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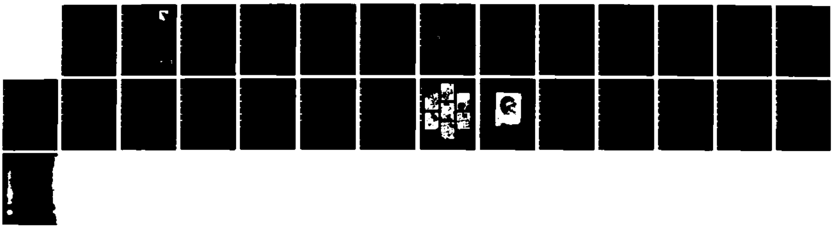

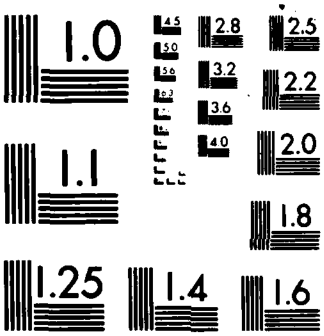

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AF AEROSPACE MEDICAL RESEARCH LABORATORY

VOICE COMMUNICATION AND POSITIVE PRESSURE BREATHING IN NOISE

AD-A141 303

CHARLES W. NIXON

JANUARY 1984

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AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

NOTICES

TECHNICAL REVIEW AND APPROVAL

AFAMRL-TR-84- 009

The voluntary informed consent of the subjects used in this research was obtained as required by Air Force Regulation 169-3.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

HENNING E. VON GIERKE, Dr Ing
Director
Biodynamics and Bioengineering Division
Air Force Aerospace Medical Research Laboratory

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The speech intelligibility of talkers and listeners using military voice communications equipment was measured in the laboratory under conditions of positive pressure breathing and tactical aircraft cockpit noise environments. Results indicated that positive pressure breathing did not significantly degrade speech intelligibility until the noise environment reached 115 dB. A trend suggesting that intelligibility decreased with increased pressure was observed across the other experimental conditions. Positive pressure breathing

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SUMMARY

The speech intelligibility of talkers and listeners using military voice communications equipment was measured in the laboratory under conditions of positive pressure breathing and tactical aircraft cockpit noise environments. Results indicated that positive pressure breathing did not significantly degrade speech intelligibility until the noise environment reached 115 dB. A trend suggesting that intelligibility decreased with increased pressure was observed across the other experimental conditions. Positive pressure breathing did contribute to changes in speech production which resulted in increased talker effort and decreased speech quality. A new respiration valve that could operate at lower mask pressures and would have lower internal noise levels might be highly desirable for aircrews. Speech intelligibility changes due to the cockpit noise conditions were typical of those seen in previous experiments where the percent correct responses decreased with increased levels of the noise.

PREFACE

This work was accomplished in the Biological Acoustic Branch, Biodynamics and Bioengineering Division, Air Force Aerospace Medical Research Laboratory, Aerospace Medical Division. The effort was accomplished under the Core program in Voice Communications Research in support of work unit 723109AA, "Technology Application". The author wishes to acknowledge Mrs. Alisa Workman, University of Dayton Research Institute, for her excellent work in collecting the experimental data.

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INTRODUCTION

Anecdotal stories vary regarding the impact on aircrew voice communications effectiveness of positive pressure breathing in high performance aircraft. Some aircrew members report no major communication problems while others describe speech production as difficult with a corresponding degradation of the voice communication signal. Speech production is a neuromuscular activity that is superimposed on the exhalation phase of the respiratory function. Consequently, activities that directly result in irregular or nontypical breathing indirectly alter speech from that produced during typical respiration. The increased pressure generated inside the oxygen mask during positive pressure breathing influences respiration as well as the speech signal. Also, speech may be masked at the microphone by acoustic noise from the inhalation/exhalation valves and from the ambient environment. It is clear that the speech signal under positive pressure breathing is different from that under normal pressure breathing, however it is not clear if these differences cause corresponding reductions in communications effectiveness as measured by word intelligibility.

At present there is renewed interest in evaluating the potential of positive pressure breathing as a means of increasing g-tolerance of aircrew members during high g maneuvers in tactical aircraft. Under these flight conditions, speech production is likely to be affected by the direct impact of the g-forces on the aircrew member and his reactions to them as well as by possible interactions with the positive pressure breathing. This study collected objective data on voice communications performance under conditions of positive pressure breathing but did not examine the additional factors imposed by the high g-forces of acceleration. Subsequent phases of the effort intend to examine the question of word intelligibility under positive pressure breathing and g-force loading produced by a human centrifuge research facility. Both research and experience have shown that the quality of the speech signal can be degraded by such things as distortion, rate changes, missing sounds and band pass filtering without necessarily causing significant reductions in speech intelligibility. The purpose of this investigation was to determine the word intelligibility of speech communication of talkers and listeners wearing flight helmets and oxygen masks under conditions of positive pressure breathing and high level cockpit noise.

