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USAARU REPORT NO. 69-1

USER EVALUATIONS OF TWO AIRCREW PROTECTIVE HELMETS

By

James A. Bynum, CPT MSC

AUGUST 1968

U. S. ARMY AEROMEDICAL RESEARCH UNIT
Fort Rucker, Alabama

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ABSTRACT

Two aircrew protective helmets were evaluated by 24 instructor pilots who were divided equally into groups subjected to three ambient noise environments. Pilots rated the Army APH-5 and the SPH-3X (Experimental) on eight categories designed to assess relative comfort, acceptability, and noise attenuation. Ratings were compared, using a Split-Plot Factorial Analysis of Variance. Significant differences were found between helmets on 7 of the 8 characteristics rated and results favored the SPH-3X in 6 characteristics.

APPROVED: [signature]
ROBERT W. BAILEY
LTC., MSC
Commanding

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INTRODUCTION

In 1961 and 1962, a task group composed of representatives of Army agencies met and outlined the Qualitative Materiel Requirements (QMR) for aircrew protective helmets[1,2,3]. The list of helmet requirements outlined consisted of the following:

1. Compatibility with voice communication and attenuation against excessive noise.

2. Compatibility with integrated sun visor.

3. Flash-blindness protection.

4. Oxygen and gas mask compatibility.

5. Ballistics protection.

6. Comfort.

7. Crash protection.

It is obvious that certain compromises are necessary if these requirements are to be met because a helmet which would fully protect against all contingencies would certainly approach the weight limits which a crewman could sustain both in terms of comfort as well as in terms of head and neck injury.

The APH-5, developed by the Navy, has been used by the Army since 1954. Although it has provided good head injury protection, it is not without deficiencies, as pointed out in Av SER Report 62-6[4].

Natick Laboratories has made several modifications to the APH-5 which have improved ballistic protection. In addition, nylon slides have replaced metal slides on the visor retention apparatus and the nape strap has been redesigned in an effort to improve retention and there are indications that other improvements would add to the protective capabilities of the helmet in terms of crash survival[5].

Thoughtful people would agree on the importance of crash protective capabilities as a requirement in helmet improvement as well as any other design modification which would surpass the technical characteristics of the proposed QMR, therefore considerable attention has been given to noise attenuation and communications as areas which merit attention. Some reports[6,7,8,9] have indicated that the APH-5 offers adequate attenuation of excessive noise in parts of the sound spectrum. Improvement in noise attenuation is called for because of inadequate attenuation in other parts of the sound spectrum. In addition, these reports[6,8,9] indicate other helmets could be procured which would surpass the APH-5 attenuation characteristics and those of the proposed QMR across the spectrum.

Therefore, an existing helmet could be obtained which would offer increased protection in all areas outlined in the QMR, and it is clear that the best interests of the aircraft crewman and the government would be served if this helmet was selected as a standard issue item. However, as indicated above, there are compromises which are necessary in order to maximize the benefits outlined as desirable in the QMR.

Since the Army aviator of today has only had experience, officially at least, with the APH-5 issued him, certain problems may present themselves if an improved helmet of different design was offered him. Berger, Matheny, and Newmiller[10] point out that military organizations, characterized by stability, are resistant to change. The same is true of people. Berger, et al. point out further that there is a difference between adoption and acceptance. An item may be adopted for use without being accepted by the user. Of course, the military user has little choice most of the time regarding the equipment he uses but there is a general tendency to resist the change to new equipment unless the user has had a trial period during which an item's advantages and disadvantages can be actively experienced rather than merely being passively imparted to the user.

For these reasons, a trial period was devised so that users could evaluate an experimental helmet, the SPH-3X* (see Figures 1-3) during a time period of two weeks so that comparison could be made between the SPH-3X and the standard APH-5.

The SPH-3X has been designed to meet or exceed the technical characteristics of the QMR and the characteristics of the APH-5, but its design characteristics are unique enough to warrant comparisons of the two in terms of user acceptance as well as laboratory testing of its physical design characteristics.

METHOD

A Split-Plot Factorial 32.2 experimental design, as shown in Table 1, was used in the helmet evaluation[11]. This design permitted assessment of differences between helmets, between noise level groups, and differences attributable to order of rating the two helmets.

Ten instructor pilots were selected from each of the branches of the Aviation School that were included for evaluation. Because of certain helmet malfunctions, administrative difficulties, and in the interest of keeping equal numbers per group, eight subjects were finally selected randomly from each group of ten yielding an N of 24 for the final analysis.

Each pilot wore the SPH-3X helmet for a two-week period. (A longer period was desired, but a report deadline precluded this.)

A graphic rating scale[12] was devised to rate the helmets on eight categories: (See Appendix.)

(a) Attractiveness and appearance.

