$) were found between the mean subjective reaction at the onset (rating of 3.04) and after the 30 minute exposure (rating of 4.06) to non-aversive sounds. This difference suggested increasing sensitization as opposed to adaptation to the non-aversive sounds with sustained exposure. Differences between mean subjective reactions at the beginning and end of the 30-minute

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* This is a confounded category, (see pp. 25 and 26), 12 of the 20 sounds are more correctly categorized as aversive.

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exposures to the aversive sounds were insignificant, although a slight drop in annoyance level was indicated (from a rating of 7.38 to 7.15).

A randomized-block factorial analysis of variance was conducted on all physiological parameters whose means by test conditions are displayed in Figures 10-12. By dividing the 30 minutes of continuous exposure to each sound into three ten-minute segments, adaptation tendencies within a specific time interval for the physiological responses to the 6 aversive and 2 non-aversive test

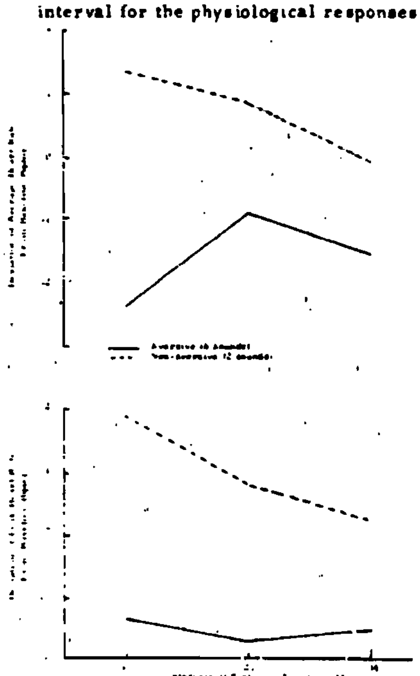

FIGURE 10. MEAN HEART RATE RESPONSE TO SUSTAINED EXPOSURE OF SELECT TEST SOUNDS

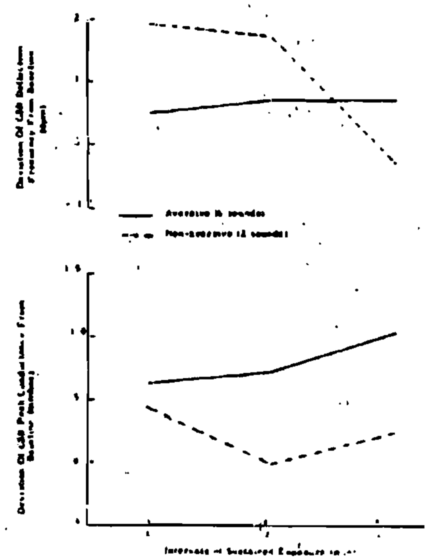

FIGURE 11. MEAN GSR RESPONSE TO SUSTAINED EXPOSURE OF SELECT TEST SOUNDS

sounds were evaluated.

Because there were no significant departures from baseline responses in any of the 10-minute segments for both GSR and heart rate measures, no evaluation for adaptation was warranted.

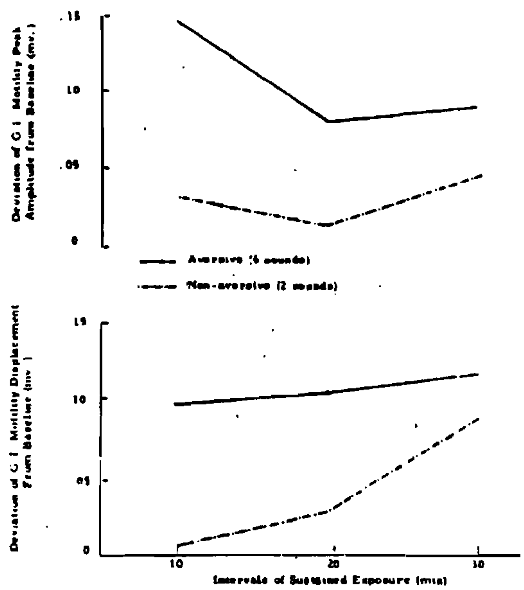

FIGURE 12. MEAN G.I. MOTILITY RESPONSE TO SUSTAINED EXPOSURE OF SELECT TEST SOUNDS

Significant deviations from baselines responses were indicated solely by G.I. Motility displacement ($F = 4.25$, $p < .05$), and peak amplitude ($F = 4.63$, $p < .05$).

A gradual increase in G.I. Motility displacement under both aversive and non-aversive sound conditions was culminated by the significant response ($p < .05$) to the aversive sounds relative to baseline in the final ten minutes of exposure. The significant rise in the peak amplitude of G.I. Motility during the first ten minutes of exposure to aversive sounds was followed by a slight decrease which nevertheless remained significantly above baseline values for the rest of the 30 minute exposure trial. Based on these observations, it appeared that no adaptation of the G.I. Motility response to sustained aversive sounds occurred.

C. Phase III. Modification of Response Towards Aversive and Non-aversive Sounds by Pictorial and Narrative Contextual Materials

1. Subjective Response Modification

Mean subjective ratings obtained before, during, and after coupling favorable contextual materials with 9 aversive sounds and coupling unfavorable contextual materials with 2 non-aversive sounds and 7 aversive sounds are shown in Table IX (see p. 20 regarding specific sounds used in this phase). A randomized block-factorial (RBF) analysis of variance performed on the differences between these test condition means established the presence of overall significant effects ($F = 6.95$, $p < .01$).

TABLE IX. MEAN COMPARISONS FOR SUBJECTIVE RATINGS BEFORE, DURING AND AFTER COUPLING TO RESPONSE MODIFICATION MATERIALS

Sound Condition	Mean Subjective Response At Session Relative to Presentation Of Contextual Materials: Before (B)	During (D)	After (A)	Mean Comparison	Significance Level
Aversive-Favorable Contextual Materials	7.44	6.54	7.15	B-D A-D B-A	$p <$ .01 $p <$ .05 N.S.
Aversive-Unfavorable Contextual Materials	6.52	6.56	6.82	B-D A-D All B-A	N.S.
Non-aversive-Unfavorable Contextual Materials	3.56	6.43	2.88	B-D A-D B-A	$p <$ .05 $p <$ .01 $p <$ .05

Duncan's multiple mean comparisons as shown in Table IX reveal that the annoyance level to the aversive sounds was significantly reduced upon coupling with favorable contextual materials and the annoyance level to the non-aversive sounds was significantly increased with coupling to unfavorable pictorial and narrative materials. No significant effect was observed for those 7 aversive sounds paired with unfavorable contextual materials. Also notable here is the reversion to the original annoyance ratings for the aversive sounds upon subsequent exposures without the biasing materials. For the non-aversive sounds, there is a shift to the level suggesting even more pleasantness. In both instances, the moderating influen-.e of the contextual materials appears short-lived.

2. Physiologic Modification

Randomized-block factorial analyses of variance were performed for the mean data displayed in Figures 13-15. No overall significant F-ratios were found between the mean physiological responses to the three sound groups (aversive sound coupled with favorable contextual materials, aversive sound with unfavorable materials, and non-aversive sound with unfavorable materials). However, the variance associated with the effects of the response-modifying materials proved significant for G. I. Motility peak amplitude ($F = 8.5$ $p < .01$) and GSR deflection frequency ($F = 7.30$ $p < .01$). Significant mean differences between these responses to the test sounds coupled with biasing contextual materials and those responses obtained under control conditions, i.e., baseline, contextual materials baseline, and initial exposure to the test sounds without any contextual materials, were revealed by Duncan's Multiple Range Test as summarized in Table X.

A significant increase in G.I. Motility peak amplitudes occurred during the presentation of the non-aversive sounds with unfavorable

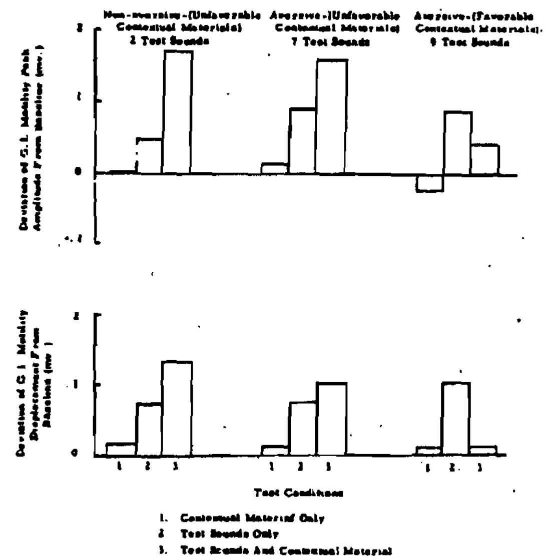

FIGURE 13. EFFECTS OF PAIRING BIASED PICTORIAL/NARRATIVE CONTEXTUAL MATERIAL WITH SELECT TEST SOUNDS ON MEAN G.I. MOTILITY RESPONSES

contextual materials when compared to the measures observed for the initial exposure to the non-aversive sounds and both baselines. These differences exhibit an effect of increased annoyance toward the non-aversive sounds accompanied by the unfavorable contextual materials. Coupling favorable pictorial and narrative information with aversive sounds produced a GSR deflection frequency response which was <u>not</u> significantly different from either of the baselines but was significantly lower than that response obtained when the sounds were presented in the first aversive test session. However, this same pattern of response occurred for the non-aversive sounds and, therefore, the influence which the contextual materials can be said to have in altering the physiologic response to aversive sound is trivial. Essentially very few of the physiological parameters demonstrated a significant change as a result of pairing contextual materials with the test sounds.