APPROACH

The word intelligibility of volunteer subjects was measured in a voice communications research facility under five different respiration conditions in four levels of a fighter cockpit noise environment. Subjects participated as talkers and listeners and wore the HGU-26/P standard Air Force flight helmet with either the MBU-5/P or the MBU-12/P low profile oxygen mask connected to a standard aircraft communication system. Talkers in the study wore the MBU-12/P oxygen mask and spoke standardized speech materials under the different oxygen mask positive pressure breathing conditions while in the presence of different intensity levels of a typical high performance tactical aircraft cockpit noise. Listeners evaluated the speech materials in terms of correct identification under the same positive pressure breathing and noise conditions as the talkers. In one phase of the study these intelligibility measurements were made over a communication link containing only the Air Force standard AIC-25 aircraft intercommunication system (Figure 1a) and, in another phase, the link contained the ARC-164 UHF-AM aircraft transceivers in addition to the AIC-25 system (Figure 1b). Experimental data were analysed in terms of percent correct responses to the word intelligibility measures.

SUBJECTS

Ten trained volunteer subjects, five male and five female, participated in this laboratory investigation. All were recruited from the general civilian population and were paid an hourly rate for their participation. Subjects were highly experienced in speech communication testing and were fully trained on the requirements of this investigation prior to data collection.

The natural speech produced by these subjects was general mid-western American speech; none exhibited a noticeable accent, dialect or speech problem. Five of the subjects, three male and two female, participated as trained talkers. All ten subjects participated as listeners. The hearing of all subjects was normal. The hearing levels were no greater than 15 dB in either ear at any standard audiometric test frequency from 500 Hz to 6000 Hz (Reference 1).

APPARATUS

VOCRES

This investigation was accomplished using the Voice Communication Research and Evaluation System (VOCRES) at the Air Force Aerospace Medical Research Laboratory (Reference 2). VOCRES is displayed in Figure 2 and consists of a central processing unit that controls the experimental sessions and ten individual communication test stations each equipped with a 64 character alphanumeric plasma display, a subject response unit consisting of special keyboards for inputing performance response data to the central processor, and a large volume unit (VU) meter that indicates voice level of speech generated at that station. Each station also contains the AIC-25 aircraft intercommunication system, the Air Force standard voice communications headgear, an air respiration system with A-14 manual diluter demand regulators and AF standard oxygen masks. A programmable high intensity sound system is used for emulating operational noise environments in the laboratory. The VOCRES central processing unit provides real time response measurement, performance display, data collection and reduction. The VOCRES system is easily adapted to various requirements such as the incorporation of different aircraft radios, audio communications jammers, special speech processors, and the like, that are not integral components of VOCRES.

STANDARD VOICE COMMUNICATIONS HEADGEAR

Subjects wore the Air Force standard flight helmet, HGU-26/P with MX8376/AR earcups, and the MBU-5/P or MBU-12/P oxygen mask (Figure 3). Most subjects were measured for proper fit with both the helmets and the oxygen masks by a research anthropologist. The amount of average hearing protection provided by properly fit helmets worn with the chin strap (not with the oxygen mask as worn in this study) and measured in accordance with American National Standards Procedures (reference 3) is shown in Table 1. The wearer with a proper fitting helmet obtains good high frequency protection above 800 Hz to 1000 Hz with poor protection at the low frequencies.

TABLE 1

MEAN REAL EAR ATTENUATION AND STANDARD DEVIATIONS OF AIR FORCE STANDARD FLIGHT HELMET HGU-26/P WITH MX8376/AR EARCUPS

	FREQUENCY (HZ)								
	125	250	500	1000	2000	3150	4000	6300	8000
AVERAGE ATTENUATION	7	6	14	22	33	43	44	40	38
STANDARD DEVIATION	5.1	5.6	5.0	4.4	6.5	5.7	5.7	11.0	10.7

Both the MBU-5/P and MBU-12/P oxygen masks are equipped with the standard M-101 noise cancelling microphone. The frequency response of a typical M-101 microphone housed in the low profile MBU-5/P unit is shown in Figure 4.

RESPIRATION SYSTEM

The air breathing system that supplies the A-14 diluter demand regulators and the oxygen masks consists of a large compressor, storage cylinders or buffer stage and a manifold that feeds the air to the individual stations. The normal operating pressure in the system is 150 psig, which allows all breathing options available on the A-14 regulator to be used under the laboratory conditions. In this experiment the A-14 regulator was set to represent the four conditions of positive pressure breathing shown in Table 2.