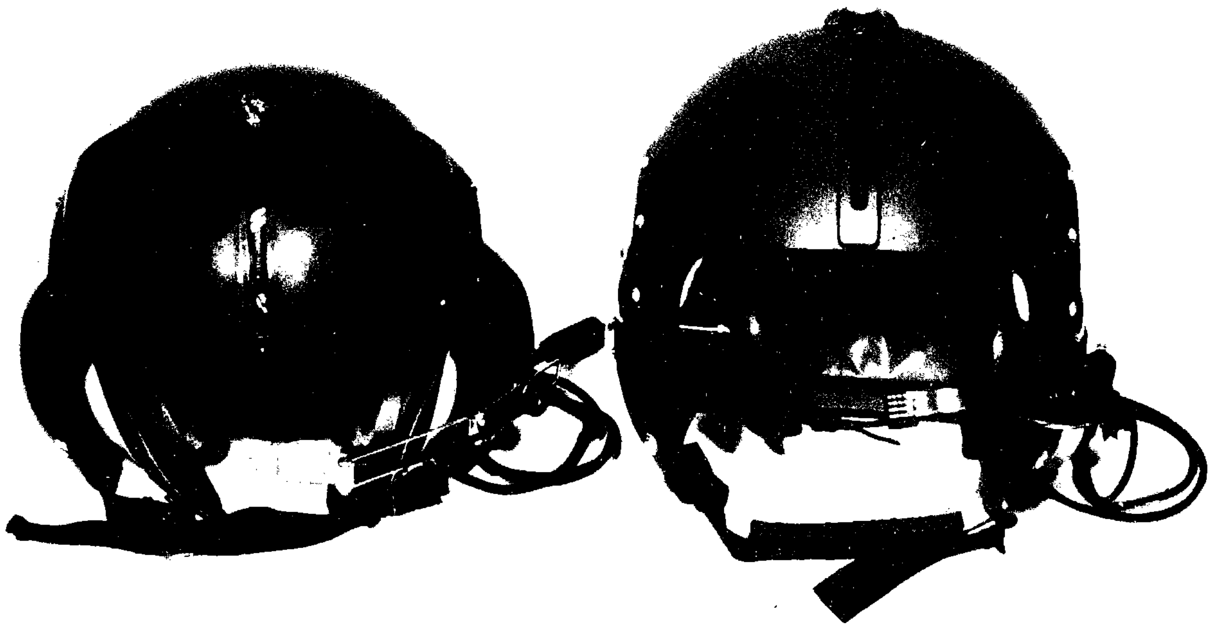
(b) Ease of putting on and removing.

(c) Suspension System.

(d) Wearing comfort during extended periods.

---

* The nomenclature SPH-3X is a USAARU designation for a special model of SPH-3 (DH-110) manufactured by Gentex, and merely indicates an experimental model. This model is to be distinguished from the SPH-3 (Modified) (LS), also manufactured by Gentex.



SPH-3X APH-5

Figure 1.

Front view of the experimental SPH-3X and the Standard Army APH-5.