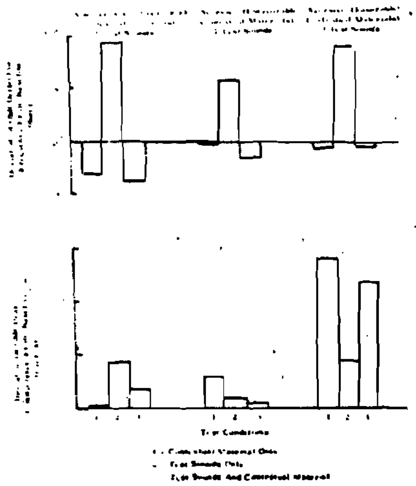

FIGURE 14. EFFECTS OF PAIRING BIASED PICTORIAL/NARRATIVE CONTEXTUAL MATERIAL WITH SELECT TEST SOUNDS ON MEAN GSR RESPONSES

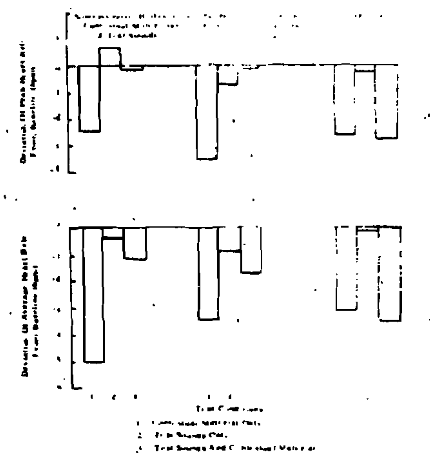

FIGURE 15. EFFECTS OF PAIRING BIASED PICTORIAL/NARRATIVE CONTEXTUAL MATERIALS WITH SELECT TEST SOUNDS ON MEAN HEART RATE RESPONSES

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TABLE X. MEAN DIFFERENCES REFLECTING SIGNIFICANT INFLUENCE OF RESPONSE MODIFYING MATERIALS FOR G.I. MOTILITY AND GSR RESPONSES

Response Measure	Sound Conditions	Means* B	CB	I	RM	Mean Comparisons	Significance Level
G. I. Motility Peak Amplitude	Non-aversive Unfavorable C. M.	.311	.312	.359	.481	RM-I	p < .05
						RM-CB	p < .01
						RM-B	p < .01
GSR Deflection Frequency	Aversive Favorable C. M.	2.67	2.90	3.76	2.83	RM-I	p < .05
						RM-CB	NS
						RM-B	[illegible]
	Non-aversive Unfavorable C. M.	2.87	2.56	3.62	2.49	RM-I	< [illegible]
						RM-CB	[illegible]
						RM-B	[illegible]

* B = Baseline

CB = Contextual Material Baseline

I = Initial (1st exposure) Test Session

RM = Response Modification Test Session

3. Semantic Differential - Measurements of Meaning

a. Meaning of Aversive and Non-aversive Sounds

In order to compare possible differences in meaning between sounds that are judged aversive and non-aversive, ratings on the semantic differential scales were acquired from the subjects for all of the test sounds prior to any attempts to modify responses. The average of the scaled ratings for the 8 most aversive test sounds from Table III were then contrasted with those for the 8 non-aversive test sounds and semantic profiles for these sounds developed. These are shown in Tables XI - XXVI.

TABLE XI. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- SURF AND SEAGULLS

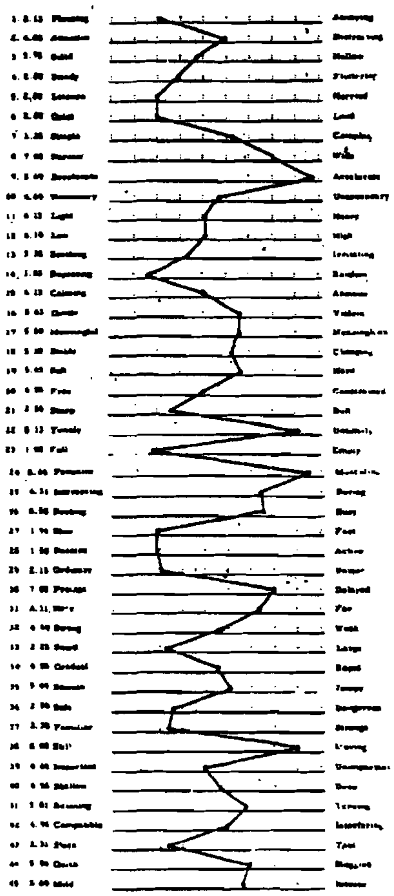


TABLE XII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- MOCKING BIRD

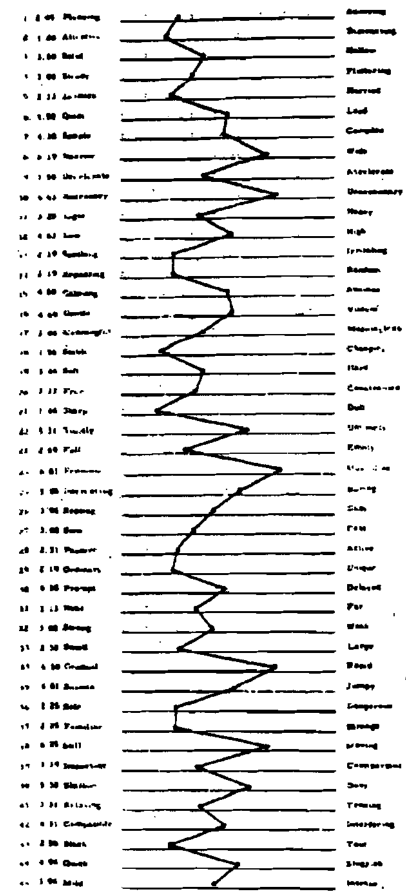


TABLE XIII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- RUNNING STREAM

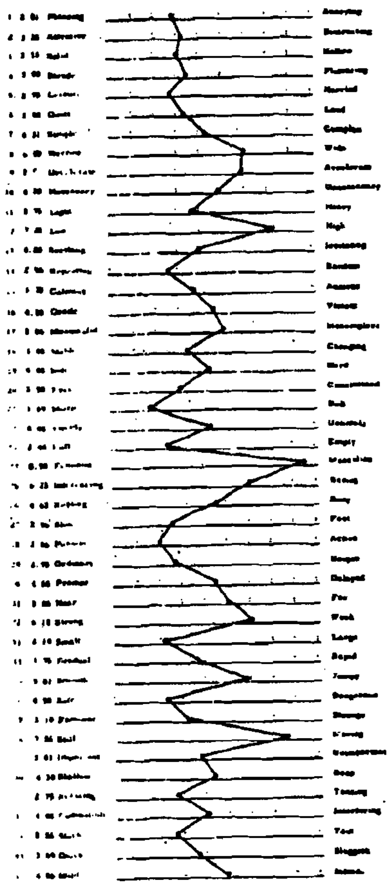


TABLE XIV. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- MOOD MUSIC

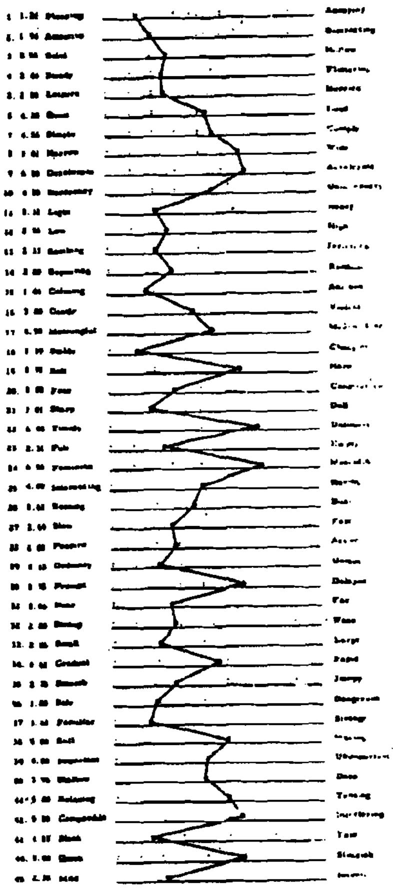


TABLE XV. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- PIANO CHORDS

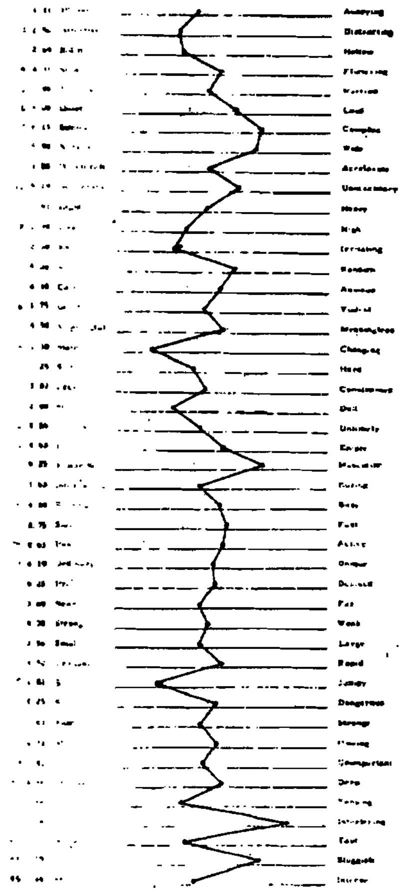


TABLE XVI. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- CRICKETS AND NIGHT SOUNDS

