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FAA TECHNICAL CENTER LETTER REPORT

TRAFFIC ADVISORY SERVICE USER EVALUATION

by

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ABSTRACT

This report presents the results of a series of interviews taken with 17 pilots who had experience with either the Automatic Traffic Advisory and Resolution Service (ATARS) or the Cockpit Display of Traffic Information (CDTI) flight testing. The purpose of this study was to determine what the pilots considered to be the salient features of a traffic situation display.

The pilots expressed that the most important features are those that alert the pilot to the existence of other aircraft and show the aircrafts' relative location. The pilots' satisfaction with the thresholds used in the previous tests indicates that the diplay range need not normally exceed four nautical miles except in the case of high speed aircraft closing from the forward direction.

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INTRODUCTION

Seventeen pilots who participated in the testing of either the Automatic Traffic Advisory and Resolution Service (ATARS) or the Cockpit Display of Traffic Information (CDTI) were asked to re-evaluate and comment on these services in a series of structured interviews (see the Appendix for a copy of the interview form). The purpose of this interview series was to narrow the focus of future system design and testing by identifying the salient features of such displays, their applicability in different situations, and how this may relate to certain personal characteristics of the pilots such as age, education, experience, and type of work.

BACKGROUND

From November 1980 to February 1981, two major flight tests were performed at the Federal Aviation Administration Technical Center (FAATC) to assess the utility of an Automatic Traffic Advisory and Resolution Service (ATARS) (Reference 1) and a Cockpit Display of Traffic Information (CDTI). Both tests used the same aircraft (a Beechcraft Baron, BE-55), the same display equipment (a Bendix 5-inch color weather radar CRT), and the same ground-based facility (the Mode S sensor) to track and uplink to the aircraft the information necessary to display all nearby aircraft equipped with a Mode C (ATCRBS) or a Mode S transponder.

Although the two test series used the same equipment, their uses were quite different. ATARS was a collision avoidance system that displayed pictorial traffic advisories and alphanumeric conflict resolution advisories suggesting escape maneuvers. CDTI was primarily concerned with separation maintenance, spacing and merging traffic in IFR conditions.

OBJECTIVES

The principal objective of the pilot interview series is to determine what features a Traffic Advisory Service (TAS) traffic situation display should contain. In analyzing the opinions of pilots with previous experience in using traffic situation displays, the following five objectives were examined:

1. What features of the display do pilots say are most useful?

2. How do their assessments differ when considering situations with different workload, traffic, and weather conditions?

3. How are their assessments affected by personal data such as age, education, experience, and type of work?

4. How do pilots rate the utility of a TAS in the Air Traffic Control (ATC) system?

5. What are pilots' comments and recommendations concerning the TAS?

SUMMARY OF RESULTS

This section presents the major results of the analysis in two parts:

1. Assessment of the TAS
2. Pilot Comments

The pilots rated on a 1-to-7 scale (high of 7, low of 1) and ranked on an 11-to-1 scale the (high of 1, low of 11) the display features according to their usefulness in each of six proposed flight situations.

The averages of both the ratings and rankings were grouped into three distinct catogories(page 11): high, middle, and low (figures 1 and 6). The most highly ranked and rated features of the display were those that alerted the pilot to the presence (audio warning) and relative location (bearing and altitude) of near-by traffic (page 20). The rankings and ratings were quite stable over the six flight situations areas with one exception, indicating that pilots are interested in the same information in a variety of circumstances. The exception to this stability across flight situation was the feature "Audio Warning." The variation of "Audio Warnings'" ratings and rankings indicate that the pilot's initial awareness of an encounter is affected by workload and by other media such as ATC or a previous encounter where his attention has already been brought to the display(page 14).

In the section on pilot comments twelve out of the seventeen pilots (71%) said that the thresholds (i.e. timing and distance of the displayed traffic) were satisfactory (page 25). The satisfaction with the thresholds and the low ranking and rating of the "Out-of-Range Traffic Symbol" suggest that the pilots are less concerned with traffic outside of their immediate vicinity (>4nm).

All of the pilots said that the TAS was definitely an aid to visual acquisition. The relative position (range, bearing, and altitude) of the other aircraft was judged to be the most impressive features by ninety-four percent of the pilots (page 27).

The least impressive aspects of the systems they had flown (page 27) were tracker lag, reliability, and clutter.

Tracker lag is the delay time inherent in the system for updating the displayed information of which sensor scan time is the greatest component (4.7 seconds). The concerns with the reliability of the system were that the sensor might drop surveillance tracking because of either hardware or software problems thus causing the display to go blank or hold the last displayed message.

Clutter could occur if too much symbology was displayed on the screen at the same time causing confusion in reading the displayed information.