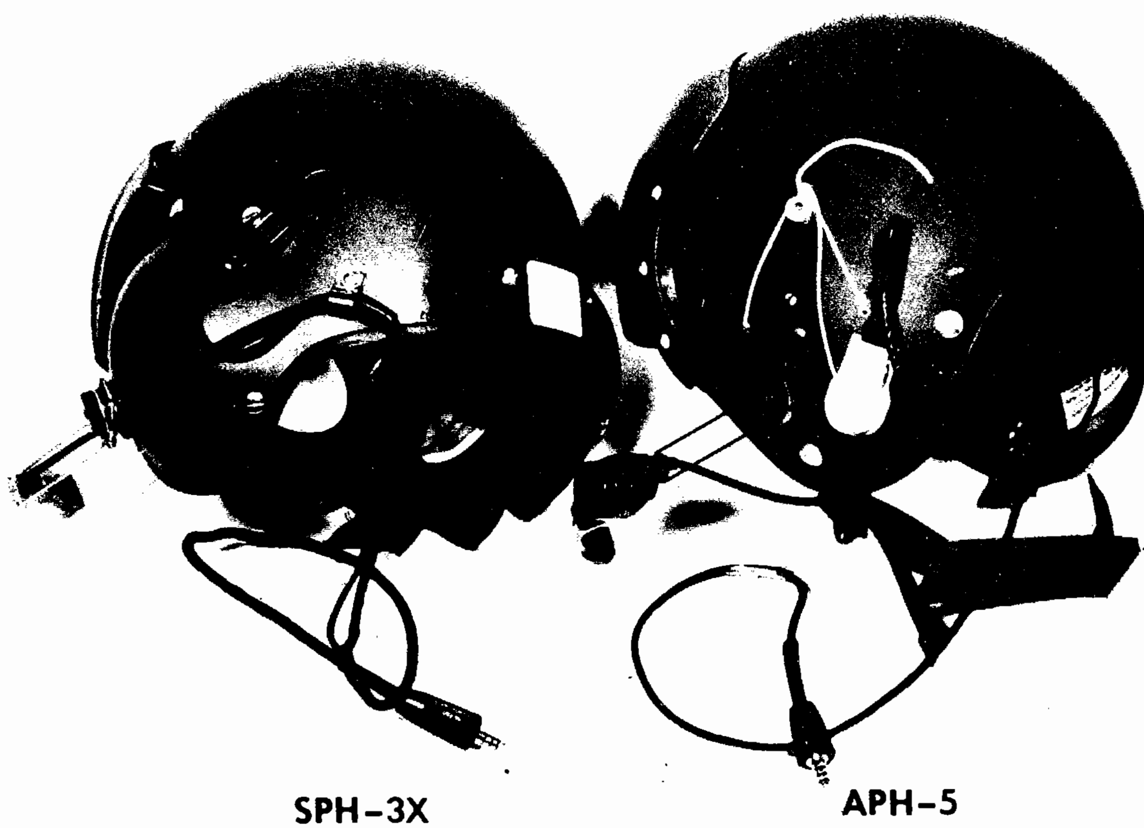
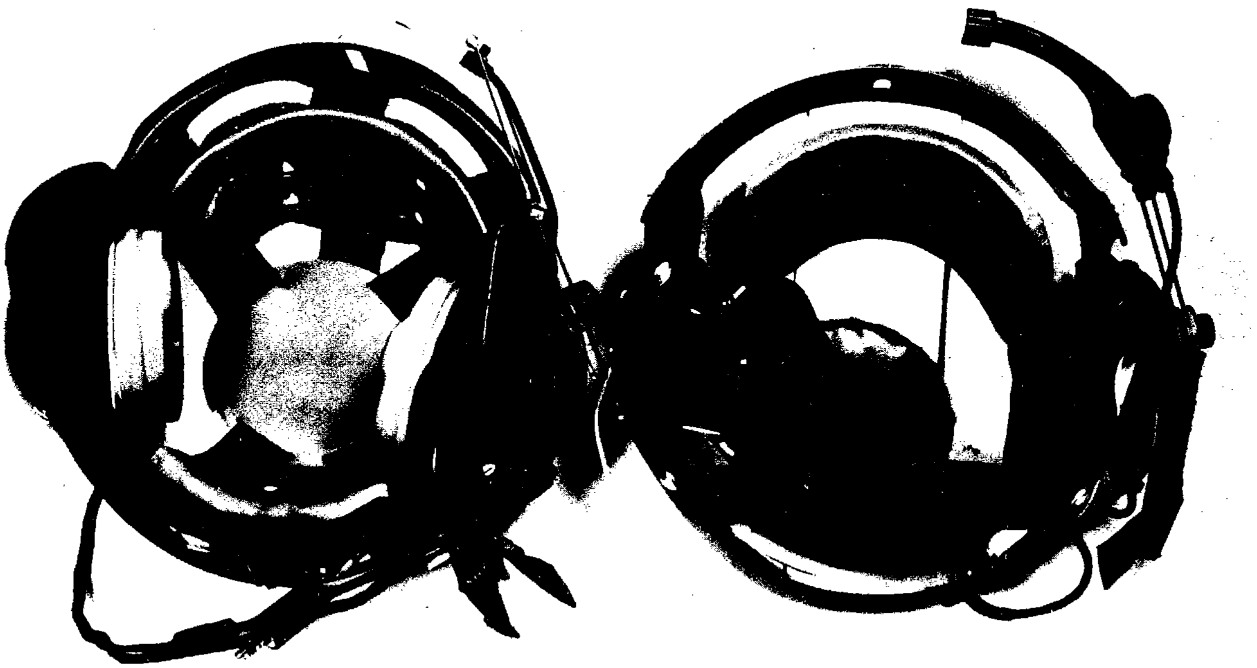


Figure 2.

View of the left rear of the experimental SPH-3X and the Standard Army APH-5.



SPH-3X **APH-5**

Figure 3.

View of the Suspension Systems of the experimental SPH-3X and the Standard Army APH-5.

Table 1

Type SPF 32.2 Experimental Design

		New Helmet (b_1)	Old Helmet (b_2)
High Noise (Impulse) (a_1)	Eval. first (c_1)	x_1 : x_4	x_1 : x_4
	Eval. second (c_2)	x_5 : x_8	x_5 : x_8
High Noise (Steady State) (a_2)	Eval. first (c_1)	x_9 : x_{12}	x_9 : x_{12}
	Eval. second (c_2)	x_{13} : x_{16}	x_{13} : x_{16}
Low/Medium Noise (Steady State) (a_3)	Eval. first (c_1)	x_{17} : x_{20}	x_{17} : x_{20}
	Eval. second (c_2)	x_{21} : x_{24}	x_{21} : x_{24}

Legend

- a_1 - High Noise (Impulse), (Helicopter Gun Ships)
- a_2 - High Noise (Steady State), (Multi-engine helicopters)
- a_3 - Low/Medium Noise (Steady State) (Single engine helicopters)
- b_1 - New helmet, (SPH-3X)
- b_2 - Old helmet, (APH-5)
- c_1 - Evaluate first, (Order of rating b_1 or b_2)
- c_2 - Evaluate second, (Order of rating b_1 or b_2).