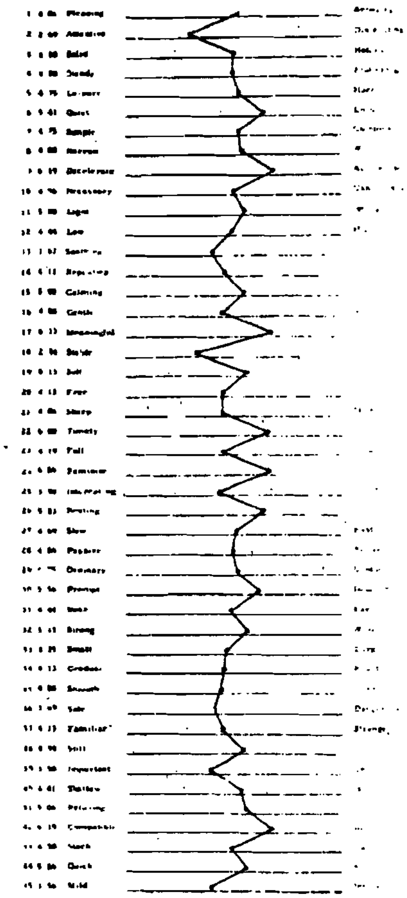


TABLE XVII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- ROCK 'N ROLL MUSIC

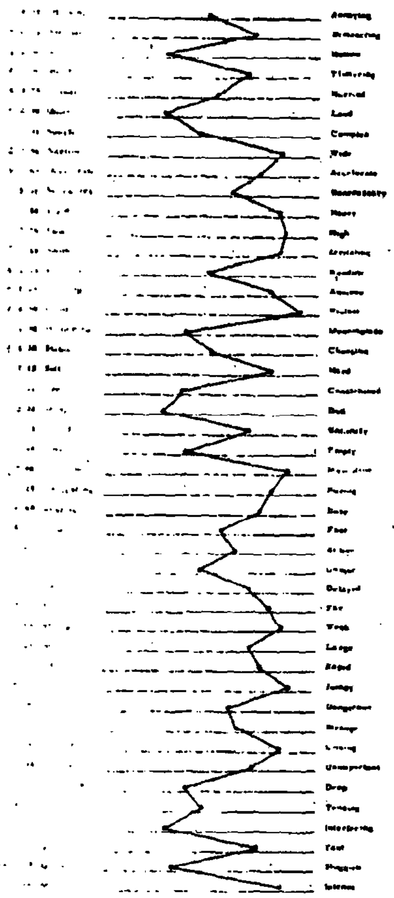


TABLE XVIII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- SPACE SOUNDS

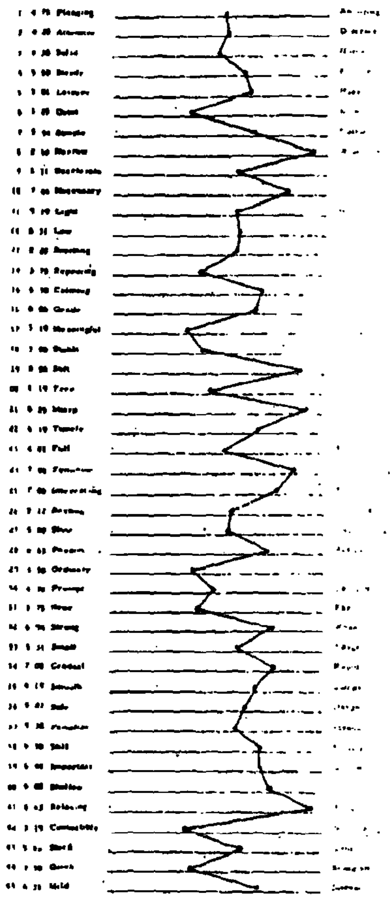


TABLE XIX. SEMANTIC PROFILE FOR AVERSIVE SOUND -- PLASTIC TURNED IN CUP

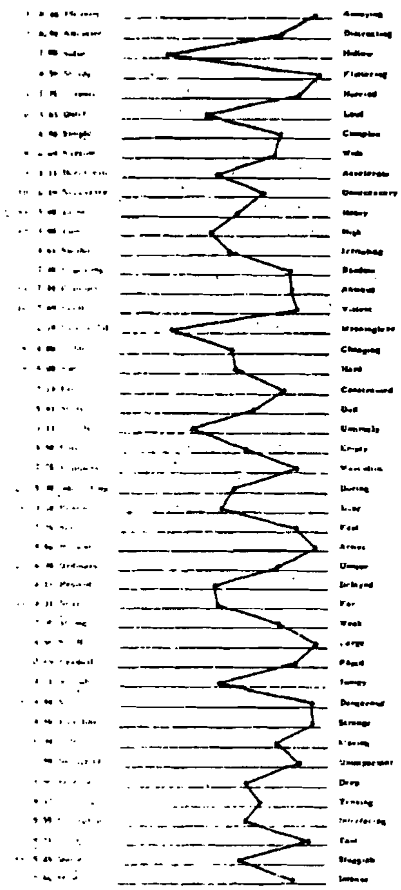


TABLE XX. SEMANTIC PROFILE FOR AVERSIVE SOUND -- FINGER RUNNING ACROSS BLACKBOARD

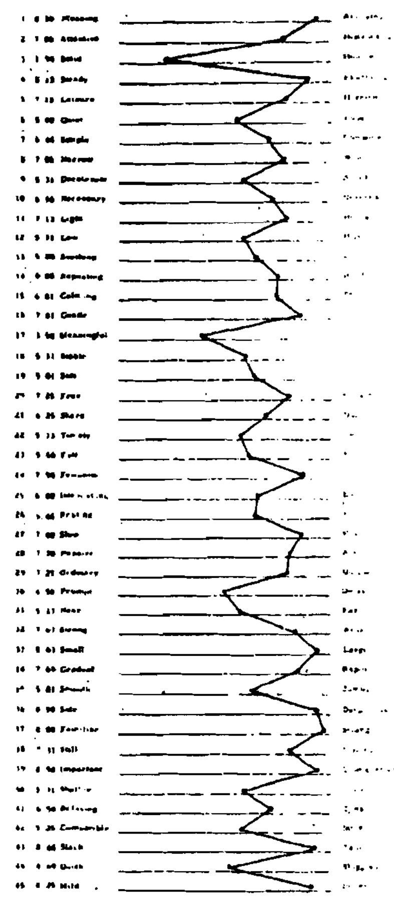


TABLE XXI. SEMANTIC PROFILE FOR AVERSIVE SOUND -- HIGH SPEED DRILL

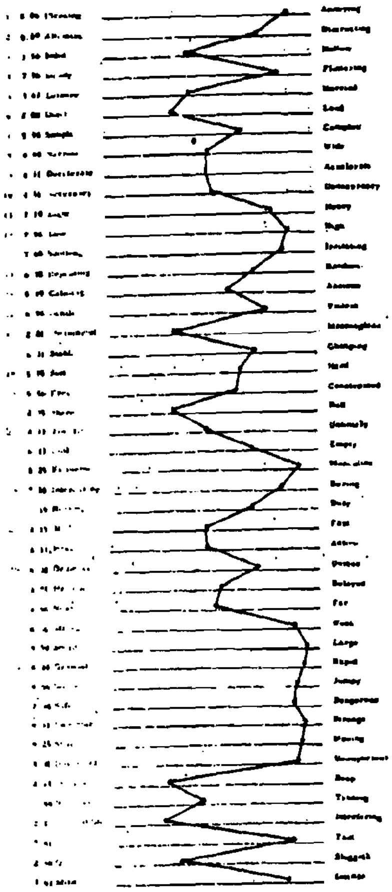


TABLE XXII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- STYROFOAM WADS RUBBED TOGETHER

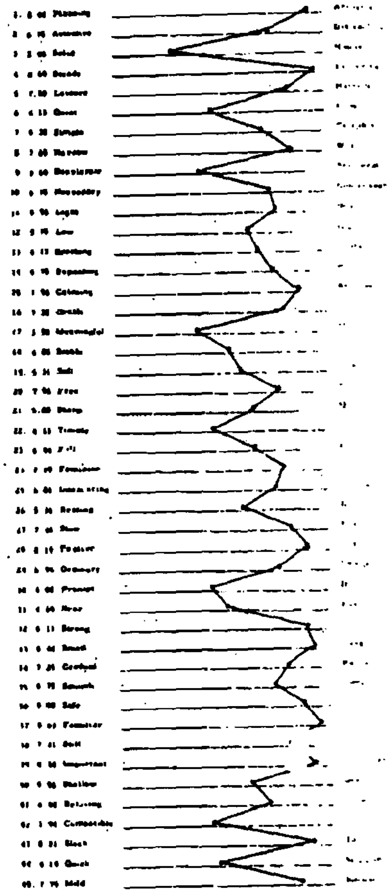


TABLE XXIII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- MAGIC MARKER PEN