TABLE 2

POSITIVE PRESSURE BREATHING CONDITIONS IN TERMS OF EMULATED ALTITUDE AND PRESSURE IN INCHES OF WATER

ALTITUDE (1000FT)	PRESSURE (INCHES OF WATER)
NORMAL	1.75 ± 0.5
41,000	4.00 ± 0.5
43,000	6.00 ± 0.5
45,000	8.00 ± 0.5
ABOVE 45,000	12.00 ± 1.0

HIGH INTENSITY SOUND SYSTEM

The high intensity sound system is a versatile electrodynamic system that permits the accurate reproduction in the laboratory of ambient and environmental noise conditions of operational situations. A noise generator and spectrum shaper allow most military cockpit noise environments (spectrum and level) within the 20 Hz to 20KHz frequency range to be generated inside the VOCRES test chamber. The measurement phases of this study were conducted in a generic emulated cockpit noise of a high performance aircraft. Data were collected at four different levels of the noise condition, ambient (75 dB), 95 dB, 105 dB and 115 dB sound pressure level (re 20 uPa). The actual noise spectrum is shown in Table 3.

TABLE 3

ONE THIRD OCTAVE BAND SPECTRUM OF NOISE FOR 105 dB OASPL USED IN POSITIVE PRESSURE BREATHING STUDY

ONE THIRD OCTAVE BAND CENTER FREQUENCIES (Hz)	SOUND PRESSURE LEVEL (dB,SPL)	ONE THIRD OCTAVE BAND CENTER FREQUENCIES (Hz)	SOUND PRESSURE LEVEL (dB,SPL)
25	70.2	630	84.6
31.5	80.4	800	86.2
40	84.1	1000	86.8
50	88.2	1250	88.2
63	95.5	1600	91.0
80	94.9	2000	95.7
100	86.3	2500	97.2
125	98.3	3150	95.7
160	90.3	4000	93.7
200	91.8	5000	91.9
250	89.4	6300	85.6
315	85.3	8000	82.9
400	85.8	10000	79.4
500	84.0	12500	70.5

TEST MATERIALS

This investigation employed a standardized measure of intelligibility, the Modified Rhyme Test (MRT) as developed by House, et al., (Reference 4), for evaluating voice communication performance. The MRT was selected over other materials because it is the test of choice for evaluating the performance of military voice communication systems in the presence of environmental noise (Reference 5). The materials consist of lists of 50 one-syllable words that are equivalent lists in intelligibility. Each test word is spoken by the talker embedded within a universal carrier phrase, "Number .., you will mark ____, please". The listener selects the word believed spoken by the talker from the set of six response words. A correction factor is applied to the scores to compensate for correct responses obtained by guessing. The MRT is easy to administer, score and evaluate and it does not require extensive training of listeners.

PERFORMANCE CRITERION

The MRT tests have been used in the VOCRES facility for numerous investigations of components and systems that have subsequently been used in operational situations. The laboratory performance of these components and systems has been very similar to their operational performance. On the basis of these data and experiences a set of criterion measures has been adopted as a predictor of expected operational performance. Systems and components that perform at an intelligibility level of about 70% and below are not acceptable for operational applications. Those with performance in the 70% to 80% range are considered marginal and their success depends upon the specific conditions under which they are implemented. Intelligibility performance at about 80% and above has been fully acceptable under operational conditions.

EXPERIMENTAL PROCEDURE

This investigation utilized a Round Robin type paradigm wherein selected subjects performed as talkers and all subjects participated as listeners. The talker on any one trial served as a listener on previous and subsequent trials while non-talkers participated as listeners on all trials. All ten experimental subjects participated simultaneously in the sessions, using the procedure just described. All subjects participated in all sessions, serving as their own controls.

The subjects entered the test facility and went to their assigned communication station where they donned the flight helmet and oxygen mask that had been fit to them. The output of the communication headphones had been set at a comfortable level by each subject during the practice trials and was not readjusted during the experiment. The respiration conditions were set by the Experimenter as called for by the experimental design. The aircraft cockpit noise environment was introduced into the chamber after all subjects indicated their readiness to begin. A five second countdown was begun during which the talker and listeners were identified for that test. The talker station then displayed the first phrase to be spoken. The other nine stations displayed the six word answer set to the listeners. The talker spoke the key word in the carrier phrase and the listeners selected the one word that they heard from the set of six by pressing the appropriate response button adjacent to the word. The responses were recorded and tabulated by the central processor. This procedure was repeated for each item in the 50 word list to complete the trial.

A trial consisted of one talker presenting one 50-item word list to nine listeners. The talker intelligibility was the mean of the percent correct responses of the nine listeners. Five talkers participated in each experimental condition. The performance measure for an experimental condition was the mean intelligibility score of the five talkers. A session included about seven word lists and was followed by a 15 minute rest period for the subjects. Three 40 minute sessions were completed each day. The Experimenter changed the test variables between trials in accordance with the experimental design. All conditions, including pressure breathing, noise, talker and word list were counterbalanced and randomized to minimize order effects.

RESULTS

Data are presented in Table 4 for the main variables of positive pressure breathing, noise, and intercommunication system with radio or without radio in terms of the criterion measure of percent correct word intelligibility. Each entry is the mean word intelligibility of nine listeners responding to one talker for the various conditions designated. These data have been adjusted for correct responses that might have been obtained by guessing according to the following formula.

$$\text{Corrected Score} = \left(\text{no. correct} - \frac{\text{no. incorrect}}{5}\right) \times 2$$

The data in Table 5 have been collapsed over positive pressure breathing to allow the influence of the various talkers to be examined.