Whether the systems increased workload depended upon the type of system used. For CDTI the workload increase was greater than with ATARS since the CDTI flight test series was run under the hood (simulated IFR conditions) and necessitated a more concentrated cockpit management procedure. With the ATARS flight test series there was little to no increase in workload and was always seen as acceptable (page 28).

The pilots would prefer to have the display in the main scan area (directly in front of the left seat) and integrated into one of the primary flight instruments. However, considering the problems with fitting a display with the primary flight instruments the best location for the diplay was judged to be the center console.

Ninety-four percent of the pilots preferred a relative altitude indicator for the intruder aircraft over absolute altitude.

The majority of the pilots felt that a TAS would decrease ATC workload or complement the ATC system since an automatic traffic advisory service could be used as a backup and would provide a continuous advisory without burdening the air traffic controller (page 30).

Fifty-three percent of the pilots said that since their experience with either the ATARS or the CDTI systems there were times when they wished that they had had the system while flying. This usually occurred around busy airports or on long cross-country (enroute) trips.

INTERVIEW DESCRIPTION

Seventeen pilots who participated in the ATARS or CDTI flights were interviewed to obtain their opinions on what features a Traffic Advisory Service (TAS) should contain. Each of the interviews took approximately one hour and was divided into four parts.

The first part solicited background information including age, level of education, flight experience, and type of work. The pilot was told that the privacy of his or her responses was guaranteed and that the data would be used for statistical purposes only.

In the second part the pilot was given a deck of eleven cards each containing a feature that might be found in a TAS display. The pilot was told to sort the cards in the order of their usefulness, and then assign a rank from 1 (most useful) to 11 (least useful). Once the features were ranked, the pilot rated each feature using the following scale.

7 - Utmost Use

6 -

5 - Very Useful

4 -

3 - Little Use

2 -

1 - No Use

The reason that both ranking and rating scales were used is that they show the relative and the absolute value of the features to the pilot, respectively. The ranking scale has the advantage of showing the value of each of the features relative to one another in the event that one rating value is assigned to more than one feature. The rating scale has the advantage of revealing gaps that may divide the features into groups.

The pilot performed this ranking and rating six times with respect to the following six different flight situations:

1. Light-To-Moderate Workload
2. Heavy Workload
3. Blunder Prevention
4. Reduced Visibility
5. Heavy Traffic Areas
6. Verification of ATC Advisories

After each sort the cards were mixed up so that the pilot would have to consider each situation independently and not just leave the cards in the same order each time.

In the third part of the interview the relationship between the Air Traffic Control (ATC) system and a TAS was explored. The pilot was asked to rate the usefulness of a TAS working together with the current level of ATC involvement (advisories supplied to VFR aircraft on a work-permitting basis), and when working together with two hypothetical levels of ATC involvement (1. mandatory advisories for all VFR aircraft within 1 mile of one another, 2. No advisories for VFR aircraft), using the above 1 to 7 scale.

In the fourth part the pilot was asked eleven open-ended questions concerning their opinions about the previous systems that they helped test. These questions were asked throughout the interview.

DATA ANALYSIS

The results of the analysis are presented in two parts. The first part (Assessment of Displayed Information) examines how the pilots rated and ranked the utility of eleven display features. The second part (Pilot Comments) presents the results of detailed examination of the pilots' comments to the eleven open-ended questions asked throughout the interview.

The interview data were analyzed using both various parametric and non-parametric statistical tests and by examination of descriptive statistics (e.g. frequency distributions). Text data obtained from responses by test participants to open-ended questions asking for comments were categorized and tabulated for analysis.

ASSESSMENT OF THE TAS

This section is in two parts. The first part (Assessment of the Displayed Information) examines how the pilots rated and ranked the basic displayed features. The second part of this section (Dependence of Results on Background) examines the relationship between these ratings and rankings, and the pilots' backgrounds.

Assessment of the Displayed Information

To explore the pilots' opinions of the eleven displayed features two scales were used: a ranking scale (high of 1, low of 11), and a rating scale (high of 7, low of 1).

Table 1 presents the means of the rankings and ratings for each of the eleven features across all six flight situations and Figure 1 shows these graphically. The features are numbered in the order that was used in the interview form and this is retained here because all of the graphs generated during the data reduction employ this numbering scheme. It can be seen from Figure 1 that there are indeed distinct gaps in the ratings that divide the

FEATURE	MEAN RANKING	MEAN RATING
1. Relative Altitude of Other Aircraft	3.14	6.33
2. Vertical Speed of Other Aircraft	6.07	4.90
3. Traffic Course Track	5.17	5.20
4. Own Aircraft Course Track	9.06	3.19
5. Ground Speed of Other Aircraft	7.14	4.12
6. Range Ring (2 mile)	6.13	4.75
7. Point of Closest Approach	6.37	4.68
8. Out-of-Range Traffic Symbol	9.29	2.93
9. Audio Warning	4.63	5.30
10. Relative Motion Line	5.78	4.91
11. Relative Bearing of Other Aircraft	2.58	6.27