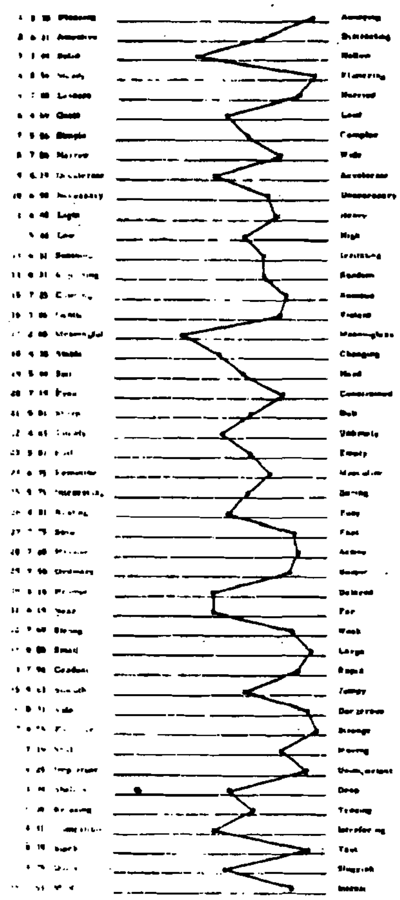


TABLE XXIV. SEMANTIC PROFILE FOR AVERSIVE SOUND -- STEADY WAVEFORM

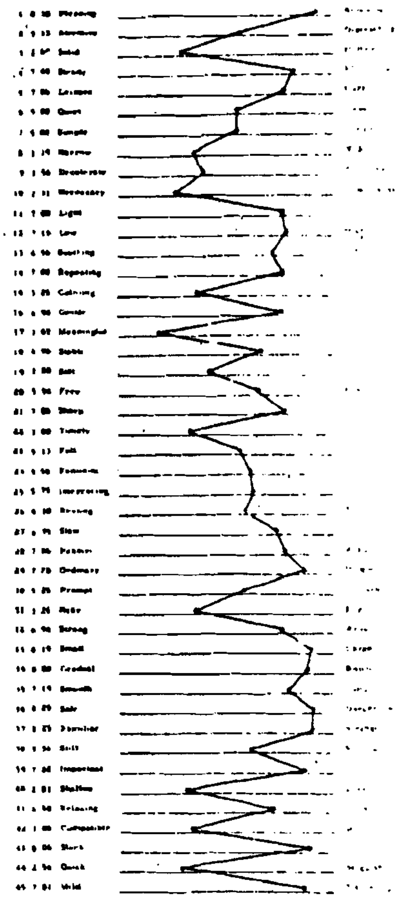


TABLE XXV. SEMANTIC PROFILE FOR AVERSIVE SOUND -- FILING ON METAL

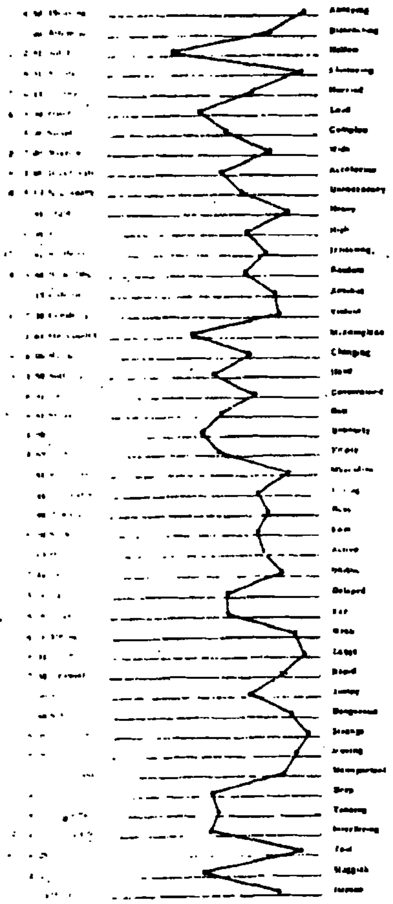
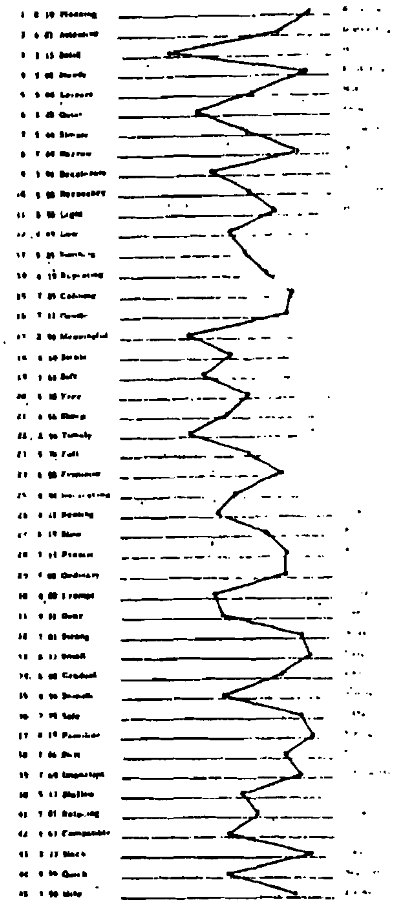


TABLE XXVI. SEMANTIC PROFILE FOR AVERSIVE SOUND -- VELCRO STRIPS BEING PULLED APART



The 45 bipolar adjective-pair scales constituting the semantic profile evidenced some differences in ratings between the two types of sounds. Specifically, only the aversive sounds revealed extreme ratings on a number of scales, whereas ratings for the non-aversive sounds were generally closer to the mid-range. The extreme ratings for the aversive sounds indicated not only annoyance, but judgments of strange, unimportant, large, taut, fluttering and dangerous. Only one of the non-aversive sounds (mood music) was judged as extremely pleasing; i.e., fell in the second most extreme scale interval. Thus, the non-aversive sounds do not convey clear indications of pleasantness but tend to have a more neutral meaning.

b. Modification of Meanings of Aversive and Non-aversive Sounds by Pairing with Biased Contextual Materials

To assess the changes in meaning which occurred when select aversive sounds were coupled with favorable and unfavorable pictorial/narrative materials and non-aversive sounds were paired with unfavorable contextual materials, Wilcoxon T tests were applied to the ratings given before and after response-modifying materials were presented. Such tests were performed on 21 select semantic differential scales which most clearly distinguished between the meanings conveyed by aversive relative to the non-aversive sounds. These before-after comparisons on the select scales are shown in Tables XXVII - XLIV. It is seen that the modifying materials only affected the impressions of aversive sound under unfavorable contextual influence. Of the 7 sounds in this group, 6 revealed significant shifts on the 21 select scales in the anticipated direction. That is, the scale ratings for these aversive sounds were shifted to higher values by the unfavorable contextual materials, depicting a change toward impressions which were characteristic of the more annoying sounds.

One of the nine aversive sounds paired with favorable contextual materials demonstrated significant change in its semantic profile values befitting more positive and acceptable sound attributes. Insofar as the shifts in subjective meanings were not substantially in the direction of more unpleasant sound impressions, the two non-aversive sounds were not influenced by the unfavorable materials.

TABLE XXVII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- RUNNING STREAM -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

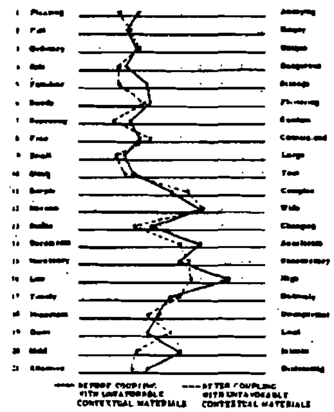


TABLE XXVIII. SEMANTIC PROFILE FOR NON-AVERSIVE SOUND -- ROCK 'N ROLL -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