POSITIVE PRESSURE BREATHING

Inspection of the data in Figure 4 reveals that changes in word intelligibility were not large across the different mask pressure conditions. Word intelligibility was almost always highest under the normal breathing condition (1.75 ±0.05 inches of water) and lowest under the maximum pressure breathing condition (12.0 ±1.0 inches of water). The magnitude of these changes attributed to the pressure breathing was relatively small, amounting to only 5% and less, with one exception. The intelligibility for the highest mask pressure condition was a significant 14% less than for the normal mask pressure for the 115 dB noise exposure condition with the intercom system only in the communication link. The same mask pressure and noise conditions with the ARC-164 transceivers in the communication link did not exhibit this same large reduction in intelligibility. The overall changes in performance due to the noise and pressure conditions are displayed in Figure 5.

SUBJECTIVE COMMENTS

The trained experimental subjects typically provide subjective comments to the experimenter when something in the test situation is observed or suspected of being atypical or out of order. Consequently, comments were not solicited from the subjects in an effort to avoid calling attention to the positive pressure breathing. Nevertheless, several subjects voluntarily reported to the experimenter that talking was a very difficult task under the positive pressure breathing conditions. No comments were received about the listening task.

NOISE CONDITION

The most significant changes in the word intelligibility measured in this study were caused by the noise conditions. These changes due to noise are summarized in Table 4. The overall intelligibility ranged from a little over 60% correct for the highest noise to above 95% correct for the lowest noise condition. The major effect is at the 115 dB noise condition where intelligibility is 30% to 35% less than at the ambient condition. Data values for the ambient and the 95 dB noise conditions are about the same. Intelligibility in the 105 dB noise is about 10% less than in these conditions whereas the differences between 105 dB and 115 dB are 15% and more. These main effects of the noise conditions are evident from the curves in Figure 6.

INTERCOMMUNICATION SYSTEM WITH AND WITHOUT RADIOS

The basic response data for the intercommunication system variable is also presented in Figure 5. Some differences between the two sets of data may be seen at the positive pressure conditions of 43,000 feet and below and the 105 dB and 115 dB noise conditions. The intelligibility is slightly better without the radios under these conditions. This is particualrly the case for the 115 dB noise condition cited earlier. Results at the other experimental conditions are generally the same for the two intercommunication system conditions of with or without the aircraft radios. The overall effect collapsed over positive pressure and talker may be seen in Figure 6 where a slight trend for poorer scores with the radio is suggested with the greatest difference appearing at the 115 dB noise condition.

TALKER INTELLIGIBILITY

Data on talker intelligibility are summarized in Table 5 which presents the intelligibility of the individual talkers in terms of noise and intercommunication system conditions, collapsed over pressure breathing and altitude. These data are ordered highest (best intelligibility) to lowest from the left to the right columns. The range of intelligibility across five talkers is 10%, from approximately 80% to 90%, which is the typical range for average talkers. The best and worst talkers were male and the second and third best talkers were female. Talker number 5, a male, produced the lowest average intelligibility scores which were below 80%.

DISCUSSION

The measured changes in intelligibility due to positive pressure breathing were relatively small, except for the one 115 dB noise condition cited earlier. A trend toward decreasing performance with increasing mask pressure was present, however the amount of the change in these conditions was not significant. These laboratory data suggest that positive pressure breathing contributed to the changes in voice communications experienced and reported by crewmembers but did not, with one exception, significantly degrade intelligibility. This laboratory finding is consistent with the experience that the quality of the speech signal can be markedly degraded without a corresponding reduction in intelligibility. This resistance to decreased intelligibility is due in large part to the redundancy and statistics of the language.

Word intelligibility was degraded in a reasonably predictable manner by the noise conditions of this study. The word intelligibility was acceptable for the three lowest level noise conditions, however, in a level of 115 dB the communications effectiveness was marginal to unacceptable. This lowered intelligibility was due to the interference effect of the noise and was not directly influenced by the positive pressure breathing. The primary source of the noise was the simulated cockpit environment in the test chamber whereas the secondary source was the increased noise in the oxygen mask due to operation of the valves and the forced breathing of the crewmember under increased pressure. The oxygen mask noise was not measured in this study.

The word intelligibility scores for the intercommunication system were only slightly more than for the intercommunication system with radios. These differences were very small except at the 115 dB noise condition. This condition of normal respiration with standard oxygen masks in 115 dB noise environments is frequently run as a control condition in many inhouse studies. An average score of about 70% is typically measured for this condition, which suggests that the average score for the same condition measured in this study is probably spuriously high.

