

UNCLASSIFIED

AD NUMBER
AD051810
LIMITATION CHANGES
TO: Approved for public release; distribution is unlimited.
FROM: Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; 30 NOV 1954. Other requests shall be referred to Office of Naval Research, 875 North Randolph Street, Arlington, VA 22203.
AUTHORITY
ONR ltr, 26 Oct 1977

THIS PAGE IS UNCLASSIFIED

THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

Armed Services Technical Information Agency

Because of our limited supply, you are requested to return this copy WHEN IT HAS SERVED YOUR PURPOSE so that it may be made available to other requesters. Your cooperation will be appreciated.

AD

51810

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

**Reproduced by
DOCUMENT SERVICE CENTER
KNOTT BUILDING, DAYTON, 2, OHIO**

UNCLASSIFIED

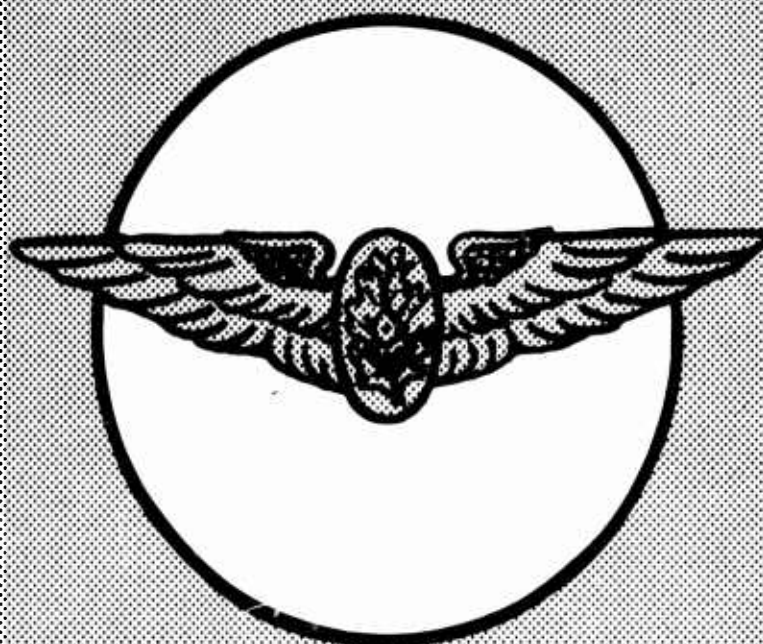
AL NO. 51810

ASTIA FILE COPY



THE EFFECT ON INTELLIGIBILITY SCORES OF SPECIFIC
INSTRUCTIONS REGARDING TALKING

JOINT PROJECT REPORT NO. NM 001 064.01.35



RESEARCH REPORT

OF THE

U. S. NAVAL SCHOOL OF AVIATION MEDICINE

NAVAL AIR STATION

PENSACOLA FLORIDA

U. S. NAVAL SCHOOL OF AVIATION MEDICINE
NAVAL AIR STATION
PENSACOLA, FLORIDA

JOINT PROJECT REPORT NO. 35

The Ohio State University Research Foundation
Columbus, Ohio, under Contract N6ONR 22525
Office of Naval Research Project Designation No. NR 145-993

and

U. S. Naval School of Aviation Medicine
The Bureau of Medicine and Surgery Project NM 001 064.01.35

THE EFFECT ON INTELLIGIBILITY SCORES OF SPECIFIC
INSTRUCTIONS REGARDING TALKING

Report by

Gilbert C. Tolhurst

Approved by

John W. Black
Project Director

W. E. Utterback
Acting Director

and

Captain Ashton Graybiel, MC, USN
Director of Research
U. S. Naval School of Aviation Medicine

Released by

Captain Julius C. Early, MC, USN
Commanding Officer

30 November 1954

SUMMARY

Problem: A speaker's manner of utterance can be altered by instruction. Various instructions have been found to improve intelligibility. Three short single instructions were given to Naval flight students, who spoke under conditions of an air acoustic channel, to determine if the instructions would be reflected in intelligibility changes.

Results: In the present study the intelligibility scores of speakers were raised as they followed any one of three instructions, "talk loudly," "articulate precisely," and "talk fast." Although these instructions may seem to pertain directly to different primary accompaniments of intelligibility, each instruction may have raised the sound pressure level of the speech, or modified the speaker's verbal manner by some interaction of intelligibility factors.

INTRODUCTION

The length established for a military training program in voice communication is based on the contents of the course that can be operationally validated. The time devoted to instruction in intelligibility may be only a segment of a program of greater scope that may include, for example, instruction in the equipment used to transmit voice communications, such as radio, interphone, and so forth.