(e) Reduction of external noise.

(f) Characteristics of the communications system.

(g) Evaluation of ability of helmet to protect.

(h) A general overall evaluation.

In addition, space was provided on the rating sheet for favorable and unfavorable comments regarding the helmets.

The nature of the graphic rating scale and the method of its completion permitted the SPF 32.5 Analysis of Variance. Each response was scored by measuring the distance in centimeters from the left edge of the scale to the mark. This made for a most sensitive test of differences between the two helmets as outlined.

RESULTS AND DISCUSSION

Tables 2 through 9 indicate the results of the Analyses of Variance on each of the eight variables of the scale. F_{max} tests (.05 level) were used to test for homogeneity of variance of the partitioned parts of the within-cell variation The tests indicated that the assumption of homogeneity was tenable.

Table 2 is the result of comparisons of responses in judging attractiveness and appearance of the helmets. The table indicates a significant main effect at level C, which is the evaluation sequence. That is, those who rated the SPH-3X first tended to rate both helmets differently than those who rated the APH-5 first. A comparison of means at the various levels of C indicated that those who rated the SPH-3X first gave both helmets high ratings while those who rated the APH-5 first rated both helmets lower in terms of attractiveness and appearance. The reasons for this are unknown, but it is important to note that there was no difference in the helmets themselves, as judged by the S_s. Thus, acceptance or rejectance of either helmet should not be anticipated on the basis of attractiveness and appearance.

Table 2.

Analysis of Variance: Item 1
Attractiveness and Appearance

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	2.6108	1.1435	N.S.
C (Eval. Sequence)	1	30.5518	13.3817	$p < .01$
AC	2	2.1550	.9438	N.S.
Subj. w. groups	18	2.2831		
Within subjects	24	1.2664		
B (Helmets)	1	.3852	.3684	N.S.
AB	2	1.8658	1.7844	N.S.
BC	1	1.4919	1.4268	N.S.
ABC	2	2.9825	2.8524	N.S.
B x Subj. w. groups	18	1.0456		

Table 3 represents the results of comparisons of responses of S_s when rating the ease of putting on and removing the helmets. The significant main effect B indicates a significant difference in S_s ratings of the helmets. The pilots rated the APH-5 easier to put on and remove. The inflexibility of the SPH-3X in this respect was quite noticeable and served as a major source of complaint.

Table 4 represents the results of comparing ratings of the suspension systems. Again the only significant effect noted was B (helmets). A comparison of means on this factor showed the SPH-3 suspension system to be preferred by S_s.

Table 3.

Analysis of Variance: Item 2
Ease of Putting On and Removing.

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	3.1714	.6193	NS
C (Eval. Sequence)	1	4.2601	.8320	NS
AC	2	2.9602	.5781	NS
Subj. w. groups	18	5.1203		
Within subjects	24			
B (Helmets)	1	135.6768	28.9320	$p < .01$
AB	2	3.4131	.7278	NS
BC	1	.1520	.0324	NS
ABC	2	4.8794	1.0404	NS
B x Subj. w. groups	18	4.6895		

Table 4.

Analysis of Variance: Item 3
Suspension System

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	2.2809	.6583	NS
C (Eval. Sequence)	1	4.2010	.9278	NS
AC	2	4.5057	.9950	NS
Subj. w. groups	18	4.5279		
Within subjects	24			
B (Helmets)	1	214.2077	25.8543	$p < .01$
AB	2	14.4673	1.7461	NS
BC	1	1.2031	.1452	NS
ABC	2	13.1660	1.5891	NS
B x subj. w. groups	18	8.2851		

When asked to rate the comfort of the helmets over an extended period, S_s indicated a preference for the SPH-3X. Table 5 shows the results of the analysis of these data. Again, level B is the only factor yielding a statistically significant difference.

Table 5

Analysis of Variance: Item 4
Comfort Over an Extended Period

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	1.4452	.2041	NS
C (Eval. Sequence)	1	.1102	.0155	NS
AC	2	8.8351	1.2479	NS
Subj. w. groups	18	7.0796		
Within subjects	24			
B (Helmets)	1	131.6718	16.1679	p <.01
AB	2	13.9169	1.7088	NS
BC	1	5.4002	.6630	NS
ABC	2	5.6828	.6977	NS
B x subj. w. groups	18	8.1440		

A major technical characteristic of the SPH-3X from a medical point of view is its noise attenuation. Table 6 shows that main effect B was statistically significant, indicating a difference in the noise attenuation ability of the two helmets. A comparison of means showed the SPH-3X received a considerably higher rating on this characteristic.