The intelligibility performance of the individual talkers in this study was representative of the general population. Mean intelligibility of the talkers ranged from 79 % to 90% which is typical for normal talkers. When the talker intelligibility scores in a study exceed the 10 % - 11 % range, the data must be examined to demonstrate the absence of talker effects.

This laboratory study demonstrated that positive pressure breathing in itself did not significantly degrade the intelligibility of the voice communications, although some trends in that direction were present. However, this performance might be dependent on the type of respiration valve in the oxygen masks. A new respiration valve that could operate at lower mask pressures and would have lower internal noise levels would be highly desirable for aircrews. The next question to be investigated involves the potential influence on communications of the primary variables that were omitted from this study, the g-forces produced by acceleration and the task loading or workload on the crewmember. Plans for examining the influence of task loading on the intelligibility of talkers under positive pressure breathing are incomplete. The next phase of this effort will involve recording word intelligibility materials spoken by aircrew members riding a human centrifuge research facility under conditions of g-loading and positive pressure breathing. The recordings will be evaluated by trained listeners under simulated aircraft voice communication and noise conditions. Data analysis should provide insight into potential effects and interactions that did not appear in this study in the absence of the g-loading.

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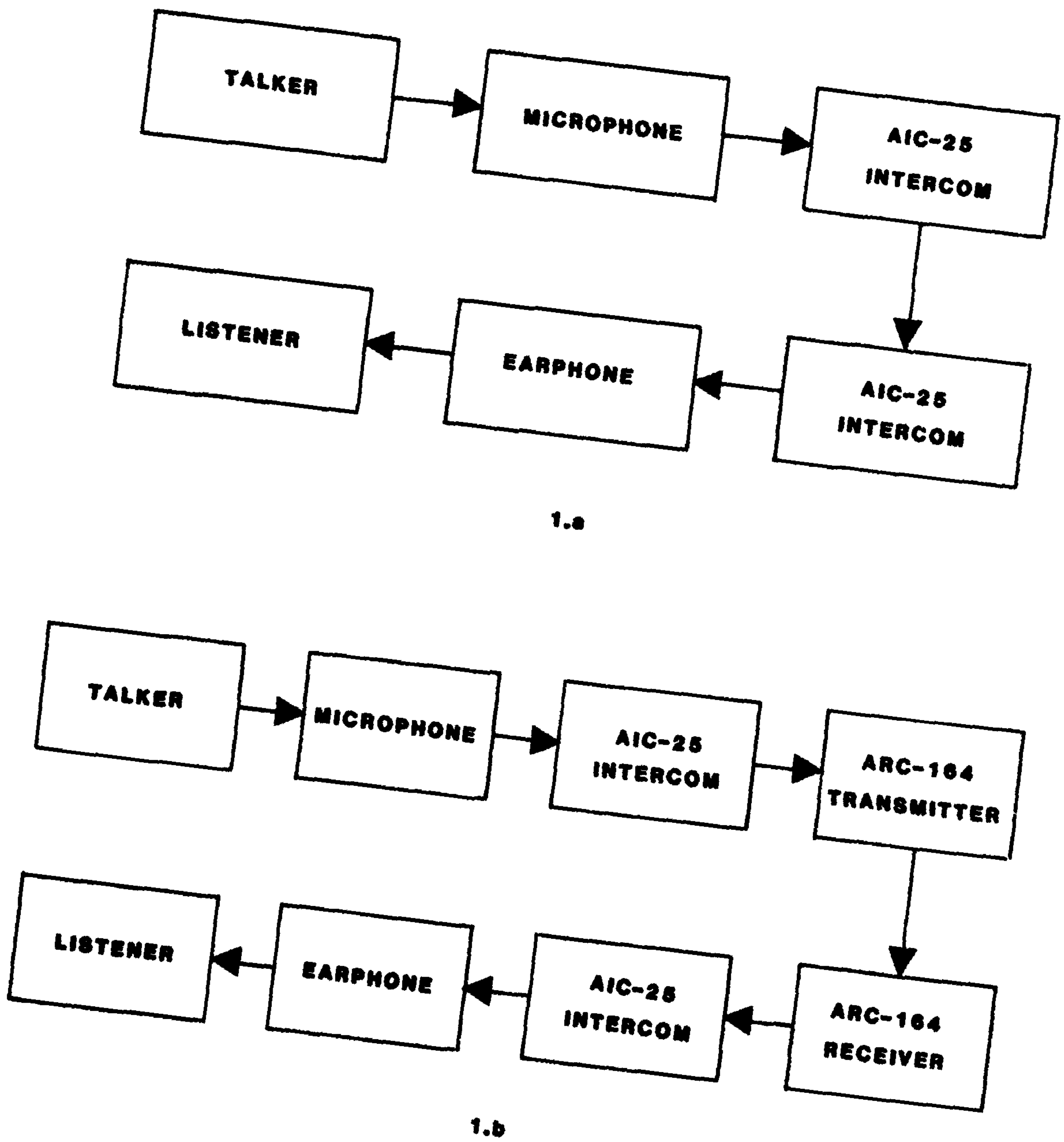

FIGURE 1

Communication Links Employed in Study. Figure 1a displays the link containing only the AIC-25 intercommunication system and Figure 1b displays the link containing both the intercom system and the ARC-164 transceivers.