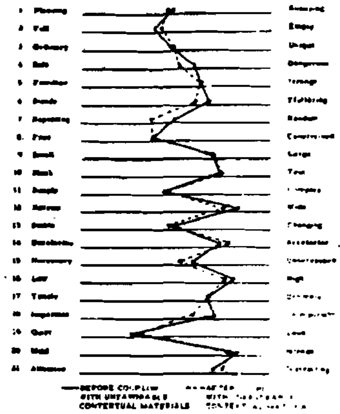


TABLE XXIX. SEMANTIC PROFILE FOR AVERSIVE SOUND -- TYPE-WRITER -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

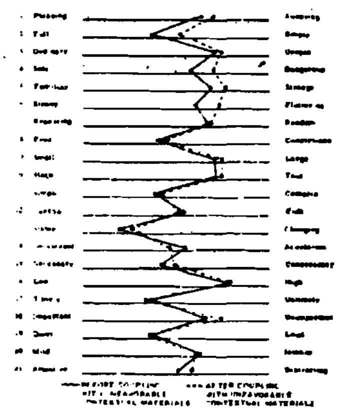


TABLE XXX. SEMANTIC PROFILE FOR AVERSIVE SOUND -- FAN BLOWER -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

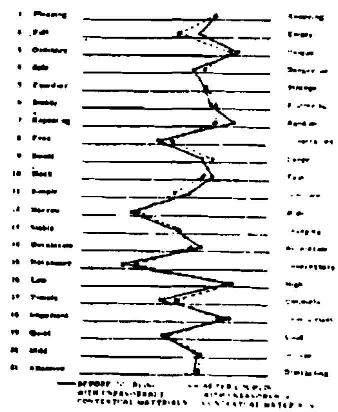


TABLE XXXI. SEMANTIC PROFILE FOR AVERSIVE SOUND -- VACUUM CLEANER -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

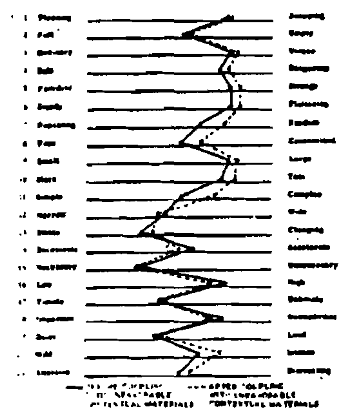


TABLE XXXII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- DOG BARKING -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

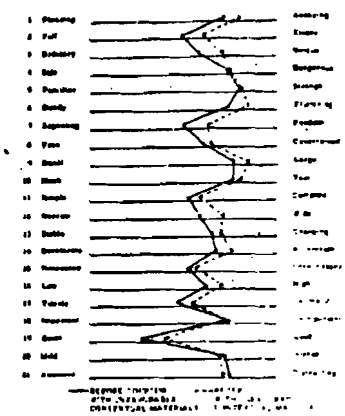


TABLE XXXIII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- WATER PUMP -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

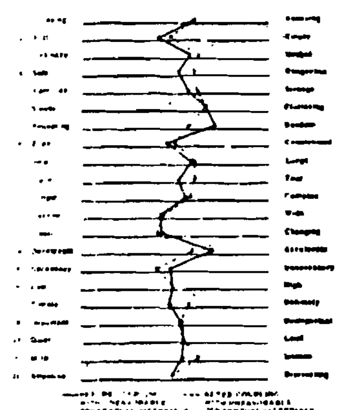


TABLE XXXIV. SEMANTIC PROFILE FOR AVERSIVE SOUND -- HAMMERING -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

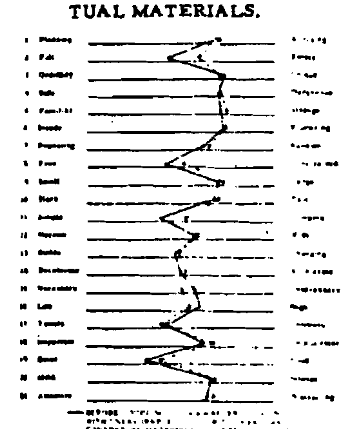


TABLE XXXV. SEMANTIC PROFILE FOR AVERSIVE SOUND -- VELCRO STRIP BEING PULLED APART -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

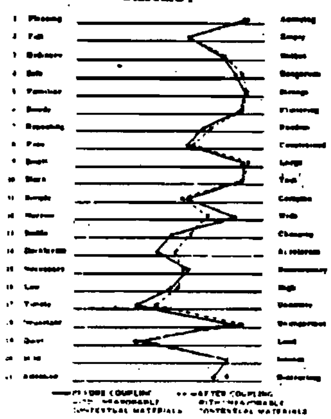


TABLE XXXVI. SEMANTIC PROFILE FOR AVERSIVE SOUND -- HACKSAW -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

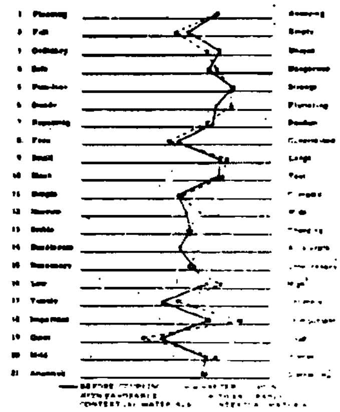


TABLE XXXVII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- HIGH SPEED DRILL -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

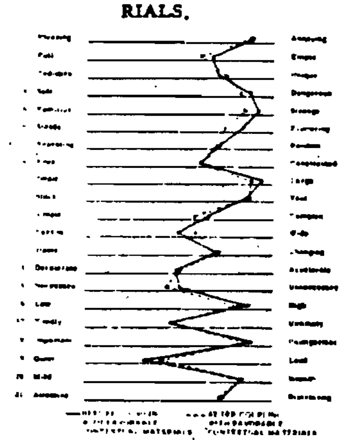


TABLE XXXVIII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- RIVETING -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

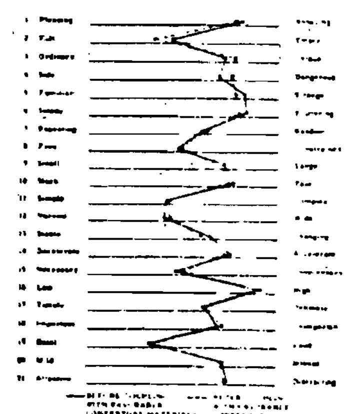


TABLE XXXIX. SEMANTIC PROFILE FOR AVERSIVE SOUND -- CLOCK TICK/ALARM -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

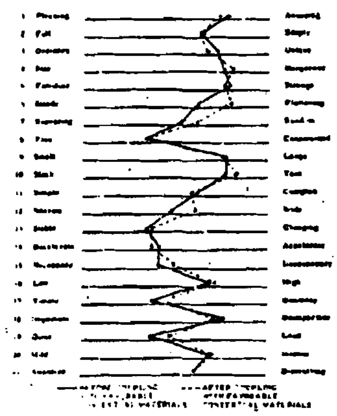


TABLE XL. SEMANTIC PROFILE FOR AVERSIVE SOUND -- MAGIC MARKER PEN -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS.

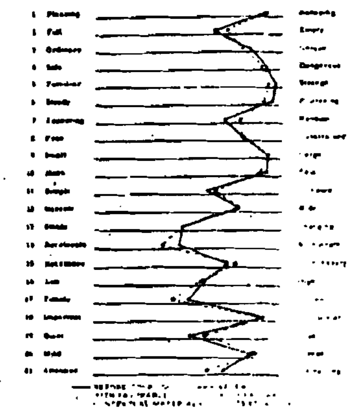


TABLE XLI. SEMANTIC PROFILE FOR AVERSIVE SOUND -- WAVE-FORM BURST -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATE-RIALS.

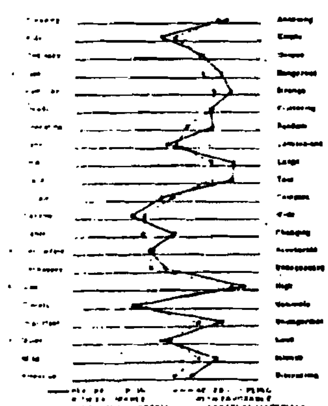


TABLE XLII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- FAUCET DRIP -- BEFORE AND AFTER COUPLING WITH CONTEX-TUAL MATERIALS.

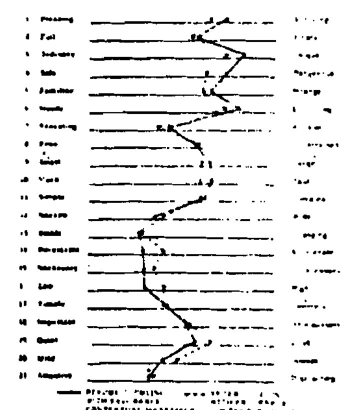


TABLE XLIII. SEMANTIC PROFILE FOR AVERSIVE SOUND -- POWER SAW -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS

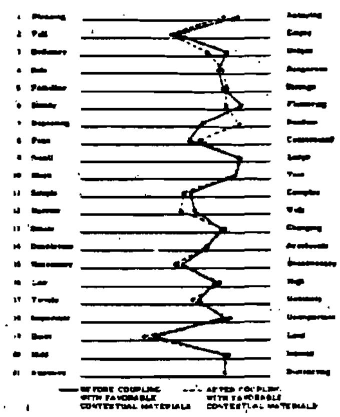
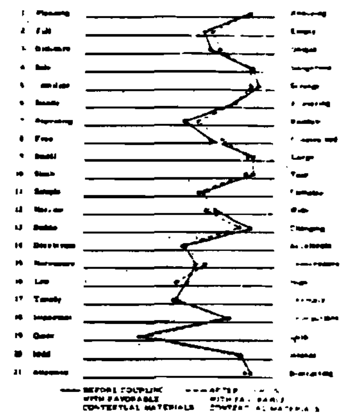


TABLE XLIV. SEMANTIC PROFILE FOR AVERSIVE SOUND -- PLATE GLASS -- BEFORE AND AFTER COUPLING WITH CONTEXTUAL MATERIALS



V. DISCUSSION

A. Initial Reaction, Accommodation, and Correlation of Subjective and Physiological Response Measures

The results from this study reveal that the majority of sounds presented to the subjects were judged more unpleasant than pleasant owing presumably to one or more annoying features. Sound with acoustic qualities of screeching, grinding and piercing were ranked as most annoying. Sounds which were unfamiliar also received high annoyance ratings. Repetition of such sounds did not induce recognition to the point where they were judged more acceptable.