Table 6

Analysis of Variance: Item 5
Reduction of External Noise

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	.7452	.3327	NS
C (Eval. Sequence)	1	2.6602	1.1876	NS
AC	2	9.5039	4.2431	p <.05
Subj. w. groups	18	2.2398		
Within subjects	24			
B (Helmets)	1	535.3352	172.7500	p <.01
AB	2	2.9064	.9373	NS
BC	1	.1752	.0565	NS
ABC	2	.9503	.3066	NS
B x subj. w. groups	18	3.0989		

The significant AC interaction means that the ratings of the groups representing the three ambient noise environments was dependent upon which helmet the S_s rated first. For example, in the high steady state noise group, the mean rating for the SPH-3X and APH-5 differed according to rating sequence. Those who rated the SPH-3X first in this group rated it higher than those who rated it second. Similarly, those who rated the APH-5 first rated it higher than those who rated it second. (Those who rated the SPH-3X first rated the APH-5 second and vice versa.) Although the helmets were rated as being significantly different, analysis of this interaction points to the fact that the magnitude of the score is dependent upon the sequence of rating, as was the case with the rating of appearance.

Table 7 represents the comparison of ratings on the communications characteristics of the two helmets. The significant B effect means that there was a significant difference in ratings. Mean scores favored the SPH-3X in this category also.

Table 7

Analysis of Variance: Item 6
Communications Characteristics

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	7.7564	1.5469	NS
C (Eval. Sequence)	1	4.5634	.9100	NS
AC	2	9.4126	1.8772	NS
Subj. w. groups	18	5.0141		
Within subjects	24			
B (Helmets)	1	196.8299	21.9067	$p < .01$
AB	2	27.3681	3.0456	NS
BC	1	3.8534	.4288	NS
ABC	2	6.5753	.7318	NS
B x Subj. w. groups	18	8.9849		

Table 8 summarizes the comparison of ratings in which S_s indicated their subjective judgment of the ability of the helmets to protect. The significant B effect indicates a difference between helmets and, again, comparison of mean ratings favored the SPH-3X.

Table 8

Analysis of Variance: Item 7
Ability to Protect

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	5.2952	.8660	NS
C (Eval. Sequence)	1	.4218	.0689	NS
AC	2	5.4731	.8951	NS
Subj. w. groups	18	6.1142		
Within subjects	24			
B (Helmets)	1	72.2751	6.5557	$p < .05$
AB	2	22.2389	2.0171	NS
BC	1	16.4503	1.4921	NS
ABC	2	1.3828	.1254	NS
B x Subj. w. groups	18	11.0247		

When asked to give the helmets an overall evaluation, the S_s rated the SPH-3X higher than the APH-5. Table 9 indicates, again, that the ratings by the different groups were dependent upon the sequence in which the helmets were rated, i.e., which was rated first. This is pointed out by the significance of the AC interaction effect.

Table 9

Analysis of Variance: Item 8
Overall Evaluation

Source	df	MS	F	P
Between subjects	23			
A (Noise Environ.)	2	1.0408	.6881	NS
C (Eval. Sequence)	1	2.6602	1.7588	NS
AC	2	9.6108	6.3542	$p < .01$
Subj. w. groups	18	1.5125		
Within subjects	24			
B (Helmets)	1	190.8018	35.3408	$p < .01$
AB	2	13.1875	2.4426	NS
BC	1	.0169	.0031	NS
ABC	2	1.9901	.3686	NS
B x Subj. w. groups	18	5.3989		

Table 10 shows the mean rating in centimeters of the two helmets on each of the eight categories. In comparing means, it should be remembered that the mean score will not correspond to the numbers along the line of the scale shown in the Appendix because the number on the scale is not in centimeters but is used merely to divide the scale to indicate relative differences in the descriptive phrases on the continuum.

Table 10

Mean Scores of the Two Helmets

	Category							
	1	2	3	4	5	6	7	8
SPH-3X	7.9291	6.4791	9.4458	9.0541	10.7250	9.8166	8.8916	9.9041
APH-5	7.7500	9.8416	5.2208	5.7416	4.0458	5.4541	6.4375	5.9166

It is clear from the data obtained that the newer SPH-3X is preferred in six of the eight categories. The stiffness of the shell appears to be the only drawback when these categories are considered.