VOCRES Research Facility. The center panel shows the Experimenter at the central processing unit control console. The remaining panels display various views of the test room, the experimental subjects, the individual subject stations and the high intensity sound source loudspeaker system in the background.

FIGURE 2

FIGURE 3

Air Force Standard Flight Helmet, HGU-26/P, with the New Low Profile MBU-12/P Oxygen Mask

RESPONSE - FREQUENCY CHARACTERISTIC OF
M-100/AIC MICROPHONE MOUNTED IN MBU-5/P
OXYGEN MASK AT GROUND LEVEL

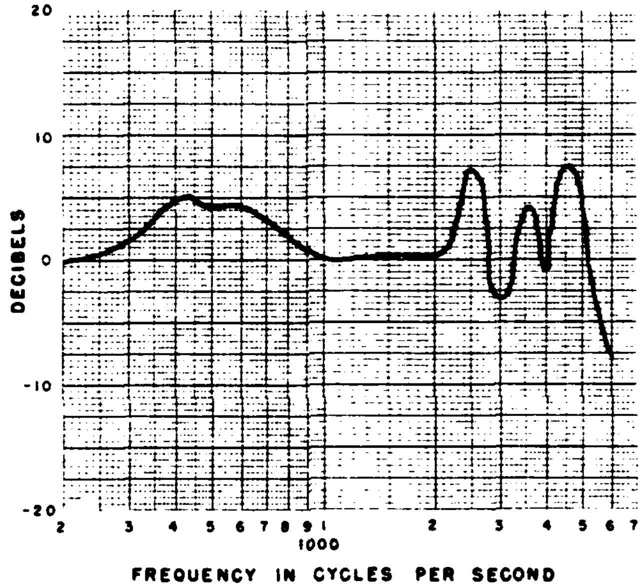

FIGURE 4

Frequency Response of the M-101 Noise Cancelling Microphone in the MBU-5/P Oxygen Mask