The most apparent finding in this part of the study was that subjective judgments to the aversive and non-aversive test sounds did not reliably change with repeated presentations. If anything, a slight increase in annoyance was registered with recurrent exposure, especially for those test sounds receiving initial pleasant ratings. These rather stable observations were in contrast to the physiological measures, most of which were altered by the repeated exposures in directions suggesting accommodation. Heart rate responses, however, tended to show a progressive decrease over test sessions relative to baseline determinations, irrespective of the judged aversive or non-aversive nature of the sounds. Noise-induced reductions in heart rate have been reported (Taccola, et al., 1963; Shatalov, et al., 1962) with this and other forms of cardiovascular response to sound showing little tendency towards accommodation.

Exposure sessions to aversive sounds produced slightly higher amplitudes of gastrointestinal response than did sessions with non-aversive sounds, this being the only physiological indicator revealing differential response to the two types of sounds.

Subjective judgments correlated better for the non-aversive test sounds with all physiological parameters as determined on the first and last sessions of repeated exposure. G.I. Motility measures showed the most consistent correlation with the subjective reactions. In general, such correlations were stronger for the observations on the first session compared with those collected on the last session. Both average and peak heart rates revealed significant negative correlations under aversive sound conditions, i.e., as subjective annoyance scale values increased, heart rate decreased, on the final session of observation but not on the first. These changes in degree of correspondence between the subjective and physiologic measures from first to last session could reflect the differential tendencies toward accommodation (or sensitization).

B. Adaptation Processes Involved in Exposure to Sustained Sound

Subjective ratings to select aversive sounds did not change in level of annoyance when the exposure time per session was increased substantially. This lack of adaptation was in general accord with the results from the accommodation phase which found no change in annoyance ratings to aversive sounds for repeated exposure sessions. For non-aversive sounds, however, there was a tendency for ratings to become more unfavorable with increasing exposure time.

Unlike the accommodation trend exhibited by G.I. Motility with repeated exposure sessions containing aversive sounds, such response measures indicated non-adaptation, and, in fact, sensitization as the exposure time per session was lengthened. G.I. Motility measures have not been typically used in characterizing human reactions to stressful or negative stimuli. Since this was the only physiological response to discriminate among the aversive and non-aversive sounds in the study, it would seem that G.I. Motility response may be deserving of more attention in stress-type investigations.

C. Modification of Responses Toward Sound by Biased Contextual Materials

The influence of response modifying materials used to create a favorable bias toward aversive sounds and an unfavorable bias toward both non-aversive and aversive sounds was generally more successful with the subjective responses than the physiological reactions. The extent of rated annoyance for select aversive sounds and the extent of rated pleasantness for select non-aversive sounds were significantly decreased during the modifying session. These response shifts were temporary since subsequent exposure to aversive sound without coupling to favorable contextual materials and to non-aversive sound without unfavorable materials showed a reversion back to the original ratings. No significant change in overall annoyance ratings was noted during or after unfavorable contextual materials were paired with select aversive sounds. These sounds, however, were the only ones which revealed changes in descriptive attributes under the contextual influence as measured by shifts in scaled adjective ratings.

Changes in the physiological parameters in the direction of the contextual bias were minimal. More significant shifts occurred in G.I. Motility and GSR deflection frequency for non-aversive sounds coupled with unfavorable contextual materials than for either group of aversive sounds.

As noted, the subjective effects introduced by the biased contextual materials were short-lived, and the question arises as to whether repeated couplings of this type could yield more lasting changes. Possibilities for effecting changes in one's acceptance of certain sounds, via these or alternative techniques of attitude change, may have utility in alleviating environmental noise problems where no threat of direct physical harm exists.

D. Meaning of Aversive and Non-aversive Sounds Measured by the Semantic Differential

Sounds judged aversive were typically described by subjects as highly annoying, strange, unimportant, large, taut, fluttering and dangerous. Chey were also generally unique, intense and distracting. Aversive sounds also tended to be somewhat random, fast and constrained. The non-aversive sounds tended to be judged considerably less at the extreme on the semantic differentials than were the aversive sounds. This suggests that the non-aversive sounds in this study were generally of a more neutral than pleasant, positive character and that the comparisons made were not those between highly negative and highly positive test sounds. Thus occurrence of significant differences should be understood in terms of comparisons between effects of negative and neutral sounds. Future research might examine differences between positive and negative sounds which may indeed produce similar physiological reactions or, on the other hand, show greater differences in physiological response than found here.

The contextual material used in this study aimed at making the aversive sounds less aversive was effective during the session it was presented but this effect did not carry over to the next session. Perhaps a more concentrated appeal to the particular characteristics presented above, e.g., describe the sounds as familiar, small, safe, important, etc., would prove more effective in reducing aversiveness over a longer period of time; or perhaps more frequent exposure to positive contextual material over an extended period of time might be more productive of the desired effect.

VI. CONCLUSIONS

The results in the present study indicate that the effects of judged aversive and non-aversive sounds upon the human listener are very complex, evoking different subjective and physiologic changes whose time courses may or may not parallel one another with recurrent or protracted exposure. Recognizing the constraints of this study and its exploratory nature, the following tentative conclusions are offered in response to the questions posed at the outset of this investigation.

A. <u>Initial Reaction and Correlation of Physiologic and Subjective Response Measures</u>

1. Sounds with screeching, grinding acoustic qualities and/or which have unpleasant meanings and unfamiliar origins are consistently rated more aversive than other sounds conveying smooth, rhythmic acoustic features, and/or recognizable origins and pleasant associations and meanings.

2. Sounds judged aversive and non-aversive in nature can induce some significant but not differentiated physiological changes relative to base-line determinations.

3. Subjective reactions to non-aversive sounds show relatively high correlations with physiologic reactions (especially gastrointestinal muscle activity) upon initial exposure but not after repeated exposures. Subjective ratings to aversive sounds have lower yet significant correlations with physiologic response measures during initial and subsequent periods of exposure.

4. Subjective reactions are positively correlated with skin conductance and gastrointestinal motility and negatively correlated with heart rate for aversive and non-aversive sounds for some but not all experimental conditions.

B. Accommodation and Adaptation Processes

1. Among the physiological response measures investigated, only G.I. Motility displacement, as a response to aversive sounds, displayed a clear trend toward accommodation, i.e., the initial response subsided with subsequent test sessions. In contradistinction, heart rate showed more suppression, although statistically insignificant, with repeated test sessions.

2. As G.I. Motility was the only physiologic measure to show a significant deviation from baseline upon initial presentation of aversive sounds, tendencies for adaptation with sustained exposure could only be assessed for this measure. No such tendencies were found. In fact, increasing exposure duration showed some sensitization of this response for the non-aversive test sounds.

3. The magnitude of subjective reaction is maintained with recurrent and sustained exposures revealing no accommodation or adaptation trend, regardless of whether the sound is aversive or non-aversive in nature. As regards the latter, some sounds rated non-aversive may take on less pleasing characteristics with sustained (continuous) exposure.

C. Modification of Responses Toward Aversive and Non-aversive Sound

1. Subjective annoyance reactions toward select aversive sounds were temporarily moderated when the sounds were accompanied with the presentation of favorable pictorial and narrative material.

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2. Pleasant reactions toward select non-aversive sounds were also temporarily diminished when the sounds were coupled with unfavorable pictorial and narrative material.

3. Physiological reactions to aversive and non-aversive sound accompanied by response modifying contextual materials did not appear to differ from the responses observed for these sounds without the contextual materials.

4. The semantic differential scales produced descriptive profiles of attributes which discriminate between impressions or meanings attached to non-aversive and aversive sounds. Shifts in these attributes due to coupling the test sounds with favorable or unfavorable contextual materials, where significant, were short-lived.

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APPENDIX A

Rating Scale Measure of Sensitivity

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RESPONSE SHEET

Subject # ____________ Date ________________ Tape # __________

Indicate how the sound affected you by placing an X mark in the blank space which represents how you felt while listening to the sound. Be sure to mark only one space.