The pilots were asked to indicate the features they liked about both helmets as well as the features they disliked. The twenty-four S_s indicated 18 good features and 15 poor features of the SPH-3X as compared to 11 good features and 20 poor features of the APH-5. A Chi-Square test of these differences was not significant. These results can be compared by dichotomizing the comments into the number of favorable and unfavorable comments about both helmets. The SPH-3X had a total of 61 favorable comments as opposed to 46 unfavorable comments. Comparing this with the APH-5, which had 29 favorable and 63 unfavorable comments, there is a significant difference in the responses (Chi-Square, 1 df, $p. < .001$).

These data are open to interpretation but one point to be made is that any comment was included and similar comments were tallied to indicate the number of favorable and unfavorable areas. Pooling and summarizing these data would give a better indication of the evaluation of the two helmets.

Subjects from the high steady-state and high impulse noise groups indicated their preference for the SPH-3X on the basis of noise reduction. Attenuation was readily detected and commented upon quite favorably.

One reason for including a low/medium noise environment was because these pilots might object to the introduction of a new helmet for different reasons, or might desire its inclusion for equally different reasons than pilots subjected to high noise environments. Therefore, to equally sample the aviator population, these pilots were included. As predicted, there was some interaction of groups and helmet preferences. Some of the pilots in the low/medium noise group commented about the noise attenuation in a manner classified as unfavorable for purposes of the study. Their complaints were centered around the fact that when all the noise was attenuated to a greater degree than that to which they were adapted, they could no longer detect auditory cues about engine operation or malfunctions by ear. This position may be tenable, but evidence points to the fact that their adaptation level could shift in such a way as to permit detection of malfunctions and other auditory cues after wearing the helmet for a longer period.

Comments comparing the design of the earphones indicated a preference for the SPH-3X. The design of the earphone retention cup of the SPH-3X is its main feature, which makes both for the noise attenuation as well as the comfort of wearing the earphone over an extended period. While some felt the earphone permitted the wearing of sunglasses with more comfort, others felt that it did not. Since both the SPH-3X and APH-5 helmets allow for differential pressure of the earphone either by means of an elastic strap or a draw-string, the pressure of each can be controlled.

Comments regarding the use of sunglasses lead to comments regarding the visor. All the SPH-3X helmets were equipped with a clear visor. Consequently, the sunglasses were required. Many comments were directed toward the inclusion of a dual visor system which allows for choice of either visor. Most pilots were combat veterans and alluded to the preference for wearing some visor down at all times.

One would predict differences of opinion regarding features of any equipment and such was the case in this test. Some individuals, for example, would not agree that the latitude afforded in fitting and adjusting the SPH-3X helmet was a favorable characteristic or that it was easy to fit. Since the majority of those testing the helmet commented favorably about fit and adjustment, unfavorable comments in this regard are open to question. A more positive effort is required to obtain an adequate adjustment with the SPH-3X and a good fit is absolutely essential for retention. If, therefore, a poor fit could be attributed to lack of a positive effort in fitting, then the comments are not considered as valid complaints. On the other hand, the SPH-3X is available in two sizes, regular and extra large. It could be that a subject was issued a regular, when in fact he would have faired better with an extra-large. Issue was on a personal basis and each subject tried on the helmet and received instructions regarding the several adjustments. But issue was also based on the size the subject stated as fitting. Thus a subject, who wore a medium APH-5 with thin pads, may have called for and accepted a regular SPH-3X, expecting a similar fit, when in fact he could have worn an extra-large with more comfort.

Several favorable comments were made about the microphone of the SPH-3X. These comments centered around the boom hinges and the latitude in adjustment afforded by this feature. In addition, the microphone seemed to cut out more background noise for some. Conversely, some subjects didn't like the placement of the mike boom.

Overall, the features of the SPH-3X were sufficiently different from the APH-5 so that if one feature was preferred in the SPH-3X, it was because it differed from the APH-5 whose feature was not liked. For example, a list of favorable comments would include the suspension system of the SPH-3X while a list of unfavorable comments about the APH-5 would include the pad system.

One factor not to be discounted is that the pilots have thousands of hours of wearing the APH-5 as compared to tens of hours of wearing the SPH-3X. The design attempted to have the pilot rate each helmet on its own merit, but carry-over is not to be ruled out, though some attempt was made to control it.

In summary, the data indicate the SPH-3X was preferred by the pilots in 6 of the 8 categorical ratings. In one, there was no significant difference while in the other the APH-5 was preferred. The majority of S_s preferred the SPH-3 because they felt the noise attenuation and the suspension system to be better. These factors affected the overall comfort of the helmets, biasing in favor of the SPH-3X, such that any less favorable attribute would be overlooked because it was felt that good noise attenuation was adequate compensation.