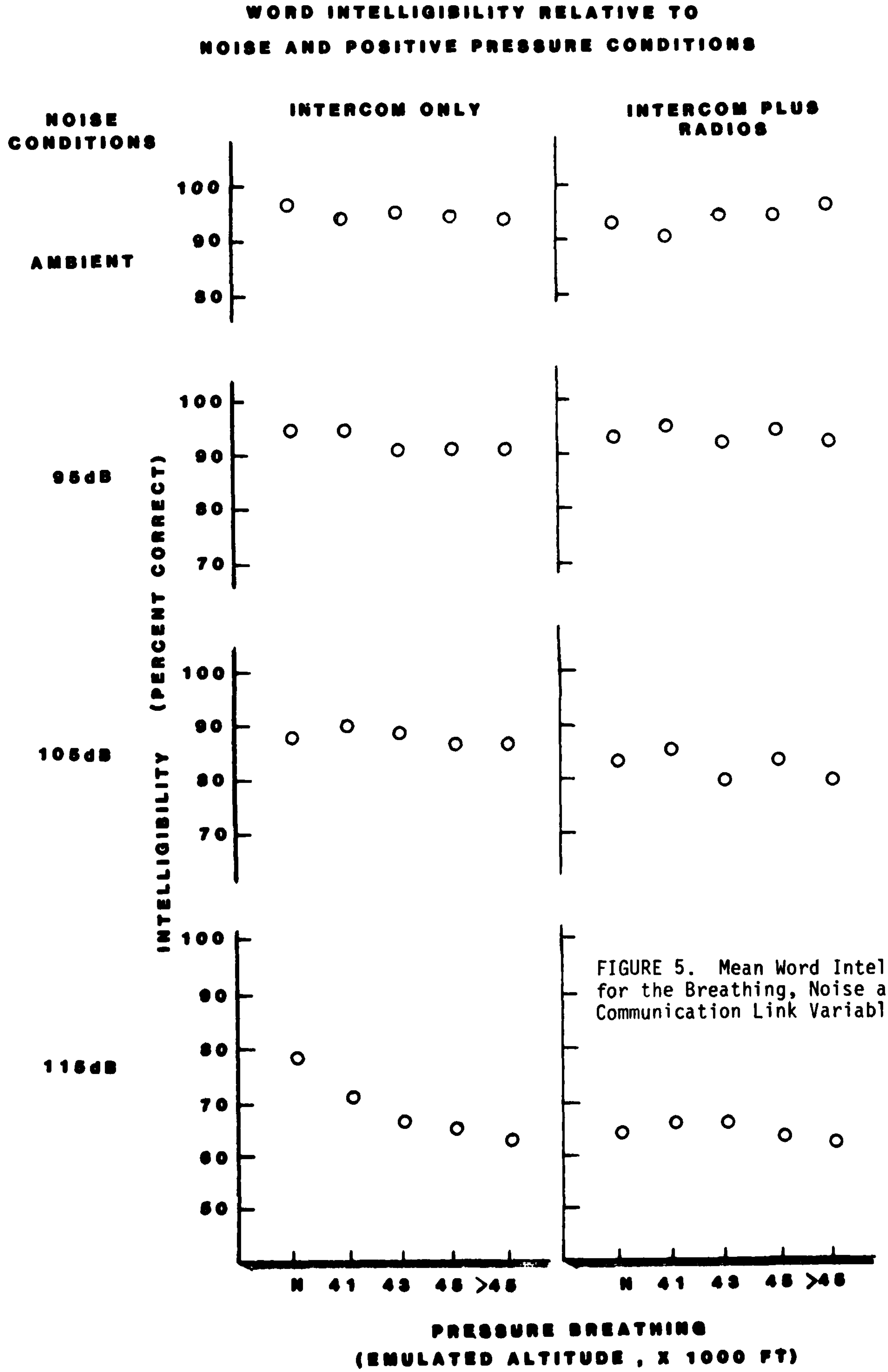

FIGURE 5. Mean Word Intelligibility for the Breathing, Noise and Communication Link Variables

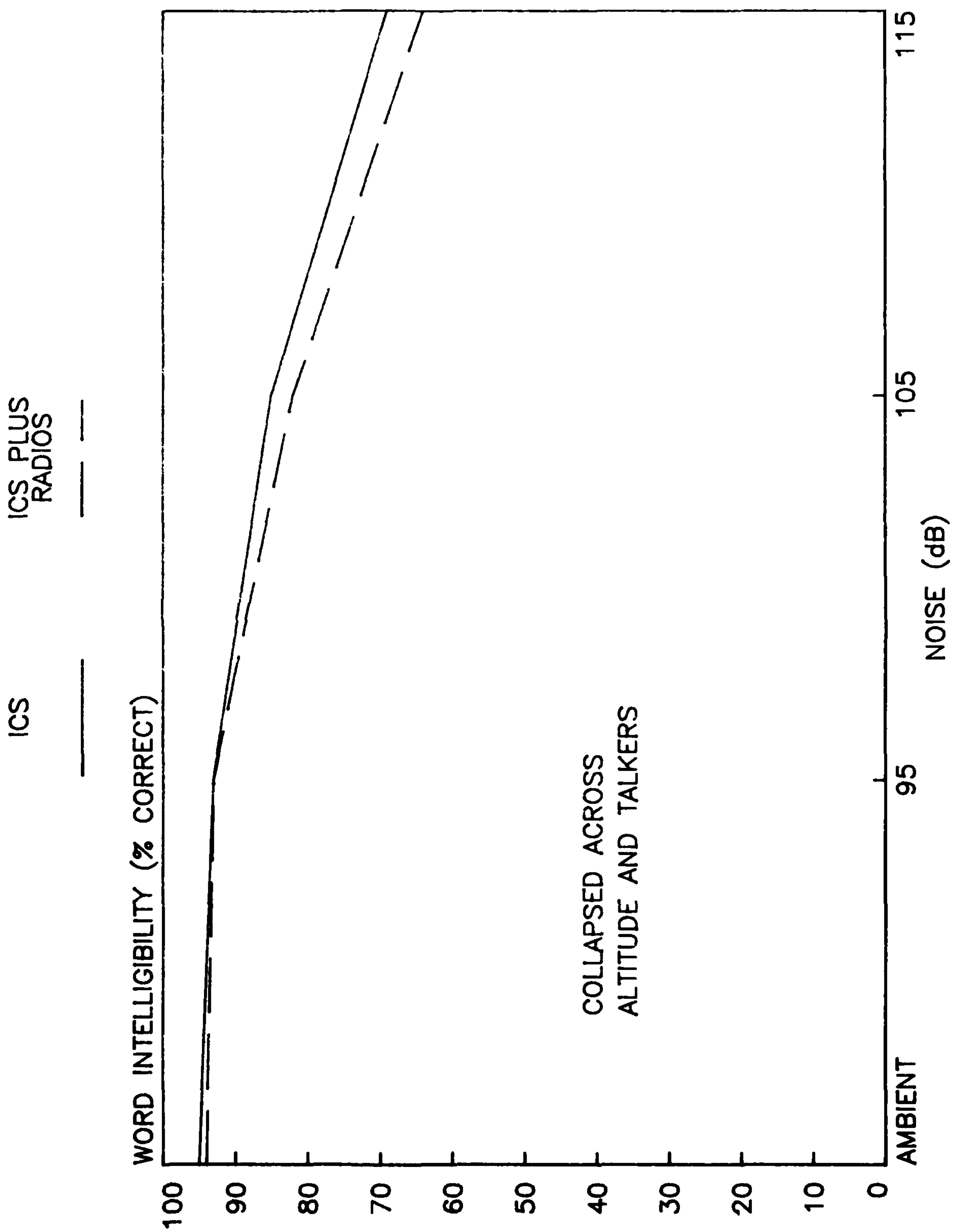

FIGURE 6

Word Intelligibility for Communication Link and Noise Conditions

MEAN WORD INTELLIGIBILITY FOR TEST VARIABLES (PERCENT CORRECT)