	Very Pleasing		Very Annoying
#1		:___:___:___:___:___:___:___:___:___:	
#2		:___:___:___:___:___:___:___:___:___:	
#3		:___:___:___:___:___:___:___:___:___:	
#4		:___:___:___:___:___:___:___:___:___:	
#5		:___:___:___:___:___:___:___:___:___:	
#6		:___:___:___:___:___:___:___:___:___:	
#7		:___:___:___:___:___:___:___:___:___:	
#8		:___:___:___:___:___:___:___:___:___:	
#9		:___:___:___:___:___:___:___:___:___:	
#10		:___:___:___:___:___:___:___:___:___:	
#11		:___:___:___:___:___:___:___:___:___:	
#12		:___:___:___:___:___:___:___:___:___:	
#13		:___:___:___:___:___:___:___:___:___:	
#14		:___:___:___:___:___:___:___:___:___:	
#15		:___:___:___:___:___:___:___:___:___:	
#16		:___:___:___:___:___:___:___:___:___:	
#17		:___:___:___:___:___:___:___:___:___:	
#18		:___:___:___:___:___:___:___:___:___:	
#19		:___:___:___:___:___:___:___:___:___:	
#20		:___:___:___:___:___:___:___:___:___:	

#21	Very Pleasing	:___:___:___:___:___:___:___:___:___:	Very Annoying
#22		:___:___:___:___:___:___:___:___:___:	
#23		:___:___:___:___:___:___:___:___:___:	
#24		:___:___:___:___:___:___:___:___:___:	
#25		:___:___:___:___:___:___:___:___:___:	
#26		:___:___:___:___:___:___:___:___:___:	
#27		:___:___:___:___:___:___:___:___:___:	
#28		:___:___:___:___:___:___:___:___:___:	
#29		:___:___:___:___:___:___:___:___:___:	
#30		:___:___:___:___:___:___:___:___:___:	
#31		:___:___:___:___:___:___:___:___:___:	
#32		:___:___:___:___:___:___:___:___:___:	
#33		:___:___:___:___:___:___:___:___:___:	
#34		:___:___:___:___:___:___:___:___:___:	
#35		:___:___:___:___:___:___:___:___:___:	
#36		:___:___:___:___:___:___:___:___:___:	
#37		:___:___:___:___:___:___:___:___:___:	
#38		:___:___:___:___:___:___:___:___:___:	
#39		:___:___:___:___:___:___:___:___:___:	
#40		:___:___:___:___:___:___:___:___:___:	

APPENDIX B

Identification of Sound Source

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IDENTIFICATION OF SOUND SOURCE

Subject # ______________ Date ________________ Tape # __________

Briefly describe in your own words the object or action producing the sound you just heard. Then indicate on your response sheet how the sound affected you by placing an X mark in the blank space which represents how you felt while listening to the sound.

Sound #1 ____

Sound #2 ____

Sound #3 ____

Sound #4 ____

Sound #5 ____

Sound #6 ____

Sound #7 ____

Sound #8 ____

Sound #9 ____

Sound #10 ____

Sound #11 ____

Sound #12 ____

Sound #13 ____

Sound #14 ____

Sound #15 ____

Sound #16 ____

Sound #17 ____

Sound #18 ____

Sound #19 ____

Sound #20 ____

Sound #21 ________________________________

Sound #22 ________________________________

Sound #23 ________________________________

Sound #24 ________________________________

Sound #25 ________________________________

Sound #26 ________________________________

Sound #27 ________________________________

Sound #28 ________________________________

Sound #29 ________________________________

Sound #30 ________________________________

Sound #31 ________________________________

Sound #32 ________________________________

Sound #33 ________________________________

Sound #34 ________________________________

Sound #35 ________________________________

Sound #36 ________________________________

Sound #37 ________________________________

Sound #38 ________________________________

Sound #39 ________________________________

Sound #40 ________________________________

APPENDIX C

Semantic *Differential:* Meaning of Sound

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Meaning of Sound

The purpose of this phase of the experiment is to discover the meaning of certain sounds by getting your rating of the sounds on a set of descriptive scales. First, listen to the sound for a few moments, then begin rating the sounds on each scale. I wish you to rate the sound on the basis of what the sound means to you. Place a check mark on each of the scales in the blank space between the dots wherever you feel the sound should be rated. For example, if you think you are listening to an airplane sound and you come to the "Fast-Slow" scale, you might want to select one of the spaces nearest the fast end of the scale such as this

Fast : ___ : X : ___ : ___ : ___ : ___ : ___ : ___ : Slow

Work as fast as you can; don't take too long to make any rating. When the hissing noise comes on, that means you have about one minute more. Don't hesitate to use the extreme ends of the scales, wherever these seem appropriate. Please complete only one rating sheet for each sound.

You may wonder how a certain scale can apply to the sound you are rating, but we have found that you will be able to make the decisions quite easily if you follow instructions, rating quickly on the basis of first impression.

Are there any questions before we begin?

MEANING OF SOUND

Subject # ________ Date ________________ Tape # ______ Sound # ______

1. Pleasing	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Annoying
2. Attentive	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Distracting
3. Solid	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Hollow
4. Steady	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Fluttering
5. Leisure	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Hurried
6. Quiet	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Loud
7. Simple	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Complex
8. Narrow	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Wide
9. Decelerate	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Accelerate
10. Necessary	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Unnecessary
11. Light	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Heavy
12. Low	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	High
13. Soothing	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Irritating
14. Repeating	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Random
15. Calming	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Anxious
16. Gentle	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Violent
17. Meaningful	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Meaningless
18. Stable	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Changing
19. Soft	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Hard
20. Free	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Constrained
21. Sharp	: __ : __ : __ : __ : __ : __ : __ : __ : __ :	Dull

Subject # ________ Date ____________ Tape # ________ Sound # ______

22.	Timely	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Untimely
23.	Full	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Empty
24.	Feminine	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Masculine
25.	Interesting	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Boring
26.	Resting	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Busy
27.	Slow	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Fast
28.	Passive	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Active
29.	Ordinary	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Unique
30.	Prompt	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Delayed
31.	Near	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Far
32.	Strong	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Weak
33.	Small	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Large
34.	Gradual	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Rapid
35.	Smooth	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Jumpy
36.	Safe	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Dangerous
37.	Familiar	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Strange
38.	Still	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Moving
39.	Important	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Unimportant
40.	Shallow	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Deep
41.	Relaxing	: ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ : ___ :	Tensing

Subject # __________ Date ________________ Tape # ________ Sound # _____

42. Compatible	:	:	:	:	:	:	:	:	:	:	Interfering
43. Slack	:	:	:	:	:	:	:	:	:	:	Taut
44. Quick	:	:	:	:	:	:	:	:	:	:	Sluggish
45. Mild	:	:	:	:	:	:	:	:	:	:	Intense

APPENDIX D

Visual Aids and Narration Used For
Attitude Modification

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NON-AVERSIVE SOUND: BABBLING BROOK

Visuals	Narration
(Dark Screen)	When I was a kid back home, we used to take great delight and pleasure in playing in and around running water. Didn't seem to make much difference whether it was up in the hills - a fresh flowing stream - or nearer home in the gutters by the sidewalk. Everything was clean and sparkling. And there was a good feel to the water. I like to think about that - brings back lots of good memories. I wonder, too, about what kind of memories the present day kids will have. It seems that the water coming now from the sewage plant is about the best treated water around Ralph Nader and others tell us what our babbling streams have been turned into. You guessed it - raw sewage. And that isn't bad enough. The poisonous chemicals are even worse. You can't get away from it. Even the oceans are killing the fish, and whatever else lives there. What a world. Makes you close your eyes when taking a drink. What's in it. I wonder if it is really safe to take a bath. Chlorine isn't going to get it all. Used to think that toilet water was an after-bath-perfume.
7 selected slides of different polluted water areas	Non-aversive sound (with advances to the next slide alternating at two 25-sec and five 26-sec intervals to provide continuous views during the 180 seconds of non-aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

NON-AVERSIVE SOUND: ROCK 'N ROLL MUSIC

Visuals	Narration
(Dark Screen)	In spite of what we read and hear so much in today's so-called news, there's really nothing wrong with modern youth. I say it again, There's nothing wrong with modern youth. Nothing, that is, which couldn't be changed with a few well placed knuckle raps, or a set of sharp pointed kicking shoes. They need to be domesticated, civilized. They are wild. You can tell it in their music. You call that music? Some people say it is mood music, others say it is gut music. It's probably the latter. Takes a lot of something to inflict that on others. Some say it's swinging music. They're probably right. Might be nice to see some of them swinging - from a limb somewhere. Bah. Humbug.
7 selected slides depicting "freaky" scenes collected from long-play record album covers	Non-aversive sound (with advances to the next slide alternating at two 25-sec and five 26-sec intervals to provide continuous views during the 180 seconds of non-aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

AVERSIVE SOUND: FAUCET DRIP

Visuals	Narration
(Dark Screen)	Close your eyes now. Relax. Relax and listen t voice. Now, visualize yourself seated comforta viewing a very fertile piece of ground. A variet carefully selected and planted in that soil. All t convert them into growth and beauty is warmth, Each drop of water is so important. Water, eac of life - a part of beauty - you can see it.
8 selected slides beginning with a water source scene and then a series of 7 blooming flowers' scenes	Aversive sound (with advances to the next slide a and 22 second intervals to provide continuous vi 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates th

AVERSIVE SOUND: MAGIC MARKER PEN SQUEAK

Visuals	Narration
(Dark Screen)	Machine-made things are cheaper. Certainly, r out nicely. But there is something special about attention to detail that goes into the handmade it and consider yourself to be present during the p building the symmetry, and design, color, shape the blown glass, the pottery, the handtooling E planned, executed and followed by another until is produced.
7 selected slides depicting handcraftsmen at work or showing the finished products	Aversive sound (with advances to the next slide a intervals and five 26-sec intervals to provide co the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates th