One point not commented on directly by the pilots was the brittleness of the communications wiring harness. Some did comment on the fact that one or both of the earphones would operate intermittently or not at all. This affected their overall evaluation of the communications. In those cases involving a faulty earphone, the trouble was remedied immediately, because of interchangeability of the earphone with those in the inventory. On the other hand, three wiring harnesses had to be replaced due to a break in the wires. It is believed that a different wiring harness should be considered in lieu of the present harness on the SPH-3X to preclude further equipment malfunction. The harness presently in use is a standard Air Force item, but for one or more reasons which remain unknown, it is a source of communications problems.

CONCLUSIONS AND RECOMMENDATIONS

These data lead to the conclusion that the SPH-3X would be acceptable to pilots if included in the inventory. Those design features which differentiate it from the APH-5 are readily detected by the pilot and his reactions are generally favorable.

On the basis of this study, the following recommendations are offered concerning the SPH-3X:

(a) Continue with interchangeable clear and tinted visors to give pilots a choice. Ease of interchangeability should be sought as one criterion.

(b) Improve the wiring harness to insure against accidental breakage. Coiled wire may be a solution, although certain difficulties in electronic gain may preclude this.

(c) In conjunction with (a) and (b) a sturdy, serviceable helmet carrying bag should be provided. One cause of wire breakage could be catching the cord in one of the zippers of the present bag. The bag should be designed to accommodate the helmet and the visor which is not in use in the helmet.

(d) Improve and make more rigid the plug attachment on the helmet.

(e) Add a chin cup or chin pad to the chin strap to prevent chafing under the neck.

Subsequent to this test, the shell design has been improved and the production helmet weight was 3.28 pounds complete with electronics. In addition, the flexibility was improved. These two improvements should add to the acceptance by pilots, based on the fact that the stiffer, somewhat heavier helmet was preferred over the APH-5.

Correction of the additional deficiencies outlined above should complement the helmet and make for greater acceptance.

APPENDIX

HELMET RATING SCALE

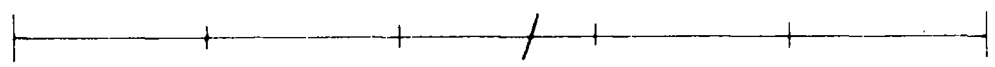
Name ______________________________________ Date ______________
(Last) (First) (M.I.)

Instructions

This rating scale is designed to obtain your opinions about the experimental helmet SPH-3X which you have been wearing.

Notice that each trait is described in a manner similar to a ruler. You should read each stem all the way through and then merely mark your response at the point on the line that best expresses your opinion about the trait.

EXAMPLE: Alabama Highways.



0	2	4	6	8	10
worst anywhere	overall poor with a few exceptions	below average	above average	overall good with a few exceptions	best anywhere

Notice that the mark was placed somewhat between numbers 4 and 6. YOU MAY PUT YOUR MARK ANYWHERE ON THE LINE. YOU NEED NOT PUT IT ON A NUMBER.

Estimate the number of hours you wore the SPH-3X. ______________
(hours)

Now complete the form.

HELMET RATING SCALE

SPH-3X

1. Attractiveness and appearance of the SPH-3X Helmet.

0	2	4	6	8	10
ugly	rather plain	below average	fairly nice looking	attractive	very attractive

2. Ease of putting on and removing the SPH-3X.

0	2	4	6	8	10
extremely difficult	quite difficult	had several problems	only a few problems	rather easy	extremely easy

3. Suspension System of the SPH-3X.

0	2	4	6	8	10
unsatisfactory	uncomfort-able	some poor features	above average	comfortable	highly desirable

4. Wearing comfort of the SPH-3X during an extended period.

0	2	4	6	8	10
unbearable	rather uncomforta-ble	slightly uncomfort-able	better than average	rather comfortable	very comfortable

5. Reduction of external noise by the SPH-3X.

0	2	4	6	8	10
no detectable reduction	only slight reduction	slightly below average	slightly above average	very good reduction	outstanding reduction characteristics

6. Characteristics of the communications system of the SPH-3X.

0	2	4	6	8	10
should be discarded	poor system needs improvement	slightly below average	slightly above average	good system little improve-ment needed	outstanding system

7. Your feeling of the ability of the SPH-3X to protect you.

0	2	4	6	8	10
appears flimsy	needs improvement	slightly below average	slightly above average	good protection	outstanding protection

8. General overall evaluation of the SPH-3X.

0	2	4	6	8	10
very unsatisfactory helmet	many undesirable characteristics	slightly below average	slightly above average	many desirable characteristics	very satisfactory helmet

9. The features I liked best about the helmet were:

10. The features I disliked about the helmet were:

HELMET RATING SCALE

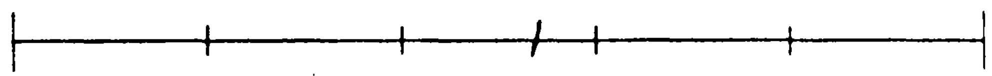
Name: ______________________________________ Date: ____________________
(Last) (First) (M.I.)

