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AUTHOR	Whitehead, Jack L.
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ABSTRACT

This study reports an analysis of the effects of moderate levels of noise on task performance of an interacting group. Groups of students first interacted in information-sharing discussions under varying conditions of noise and then responded to an objective test over the shared information and to a series of semantic differential scales designed to measure their subjective responses to noise. Four groups of five subjects each were assigned to each of three experimental conditions and one control condition. Measures were obtained of group task performance and of subjective perceptions of noise under conditions that included 50, 60, and 70 dBC levels. Results showed that performance on information-sharing tasks by small groups was unaffected by moderate levels of outside noise, although there were differences in the subjects' perceptions of the noise. (Author/RN)

EFFECTS OF NOISE ON SMALL GROUP INTERACTION

Jack L. Whitehead

The University of Texas at Austin

A preliminary study is reported in which moderate levels of noise were introduced to interacting groups performing an information-sharing task. Noise conditions included 50, 60 and 70 dBC levels. Although differences in subjective perceptions of the noise were found, there were no significant differences in task performance among the various noise groups.

1. Introduction

The growing concern for the quality of man's acoustic environment has been manifested in the United States in laws such as the Walsh-Healy Act, the Occupational Safety and Health Act of 1970, and the Aircraft Noise Abatement Act, which were enacted to provide social and legal control of the maximum allowable limits of various types of noise in different situations. Such legislation has usually grown out of an awareness of the hazards which high intensity noises pose for the individual person's health (Kupferman 1970).

Prior research on noise has been conducted primarily on measures of individual subject responses to high intensity levels of noise. Such research has identified several dimensions of noise-including intensity, predictability, and relevance--which produce variable effects on individual subjects (see Arvidson, et al. 1968, Hedri 1968, Johansson 1970, Frith 1967, Horman, et al. 1970, Kryter 1966, and Pearson, et al. 1968).

Much of human activity, however, is spent in *interaction among individuals*, especially communicative interaction. Attempts at communication among individuals may occur in the presence of high intensity levels of noise. But such attempts are usually so frustrating that the participants will either discontinue their activities or seek a quieter environment. A *quieter* environment is, however, a relative term. With the seeming omnipresence of modern technological devices, few populated areas can be found in which there is no "background" of noise produced by some type of machinery. One of the costs of advancement in technology seems to have been deterioration in the quality of man's acoustic environment. Additionally, human noise has become an increasingly prevalent factor in the design of environments where humans must interact. A pertinent question is whether such an environment with only a *moderate* level of intensity of noise produces significant effects on human communicative interaction.

The results of prior research can provide only a partial answer to this question. Research on noise effects on *individuals* has indicated that noise may induce stress and tension (Abey-Wickrama, *et al*. 1969, Farr 1967, Minckley 1968) and may reduce task performance efficiency (Dornic 1967, Harris 1968, Harris 1970). In particular, unpredictable noise (Brookshire 1969) and intermittent noise (Eschenbrenner 1971, Plutchik 1968, Warner 1969) have been found to have more adverse effects than continuous or predictable noise. Although most research has been conducted at high intensity levels (80 dB and above), Glass, Singer, and Friedman (1969) found that unpredictable noise at 56 dB resulted in lowered tolerance for frustration and impaired performance efficiency. While previous research has emphasized the inhibiting or dysfunctional effects of noise on the individual's mental state or task performance, the effects of noise on group interaction are still not known.

Wyon (1970) has suggested that greater emphasis be placed on moderate stress research and has reported preliminary results of a study of noise effects on children working in school class groups. While the analysis of the behavior of the group as a whole has not been completed, Wyon does report conclusions regarding the effects of random bursts of white noise ranging in intensity from 55-78 dBA. He found that (1) significantly more children in the noise condition appeared to be working with an obvious effort; (2) significantly more were distracted by others and stopped working; and (3) in a self-paced numerical inspection task, the children worked more slowly but were more accurate, possibly because they were repeatedly interrupted in the course of an inspection and had to start again.

Thus, the preliminary results of Wyon's study indicate that moderate levels of noise may impair task performance and that group behavior may be adversely affected by moderate levels of noise.

The present investigation was designed to answer a central question: what are the effects of moderate levels of noise on the task performance of an interacting group? A secondary question related to how various levels of noise affected subjects' perceptions of the noise. This research involved having groups of subjects first interact in information-sharing discussions under varying conditions of noise, and then respond to an objective test over the shared information and a series of semantic differential scales (Osgood, Suci, and Tannenbaum 1957, Blosser 1971) designed to measure subjective responses to noise.