AVERSIVE SOUND: ELECTRONIC SOUND CONTINUOUS PULSING 1500 CPS

Visuals	Narration
(Dark Screen)	Make sure you are comfortably seated. Close youi see, sense or feel that you are secure and comfort a rescue submarine, that is taking you to a place o submerged, avoiding choppy waters, giving you a r with absolutely no sensation of movement. It is go security. Even the sounds aboard indicate all is w sounds come through with a comforting on-course i constantly turns to the fun that is possible in and o moving safely.
7 selected scenes involving pleasure and water	Aversive sound (with advances to the next slide alt intervals and five 26-sec intervals to provide conti the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the e

AVERSIVE SOUND: POWER SAW CUTTING WOOD

Visuals	Narration
(Dark Screen)	Daydream for a minute lf you will, and now, if you will be able to find yourself in different circumstar You make the most of your opportunity to work. It depends on the time of the year for the right time t lumber business. Such magnificent views, so man timber - buildings of all shapes, sizes and uses. in all progress and growth. Raw materials shaped work and effort; and, it is nice to think of the way money.
8 selected slides involving pleasant views, buildings, wood, trees, etc.	Aversive sound (with advances to the next slide alt 22 second intervals to provide continuous views du of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the

AVERSIVE SOUND: CLOCK TICK/ALARM

Visuals	Narration
(Dark Screen)	We have to develop muscle skills and coordinations to excel in certain tasks such as typing, taking shorthand, sewing, sorting, piano playing, and oh so many other similar-type activities. One of the best ways to make this easy is to develop a schedule. A schedule frequently is as simple as just a matter of pacing. Close your eyes and think for a moment of: completing a muscle movement, successfully performing - according to a specific rhythm. The rate is comfortable. It is productive. Time passes easily. Signals indicate unit completion and you move on easily.
8 selected slides depicting interesting but rather routine activities.	Aversive sound (with advances to the next slide alternating at 23 and 22 second intervals to provide continuous views during the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

AVERSIVE SOUND: RIVETING AIR HAMMER

Visuals	Narration
(Dark Screen)	Not many of us have experienced the full impact of the restrictive Berlin Wall. A Symbol of separation, of differences between people - a Wedge that prevents loved ones from contact with each other - a Divider of people, a divider that prevents peaceful togetherness. Close your eyes now and ask yourself the question: Wouldn't everyone be happier - wouldn't everything be better - if there were some way to remove the wall? Each blow dislodges a rock, breaks the seal between pieces of cement, breaks the joints between the heavy pieces and the metal. Everyone works together to bring about harmony. People get together
8 selected wall scenes and people relating scenes	Aversive sound (with advances to the next slide alternating at 23 and 22 second intervals to provide continuous views during the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

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AVERSIVE SOUND: HACKSAW

Visuals	Narration
(Dark Screen)	We spend a large part of our lives in developing and changing the environment we encounter. We heat our homes when it is too cool, air-condition them when it is too warm. We cut and shape fabric into clothing. In fact, the developing and changing even applies to the way we think. We get rough, unfinished ideas. We sort, change and manipulate them - wear off edges - line them up in better working order. The end result is improvement. The important view to consider is the end product, where we are most comfortable - things are improved, better for the effort.
8 selected slides suggesting action and beautiful, finished construction	Aversive sound (with advances to the next slide alternating at 23 and 22 second intervals to provide continuous views during the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

AVERSIVE SOUND: HIGH SPEED DENTIST DRILL

Visuals	Narration
(Dark Screen)	Sounds of the night are quite different from sounds of the day to most of us. Riding up in an elevator gives us both sounds and sensations that are interesting and fun. This is especially true when it takes us up for a bird's-eye view of the sights at night of a large city. We can almost imagine the insect sounds - muted and intensified - depending on the way we concentrate. But the beauty, color, design and symmetry almost take full concentration as we would try to locate those familiar places we know before the sun comes up and changes the scene back to the normal.
8 selected night scenes of cities	Aversive sound (with advances to the next slide alternating at 23 and 22 second intervals to provide continuous views during the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experience)

AVERSIVE SOUND: GLASS BREAKING

Visuals	Narration
(Dark Screen)	Mobility and change - movement - have become aln most of us. We are able to move around almost at that interest us, drive in our cars, view the televi in person, follow where our interests lead us, take view things in a leisurely manner, usually without And carry forward the memories of the experienc changes in scene, the interest, and the challenge o mood.
8 selected slides to depict movement and easy flow from one concept or place to another	Aversive sound (with advances to the next slide alt second intervals to provide continuous views durin aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the e

122

AVERSIVE SOUND: WINDMILL WATER PUMP

Visuals	Narration
(Dark Screen)	Consider if you will what it would be like to have a real v you could get away from the noises, the strife, the press the closeness of people, the maddening rat race of drivin, all that most of us want to get away from. You have the c vacation on an isolated farm. Just right. No one for mil relaxation. Perfect. That is, except for one thing. At r try to sleep, you can almost hear the silence. And, then you try - tie it, lock it - that stupid windmill starts to tu pumps all night long. Counting sheep doesn't help. It jus racket.
7 selected slides alternating windmill and water flowing scenes	Aversive sound (with advances to the next slide alternatin and five 26-sec intervals to provide continuous views duri seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experie

113

AVERSIVE SOUND: VACUUM CLEANER

Visuals	Narration
(Dark Screen)	There are few noises around a house that can match the v It sounds so much like work that it makes you tired just t It really does things to anyone who happens to have the sn don't have to have a cold - or, even be allergic, a hayfev dust will stuff up your nose, make your throat sore - it ju person feel miserable, generally. The people who opera cleaners seem to develop insidious outlooks. Have you n seem to scheme and plan - wait until there is a good spot receive an important telephone call - the worst possible t here comes that vacuum cleaner - spewing dust out as fa more in.
7 selected slides of different views of a vacuum cleaner	Aversive sound (with advances to the next slide alternatin and five 26-sec intervals to provide continuous views dur of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the experie

123

AVERSIVE SOUND: TYPEWRITER

Visuals	Narration
(Dark Screen)	Would you like to make a lot of money? If you cou typewriter that is as good as they have for an auto the way to riches. You would help a lot of people noticed? They always give the noisiest typewrite the fastest and the longest, so that you can't read, talk, and it is even hard to think with all that type try to adjust. You think you have the rhythm now, seem to have the key striking noise under control. landish bell sounds, and you jump a little. You a starts all over again. You wonder whether it wou happened to bump that typewriter hard enough to p for a while.
7 selected slides of a typewriter with each new slide appearing closer to the typewriter as though moving in	Aversive sound (with advances to the next slide al and five 26-sec intervals to provide continuous vie of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the

AVERSIVE SOUND: HAMMERING

Visuals	Narration
(Dark Screen)	Have you ever stopped to consider what it is about hurt the worst? It is that pounding business, righ on top of the head, and sometimes at the back. T but the constant pounding and more pounding is ju keeps right on, like a hammer. You know how a pound - pound - pound. I think carpenters must h Have you ever watched a carpenter whacking away missing sometimes, it seems. And, always takin nail is driven all the way in. There it goes again:
7 selected slides of hammer and nail	Aversive sound (with advances to the next slide al and five 26-sec intervals to provide continuous vi of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while the subject rates

AVERSIVE SOUND: FAN BLOWER

Visuals	Narration
(Dark Screen)	You know we all look forward to a change in the w comfortable when we take a long driving trip. It i should help. At least that is what I thought recent pleasant. The clouds even seemed to make it nice still green and attractive. The trees and bushes v turn color - worth stopping a minute or two to soa end of the day it starts to develop a nip in the air. being indoors, and you start to think about a good You are lucky. Here is one with a name you trust vacancy. All is well. You take a shower, watch and prepare for bed. Not much in the way of bedc them. You do. Hear that hum? There's a fan bl room. Better check the air-conditioner. Nothing down the fan or cut it off. The switch doesn't wor management. They have already gone to bed and is lit. You have to make the best of it. Fan - col covers - are you catching cold - fan - cool - whir whir - whir - whir.
7 selected slides alternating between views of melting ice cubes and fans	Aversive sound (with advances to the next slide al and five 26-sec intervals to provide continuous vi of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rates the

125

AVERSIVE SOUND: VELCRO STRIP TEARING

Visuals	Narration
(Dark Screen)	Adhesive bandages and tape certainly are w Maybe you aren't old enough to remember ti conveniences simply were not available. W linens, shirts, and other soft, white materi bandages, to cover small cuts and bumps. than nothing, but they constantly shifted, sl Adhesive bandages nicely solved those prob easy to apply, and stay put once they are se remember a time when 2-inch wide strips o to my chest to correct a rib injury. They s In fact, maybe a little too well. The doctor when he sat down to remove the strips. He was a muffled sound like paper tearing, unt it out The doctor slowed down instead of r was worse. Have you ever had anyone take worry it instead of pulling it all the way out out on me even now, come to think of it. Re place is about the same. Opens it up again. are easy to put on. R-I-P. Taking them of
7 selected slides of different views of adhesive bandages and tapes.	Aversive sound (with advances to the next s two 25-sec and five 26-sec intervals to pro during the 180 seconds of aversive sound)
(Dark Screen)	Neutral sound (90 seconds while subject rat

END

DATE

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9-18-85