Instructions

This rating scale is designed to obtain your opinions about the Army aircrew helmet presently in the inventory - the APH-5.

Notice that each trait is described in a manner similar to a ruler. You should read each stem all the way through and then merely mark your response at the point on the line that best expresses your opinion about the trait.

EXAMPLE: Alabama Highways



0	2	4	6	8	10
worst anywhere	overall poor with a few exceptions	below average	above average	overall good with a few exceptions	best anywhere

Notice that the mark was placed somewhat between numbers 4 and 6. YOU MAY PUT YOUR MARK ANYWHERE ON THE LINE. YOU NEED NOT PUT IT ON A NUMBER.

Estimate the number of hours you have worn an APH-5. ____________ (hours)

Now turn the page and complete the form.

HELMET RATING SCALE

APH-5

1. **Attractiveness and appearance of the APH-5 Helmet.**

0	2	4	6	8	10
ugly	rather plain	below average	fairly nice looking	attractive	very attractive

2. Ease of putting on and removing the APH-5.

0	2	4	6	8	10
extremely difficult	quite difficult	had several problems	only a few problems	rather easy	extremely easy

3. Suspension System of the APH-5.

0	2	4	6	8	10
unsatisfactory	uncomfort-able	some poor features	above average	comfortable	highly desirable

4. Wearing comfort of the APH-5 during an extended period.

0	2	4	6	8	10
unbearable	rather uncomfortable	slightly uncomfort-able	better than average	rather comfortable	very comfortable

5. Reduction of external noise by the APH-5.

0	2	4	6	8	10
no detectable reduction	only slight reduction	slightly below average	slightly above average	very good reduction	outstanding reduction characteristics

6. Characteristics of the communications system of the APH-5.

0	2	4	6	8	10
should be discarded	poor system needs improvement	slightly below average	slightly above average	good system little improve-ment needed	outstanding system

7. Your feeling of the ability of the APH-5 to protect you.

0	2	4	6	8	10
appears flimsy	needs improvement	slightly below average	slightly above average	good protection	outstanding protection

8. General overall evaluation of the APH-5.

0	2	4	6	8	10
very unsatisfactory helmet	many undesirable characteristics	slightly below average	slightly above average	many desirable characteristics	very satisfactory helmet

9. The features I liked best about the helmet were:

10. The features I disliked about the helmet were:

LITERATURE CITED

1. Minutes of In-Process Review - Army Aircraft Crewman's Helmet, Quartermaster Research and Engineering Center, Natick, Mass., September, 1961. (Unpublished report).

2. Minutes of Task Group Meeting - Army Aircraft Crewman's Helmet, Quartermaster Research and Engineering Center, Natick, Mass., February, 1962. (Unpublished report).

3. Minutes of Task Group Meeting - Army Aircraft Crewman's Helmet, Quartermaster Research and Engineering Center, Natick, Mass., May, 1962. (Unpublished report).

4. Schneider, D. J. and Walhout, G. J., Helmet design criteria. Av SER (Av Cir) Report 62-6, TCREC Technical Report 62-57, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, April, 1962.

5. Haley, J. L., Turnbow, J. W., Macri, S., and Walhout, G. J., Helmet design criteria for improved crash survival. USAAVLABS Technical Report 65-44, January, 1966.

6. Camp, R. T., Jr. Real-ear sound attenuation characteristics of thirty-six ear protective devices. USAARU Report 66-6, May, 1966.

7. Camp, R. T., Jr., and Keiser, R. L. Sound attenuation characteristics of the Army APH-5 helmet. USAARU Report 67-6, February, 1967.

8. Camp, R. T., Jr., and Keiser, R. L. Sound attenuation characteristics of the Navy SPH-3 (Modified) (LS) helmet. USAARU Report 67-8, May, 1967.

9. Camp, R. T., Jr. Sound attenuation characteristics of the Navy BPH-2 helmet. USAARU Report 68-6. March, 1968.

10. Berger, P. K., Matheny, W. G., and Newmiller, C. E. The role of trial in the acceptance and adoption of new equipment. Report LS/TR 66-1. Life Sciences, Inc., August, 1966.

11. Kirk, R. E. Experimental Design: Procedures for the Behavioral Sciences. Belmont, California, Brooks/Cole, 1968.

12. Guilford, J. P. Psychometric Methods. New York, McGraw-Hill, 1954.

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13. ABSTRACT

Two aircrew protective helmets were evaluated by 24 instructor pilots who were divided equally into groups subjected to three ambient noise environments. Pilots rated the Army APH-5 and the SPH-3X (Experimental) on eight categories designed to assess relative comfort, acceptability, and noise attenuation. Ratings were compared, using a Split-Plot Factorial Analysis of Variance. Significant differences were found between helmets on 7 of the 8 characteristics rated and results favored the SPH-3X in 6 characteristics.

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