In one series of studies in which intelligibility measures provided the criterion score, four hours of instruction appeared to be justifiable and no further increment in the intelligibility of the students occurred when the training was extended to 10 hours (2, 8). Other studies have indicated the merits of instructional periods of only a few minutes duration (1, 10). This latter type of instruction, however, pertains largely to indoctrination in the use of communication equipment, particularly the microphone.

In the present study an effort was made to evaluate the relative effects of single verbal instructions, specifically "talk loudly," "articulate precisely," and "talk fast," on intelligibility scores. Since variability among experimental subjects inevitably is increased with the use of a microphone and since intelligibility testing in free-room conditions is feasible, the present study was conducted in a free room (4). The rationale in the choice of these variables was that they were subjectively selected by the investigator to be related to the term projection. This term is conventionally used by workers in the theatre to describe a spirited mode of talking, satisfactory for the stage and apparently more than ordinarily intelligible.

PROCEDURE

The testing room was a hallway 84 feet in length and 84 inches by 100 inches in height and breadth. The walls and floor were hard surfaced and the ceiling was sound treated. The room was available during periods when the experimental subjects were the only personnel in the building and when no electrical appliances, specifically an airconditioning unit and water coolers, were in operation.

One hundred forty-four experimental subjects served in 12 groups of 12 speaker-listeners to each group. Three additional subjects served with each panel as listeners only.

Each group of subjects took two intelligibility tests, Forms A and B of the multiple-choice series, in a round-robin type of administration (9). The listening stations were 15 tablet arm chairs, spaced four feet apart and backed against one side of the hallway. The chair at station 1 was 20 feet removed from the speaker's position, which, in turn, was four feet from one end of the room.

The first test was administered without special instruction, only the normal explanations of the test (4). During the progress of the second test, but prior to his second speaking, each speaker was given special instruction individually: one was told to "talk loudly," and throughout his reading of a particular test list he faced a placard that reminded him of his special assignment. The second speaker's instruction was to "articulate precisely," and the third speaker's to "talk fast." Appropriate placard reminders were also present for the second and third speaker conditions. The order of conditions was continued rotationally throughout each experimental group; thus one-third of the speakers formed each experimental condition in the second testing administration.

Forms A and B were alternately employed as the first and second tests with successive groups of subjects. The order in which the speakers read the speaker lists was systematically rotated from panel to panel; thus with panel 1, listening station 1 read list 1, and with panel 2, listening station 2 read list 1. The order of the three experimental conditions in the second administrations of the tests was also systematically rotated. However, the comparison conditions, "talk loudly," "articulate precisely," "talk rapidly" were always second in the two administrations of the tests.

Throughout, the readers were paced by a sweep-hand timer resulting in a five-second interval between the initiation of each three-word group of test items.

RESULTS

A simple analysis of variance was performed on the speaker intelligibility scores under the three experimental conditions: talk loudly, articulate precisely, talk rapidly. The analysis is summarized in Table 1. The obtained F-ratio of 6.24 between the experimental conditions and the remainder was significant at the one per cent level of confidence. The obtained mean scores were: "talk loudly," 93.9 percent; "articulate precisely," 94.5 percent; and "speak rapidly," 92.6 percent. Differences of 1.9 and 1.5 percentage points between pairs of mean scores were required for significance at the one and five percent levels of confidence respectively; thus, only the difference between "articulate precisely" and "talk rapidly" was statistically significant.

TABLE 1.

Summary of an analysis of variance among the intelligibility scores attending three experimental conditions: loud talking, fast talking, precise articulation.

Source of Variation	df	Sums of Squares	Variance	F
Conditions	2	166.16	83.08	6.24*
Remainder	141	1877.44	13.32	

*Significant at the 1% level of confidence.

The foregoing analysis related to the relative effectiveness of the three instructions. A further comparison was made by means of a series of *t*-tests in which the "uninstructed reading" scores were compared with the "instructed reading" scores. In these comparisons the reading score after instruction was significantly superior to the "uninstructed reading" score in all instances: "talk loudly," 91.9 vs. 93.9 percent (*t*, 2.50); "articulate precisely," 92.5 vs. 94.5 percent (*t*, 3.34); "read fast," 90.6 vs. 92.6 percent (*t*, 2.63). Each analysis involved 47 degrees of freedom. The increment in the "instructed" multiple-choice intelligibility score in each instance was two percent over the "uninstructed" score.