NOISE CONDITION	TALKERS	INTERCOMMUNICATION SYSTEM — PRESSURE BREATHING N	41	43	45	45	TALKER MEANS	INTERCOMMUNICATION SYSTEM WITH RADIO — PRESSURE BREATHING N	41	43	45	45	TALKER MEANS
Ambient	1	94.4	93.33	95.2	95.73	89.87	93.71	94.13	95.73	96.27	98.4	97.07	96.32
	2	97.6	87.47	90.93	91.2	91.2	91.68	92	87.73	98.4	97.33	99.47	94.99
	3	99.2	97.33	94.93	94.93	94.67	96.21	97.07	87.73	94.67	91.47	93.33	92.85
	4	97.07	96.53	95.73	92.80	96.27	95.68	89.07	88.53	89.33	93.07	96	91.2
	5	95.73	95.73	96.8	94.67	94.4	95.47	93.6	92	91.73	89.87	96	92.64
	MEANS	96.8	94.08	94.72	93.87	93.28	94.55	93.17	90.34	94.08	94.03	96.37	93.6
95dB	1	89.6	94.13	84.0	88	87.73	88.69	89.87	93.6	86.13	87.73	92.8	90.03
	2	95.2	89.87	84.8	86.67	85.87	88.48	93.33	96.8	88.8	93.87	89.07	92.37
	3	97.87	96.8	95.47	93.6	92.8	95.31	91.73	95.2	94.13	96	91.47	93.71
	4	94.4	97.33	90.4	93.07	93.6	93.76	94.40	94.4	96.8	95.73	90.4	94.35
	5	98.13	96.53	98.13	93.60	96.27	96.53	93.60	95.73	94.67	96.53	95.7	95.15
	MEANS	95.04	94.93	90.56	90.99	91.25	92.55	92.59	95.15	92.11	93.97	91.97	93.12
105dB	1	80.27	93.87	86.40	83.47	84.0	85.6	82.13	83.2	89.33	85.87	79.2	83.95
	2	88.27	81.33	86.13	62.67	70.67	77.81	80.8	82.4	77.33	75.47	69.3	77.06
	3	87.20	92.80	86.67	88.0	83.73	87.68	83.2	89.07	82.13	81.33	86.93	84.53
	4	87.47	85.87	86.67	80.27	81.33	94.32	86.67	82.4	70.4	81.07	78.13	79.73
	5	95.47	94.40	95.20	93.07	92.0	92.03	80.8	89.07	77.07	90.93	83.20	84.21
	MEANS	87.74	89.65	88.21	81.50	82.35	85.49	82.72	85.23	79.25	82.93	79.35	81.9
115dB	1	73.87	67.2	71.73	61.6	67.2	68.32	69.6	68.27	64	60.53	66.4	65.76
	2	77.87	55.73	45.07	46.93	54.93	56.1	51.73	56.8	50.67	51.47	51.47	52.43
	3	78.93	77.07	74.93	72.27	60.0	72.64	64	72	73.07	65.33	72.8	69.44
	4	77.6	69.07	64.27	64.27	65.6	68.16	58.13	54.67	70.93	71.47	55.73	62.19
	5	80.53	84.8	75.73	80.27	69.3	78.13	77.33	80	71.2	64.0	65.87	71.68
	MEANS	77.76	70.77	66.35	65.07	63.41	68.67	64.16	66.35	65.97	62.56	62.45	64.3
GRAND MEANS		87.44	87.36	84.96	77.26	82.57		83.16	84.27	82.85	83.37	82.54	

TABLE 4

Measurement Data for the Main Variables in Terms of Percent Correct Word Intelligibility

TABLE 5

TALKER INTELLIGIBILITY

SUBJECTS		MALE	FEMALE	FEMALE	MALE	MALE
RANK		1	2	3	4	5
	NOISE					
	AMB	95.47	96.21	93.71	95.68	91.68
	95 dB	96.53	95.31	88.69	93.76	88.48
ICS	105 dB	92.03	87.68	85.60	84.32	77.81
	115 dB	78.13	72.64	68.32	68.16	56.10
MEAN		90.54	87.96	84.08	85.48	78.52
	AMB	92.64	92.85	96.32	91.20	94.99
ICS	95 dB	95.15	93.71	90.03	94.35	92.37
&	105 dB	84.21	84.53	83.95	79.73	77.06
RADIO	115 dB	71.68	69.44	65.76	62.19	52.43
MEAN		85.92	85.13	84.02	81.87	79.21
GRAND MEAN		88.23	86.55	84.06	83.67	78.87

Measurement Data for Talker Intelligibility

END

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