Noise intensity was varied in a total of three experimental conditions and one control condition. Four groups of five subjects each were assigned to each of the four conditions. Each group of subjects participated in an information-sharing discussion and subsequent testing session. Measures were obtained of group task performance and of subjective perceptions of noise.

2. Method

Subjects. Subjects for this study consisted of 80 students enrolled in classes in Speech Communication at the University of Texas at Austin during the fall semester of 1971. An incentive for volunteering for the experimental sessions was offered in the form of grade points which were added to the student's score in his class.

Materials. Independent variables: The independent variable was level of intensity of noise (50 dBC, 60 dBC, and 70 dBC). The basic stimulus noise was recorded on magnetic tape and reproduced through a loudspeaker. The stimulus noise level was measured with a General Radio (model 1565-A) general purpose sound level meter. The C weighting network was used and the results were expressed as sound levels, dBC. The C weighting network is a filter with a relatively flat transfer function (i.e., it is close to linear). The meter was hand-held at the approximate level of the subjects' ears in the empty discussion room prior to the testing sessions each evening. The tape recorder volume control was then adjusted until the desired stimulus noise levels were attained. The volume controls were then marked and used in the evening's subsequent testing sessions.

Dependent variables: Measures of the effect of the noise on group interaction were obtained on two test instruments completed by the subjects immediately after the group interaction. One of the instruments was a multiple choice test on the information shared by the groups. The other consisted of semantic differential scales designed to measure subjective reactions to environmental noise.

Task materials consisted of six passages from an article on communication in an area unfamiliar to the subjects. These materials were read by the subjects during the first phase of the experimental session. All of the subjects were given a passage containing the introduction to the topic. The remaining five passages, however, were distributed so that each subject had a different passage. Subjects read the passages silently during the first phase of the session. This design ensured that the five group members had knowledge in common as well as unique individual knowledge about the topic they were later to discuss and be tested on.

Procedures. After assignment to groups and experimental conditions, subjects met for the experiment. During the session each group participated according to the following schedule:

(1) Subjects were introduced to one another and instrutions were given by the experimenter.

(2) Subjects were given written materials and were allowed to study these materials for 15 minutes.

(3) The experimenter then collected the written materials and asked the subjects to move into another room where they interacted for 25 minutes in sharing information and preparing for the objective test. During the interaction sessions the experimental stimulus was introduced by placing a loudspeaker next to the wall of the discussion room. The stimulus, which consisted of four male voices simultaneously reading different passages, was reproduced at the specified levels of intensity on an audio tape recorder. The subjects were told that "other persons are working on a project in

the next room."

(4) After 25 minutes, the experimenter re-entered the room and distributed the test materials. Subjects were allowed 15 minutes to complete the instruments.

(5) After the subject completed the test, the experimenter explained that the study would not be completed until later in the semester and that the experimenter would explain the study in a future class meeting. Subjects were then dismissed.

3. Results

The first question asked in this study was what are the effects of moderate levels of noise on the task performance of an interacting group. The task performance of the group was determined by calculating the percentage of the total number of objective answers only by interaction with other participants in his group. The mean percentage for the three noise conditions and control group were 68.20 for the 50 dBC condition, 69.20 for the 60 dBC group, 62.15 for the 70 dBC group, and 66.35 for the control group. A one-way analysis of variance (Veldman 1968) was performed on these scores to determine the effects of the varying intensities of noise on group task performance. The resulting F-ratio was not significant ($F=1.09$; $df=3/76$).

Second, it was asked how the different noise levels would affect subjects' perceptions of the environmental noise. The subjects' perceptions of environmental noise were measured by their responses to a series of fifteen semantic differential scales developed by Blosser (1971). These responses were subjected to a multiple discriminant analysis to determine which scales could best discriminate among the experimental conditions. One hundred percent of the trace was extracted by three roots, two of which were significant ($p < .05$). Root I which was significant, accounted for 71.8% of the variance and Root II which was also significant accounted for 19.8% of the variance. Root III accounted for 8.4% of the variance but was not significant. Loadings of each of the scales are given for each root in Table 1. As can be seen in Table 1, the loadings for three scales on Root I were greater than .5 (weak-powerful, bad-good, and unnoticeable-distracting) and two scales had loadings greater than .5 on Root II (unpleasant-pleasant and unn ticeable-distracting). Scale 15, unnoticeable-distracting loaded greater than .5 on both Roots I and II.