An analysis of variance involving listening positions, listening groups, and remainder yielded an F-ratio of 6.22, significant at the one percent level of confidence with 11 and 121 degrees of freedom. The mean scores for the first 12 listening stations in order from "near the speaker" to "removed from the speaker" were 94.9, 95.3, 94.7, 94.0, 93.3, 92.3, 89.9, 92.2, 90.3, 90.6, 89.3 percent. A difference between two means of 2.3 percent would be significant at the five percent level of confidence. The analysis is summarized in Table 2.

TABLE 2.

Summary of an analysis of variance among the intelligibility scores that attended 12 listening positions.

Source of Variation	df	Sums of Squares	Variance	F
Positions	11	582.24	52.93	6.22*
Panels	11	644.74	58.61	
Remainder	121	1029.02	8.50	

*Significant at the 1% level of confidence.

A test for linearity based upon an extension of the analysis of Table 2 and utilizing Lindquist's Case IV (11) failed to reject an assumption of linearity of the intelligibility scores as a function of distance ($F = 0.77$ with 10 and 121 degrees of freedom).

Earlier administrations of intelligibility tests in this room indicated that listener scores were affected adversely with increased distance between the speaker and the listener (5). An assumption of linearity of trend of intelligibility as a function of speaker-listener separation distance was not rejected in any instance. There has been, however, a consistent numerical disadvantage associated with listening position 8 and this observation is found in the results of the present study.*

A separate analysis of variance failed to reveal any difference in the scores assigned by the speaker lists of Forms A and B ($F = 0.78$; 11 and 121 df).

*Position 8 was located 34 feet from the principal reflecting end of the testing room. This distance would yield an echo having a delay time of 0.06 second, a time that has been found to be disrupting to a speaker experiencing delayed side-tone (3); and also to listener reception of monosyllables (7). Panel-by-panel, eight of the 12 scores associated with station 8 were lower than the scores assigned station 9.

RESULTS

A simple analysis of variance was performed on the speaker intelligibility scores under the three experimental conditions: talk loudly, articulate precisely, talk rapidly. The analysis is summarized in Table 1. The obtained F-ratio of 6.24 between the experimental conditions and the remainder was significant at the one per cent level of confidence. The obtained mean scores were: "talk loudly," 93.9 percent; "articulate precisely," 94.5 percent; and "speak rapidly," 92.6 percent. Differences of 1.9 and 1.5 percentage points between pairs of mean scores were required for significance at the one and five percent levels of confidence respectively; thus, only the difference between "articulate precisely" and "talk rapidly" was statistically significant.

TABLE 1.

Summary of an analysis of variance among the intelligibility scores attending three experimental conditions: loud talking, fast talking, precise articulation.

Source of Variation	df	Sums of Squares	Variance	F
Conditions	2	166.16	83.08	6.24*
Remainder	141	1877.44	13.32	

*Significant at the 1% level of confidence.

The foregoing analysis related to the relative effectiveness of the three instructions. A further comparison was made by means of a series of *t*-tests in which the "uninstructed reading" scores were compared with the "instructed reading" scores. In these comparisons the reading score after instruction was significantly superior to the "uninstructed reading" score in all instances: "talk loudly," 91.9 vs. 93.9 percent (*t*, 2.50); "articulate precisely," 92.5 vs. 94.5 percent (*t*, 3.34); "read fast," 90.6 vs. 92.6 percent (*t*, 2.63). Each analysis involved 47 degrees of freedom. The increment in the "instructed" multiple-choice intelligibility score in each instance was two percent over the "uninstructed" score.

An analysis of variance involving listening positions, listening groups, and remainder yielded an F-ratio of 6.22, significant at the one percent level of confidence with 11 and 121 degrees of freedom. The mean scores for the first 12 listening stations in order from "near the speaker" to "removed from the speaker" were 94.9, 95.3, 94.7, 94.0, 93.3, 92.3, 89.9, 92.2, 90.3, 90.6, 89.3 percent. A difference between two means of 2.3 percent would be significant at the five percent level of confidence. The analysis is summarized in Table 2.

TABLE 2.

Summary of an analysis of variance among the intelligibility scores that attended 12 listening positions.

Source of Variation	df	Sums of Squares	Variance	F
Positions	11	582.24	52.93	6.22*
Panels	11	644.74	58.61	
Remainder	121	1029.02	8.50	

*Significant at the 1% level of confidence.

A test for linearity based upon an extension of the analysis of Table 2 and utilizing Lindquist's Case IV (11) failed to reject an assumption of linearity of the intelligibility scores as a function of distance ($F = 0.77$ with 10 and 121 degrees of freedom).

Earlier administrations of intelligibility tests in this room indicated that listener scores were affected adversely with increased distance between the speaker and the listener (5). An assumption of linearity of trend of intelligibility as a function of speaker-listener separation distance was not rejected in any instance. There has been, however, a consistent numerical disadvantage associated with listening position 8 and this observation is found in the results of the present study.*

A separate analysis of variance failed to reveal any difference in the scores assigned by the speaker lists of Forms A and B ($F = 0.78$; 11 and 121 df).

*Position 8 was located 34 feet from the principal reflecting end of the testing room. This distance would yield an echo having a delay time of 0.06 second, a time that has been found to be disrupting to a speaker experiencing delayed side-tone (3); and also to listener reception of monosyllables (7). Panel-by-panel, eight of the 12 scores associated with station 8 were lower than the scores assigned station 9.

DISCUSSION AND CONCLUSION

Each of three single sentence instructions was effective in altering intelligibility scores. The possibility exists that all three instructions, "talk loudly," "articulate precisely," and "talk rapidly," affected vocal sound pressure level and thus the intelligibility scores. However, since both vocal level and precision of articulation are each intuitively and demonstrably associated with intelligibility, the inclusion of both instructions in voice communication training seems to be justified.

The multiple-choice intelligibility tests have been found to be responsive to environmental changes at the speaker's position in the testing room used in this study (5,6). Hence, if changes in speaking were induced through single-topic instructions to the speakers with respect to reading the lists of the tests, the tests were expected to respond to the changes.

Probably more needs to be known about the effect of the instruction "fast talking" before a related instruction would be wisely incorporated into a course of instruction. Up to the present time this instruction has not been associated with improvement in intelligibility and it seems illogical that it should be. It may be that any instruction to a speaker that tends to focus attention away from habitual speech patterns could affect intelligibility, although many teachers of speech, a priori, would probably not agree.

The three vocal traits, loud and fast talking as well as precise articulation, may be characteristically present in the effect termed projection in describing stage speech.

REFERENCES

1. Abrams, M. H. and others. Speech in noise: a study of the factors determining its intelligibility. Sept. 1, 1944. OSRD Rept. no. 4023.
2. Black, J. W. Effects on voice communication training. Speech Monog., 13, 1946, 2, 64-68.
3. Black, J. W. The effect of delayed side-tone upon vocal rate and intensity. J. of Speech and Hearing Disorders, 16, 1951, 56-60.
4. Black, J. W. Multiple-choice intelligibility tests. Pensacola: Joint project, Ohio State Univ. Res. Found. and U. S. Nav. School of Av. Med. 1 November 1953. Joint Project Report no. 17. The Bureau of Medicine and Surgery Project NM 001 064.01.17.
5. Black, J. W., Tolhurst, G. C. and Morrill, S. N. Applications of multiple-choice speech intelligibility tests in the evaluation and use of voice communication equipment. Pensacola: Joint project, Ohio State Univ. Res. Found. and U. S. Nav. School of Av. Med., 15 November 1953. Joint Project Report no. 19. The Bureau of Medicine and Surgery Project NM 001 064.01.19.
6. Black, J. W. and Tolhurst, G. C. Intelligibility as related to the path of airborne side-tone. Pensacola: Joint project, Ohio State Univ. Res. Found. and U. S. Nav. School of Av. Med. 15 November 1954. Joint Project Report no. 34. The Bureau of Medicine and Surgery Project NM 001 064.01.34.
7. Black, J. W. and Tolhurst, G. C. The reception of repeated speech signals. Pensacola: Joint project, Ohio State Univ. Res. Found. and U. S. Nav. School of Av. Med. 15 May 1955. Joint Project Report (in press). The Bureau of Medicine and Surgery Project NM 001 064.01.
8. Curtis, J. F. Training studies in voice communication: 1. Can intelligibility of voice communication be increased by training in voice technique? Psychological Corp., July 5, 1944. OSRD Rept. no. 3862.
9. Haagen, C. H. Intelligibility measurement: Twenty-four word multiple-choice tests. Psychological Corp., Sept. 11, 1945. OSRD Rept. no. 5567.
10. Kelly, J. C. and Mason, H. M. An experimental comparison of five conditions for voice communication training. Purdue Res. Found., August 8, 1947. Proj. 20-K-1, Rept. no. 3.
11. Lindquist, E. F. Goodness of fit of trend curves and significance of trend differences. Psychometrika, 12, 1947, 65-78.

Armed Services Technical Information Agency

Because of our limited supply, you are requested to return this copy WHEN IT HAS SERVED YOUR PURPOSE so that it may be made available to other requesters. Your cooperation will be appreciated.

AD

51810

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

Reproduced by
DOCUMENT SERVICE CENTER
KNOTT BUILDING, DAYTON, 2, OHIO

UNCLASSIFIED