In order to obtain a clearer view of the data, scores on each scale were subjected to one way analyses of variance. As shown in Table 1, F-tests on six scales were significant ($p < .05$). Subsequently, Duncan's Multiple Range Tests were computed for each of the six significant scales (Bruning and Kintz 1968). Significant differences among means on each scale are shown in Table 1 ($p < .05$, Duncan's New Multiple Range Test). The six scales on which significant F-ratios were found included the four scales which loaded above .5 on Roots I and II. The first of those scales (weak-powerful) discriminated between 1e control and the noise groups with the environmental noise being seen as most powerful in the 70 dBC condition. There were no differences in perceived powerfulness of noise between the 50 dBC and 60 dBC conditions. The second scale loading highly on Root I (bad-good) discriminated between the control and experimental groups but not among the experimental groups. The environmental noise in the control condition was seen as being better than in any of the noise groups. A third scale (unnoticeable-distracting) which loaded highly on Roots I and II discriminated between the control and all of the experimental groups. Among the noise conditions, the 60 dBC condition was perceived as being most distracting while there was no difference between the 50 and 70 dBC conditions. Finally, the other scale having a high loading on Root II (unpleasant-pleasant) discriminated between the control condition and the 60 dBC noise condition, but failed to discriminate among the three noise conditions.

4. Discussion

The primary question of interest in this study was whether moderate levels of noise would affect the performance of a small group engaged in a discussion task. The results indicate that performance on an information-sharing task by small discussion groups is unaffected by moderate levels of noise. These results are in line with those of other researchers (Hoffman 1966, Hsia 1969, Stater 1968, Sloboda 1968) who have found that human subjects are able to adapt readily to moderate levels of noise and thus experience little, if any, decrement in performance as a result of their exposure to such noise.

Future research on reactions of individuals interacting in small groups should focus on the type of noise stimulus which is introduced. Following Wyon (1970), the relevance of the noise to both the individuals in the group and task should be studied. Further, the scheduling (i.e., random, intermittent, and constant presentation) of the noise should be varied. In addition the complexity of the task should be manipulated. It is likely that differential performance results with respect to the noises would be obtained on more complex group tasks.

Another aspect of this research concerned the subjects' subjective reactions to varying noise levels. It should be noted first that on the scales which were evaluative in nature, subjects tended almost universally to consider any environmental noise, including the ambient noise in the control condition, negatively. However, within this framework, several scales stood out in discriminating the noise groups. For example, environmental noises were considered more powerful as the noise level increased. While there were no significant differences in the perceived goodness of the noise in the three noise conditions, subjects in the control condition rated the environmental noise closer to the "good" end of the scale. Environmental noise in the three noise conditions was also rated as more distracting than in the control condition. Since the scales which best discriminated among the noise conditions were evaluative, additional research should be done employing semantic differential scales which are more evaluative than most of those used in the present study. The scales which failed to discriminate among the noise conditions were highly descriptive as contrasted with the evaluative scales. It is evident that these scales are not appropriate for attempting to differentiate among varying noise levels of the type employed in this study.

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TABLE I

RESULTS OF MULTIPLE DISCRIMINANT ANALYSIS OF SUBJECTIVE REACTION SCALES

	Group Means					Loadings on Roots		
Scale	50 dBC	60 dBC	70 dBC	Cntrl	F	I	II	III
weak/powerful[+]	$2.84_{a\#}$	3.25_a	4.10_b	1.80_c	18.67*	.81	.02	.37
unpleasant/pleasant	2.80_{ab}	2.05_a	2.75_{ab}	3.35_b	3.64*	-.27	.52	-.12
bad/good	2.25_a	2.05_a	1.75_a	3.35_b	11.04*	-.70	.18	.04
unfamiliar/familiar	2.95	2.70	2.65	3.70	2.45	-.36	.17	.00
dull/sharp	2.50	2.75	2.75	2.95	0.44	-.09	.05	.27
decelerating/accelerating	3.20	2.65	3.40	2.85	2.04	.20	.38	-.22
constant/variable	2.55	2.25	2.20	2.85	0.86	-.21	.09	-.12
distant/close	3.21	3.85	4.00	3.05	1.95	.28	-.09	.43
short/long	3.45	3.53	3.55	2.90	0.76	.20	-.04	-.09
unnecessary/necessary	1.80	1.74	1.70	2.25	0.76	-.20	.14	.06
high/low	3.25	3.26	2.70	3.70	2.57	-.38	-.06	-.11
short/long	4.15_a	4.16_a	4.05_a	2.85_b	4.63*	.42	-.20	-.34
smooth/rough	2.95	3.79	3.05	2.80	2.59	.13	-.41	.22
bass/treble	1.95_a	1.95_a	2.37_{ab}	2.90_b	3.63*	-.31	.41	.37
unnoticeable/distracting	3.60_a	4.37_b	3.60_a	2.20_c	16.45*	.51	-.56	-.12

*Significant at the .05 level.

#Means with different subscripts are significantly different at the .05 level.

+The first adjective of each adjective pair was given a value of 1.0 in the quantification scheme.