TABLE 1

MEANS OF RATINGS AND RANKINGS

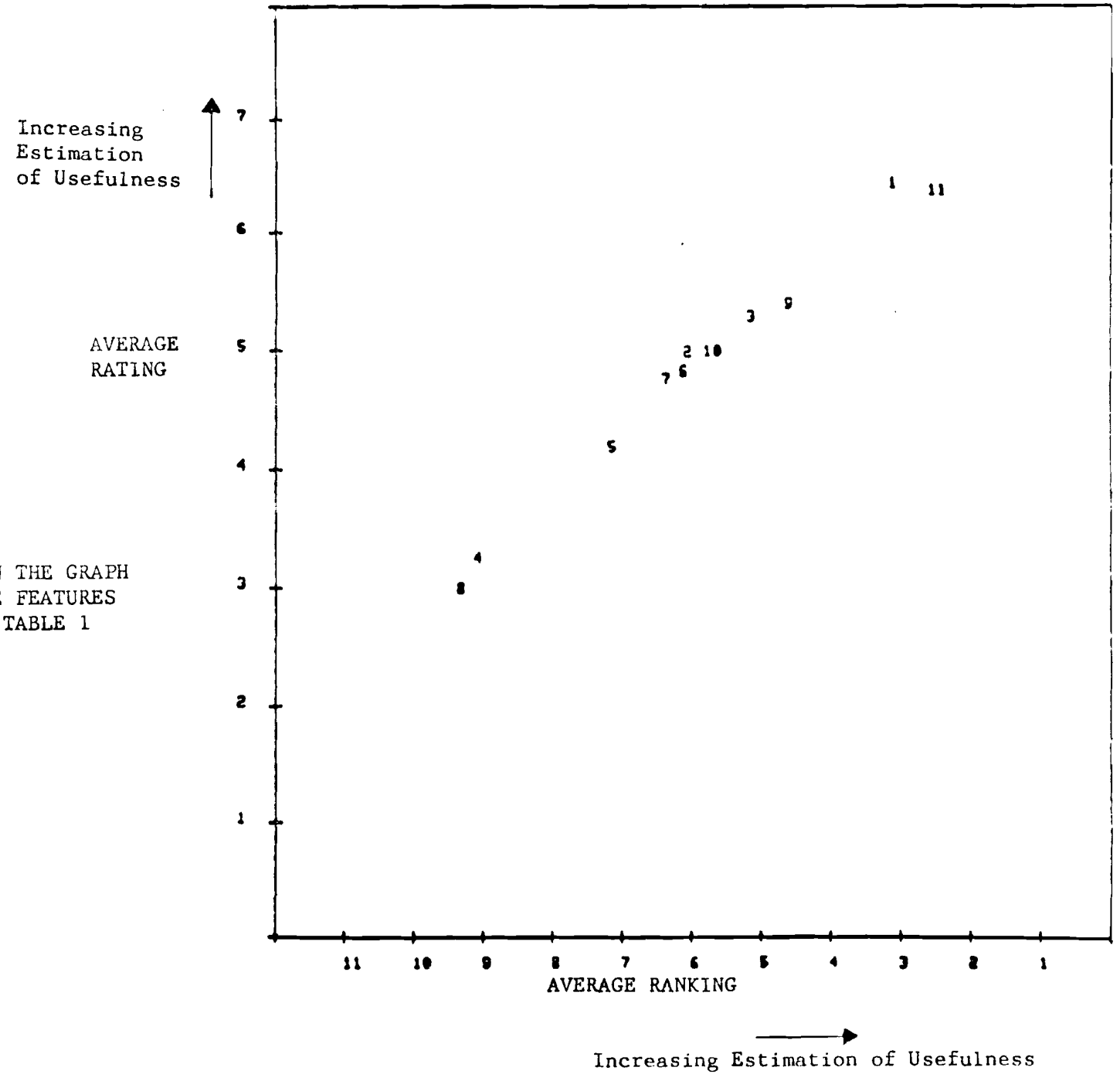

FIGURE 1 - PLOT OF AVERAGE RATING AND RANKING FOR EACH DISPLAY FEATURE OVER ALL FLIGHT SITUATIONS

features into three groups (high, middle, and low) and that these gaps are mirrored in the means of the rankings.

The means of the rankings show these gaps as a result of the distributions of the pilots' responses. Figures 2, 3, and 4 show histograms that are typical of the three groups. In the high and low groups (Figures 2 and 4), the pilots show strong agreement on the value of the features. In the middle group the responses are much more widely distributed, sometimes almost flat, indicating a lack of consensus over the features located in the middle of the rating scale (4.0-5.5). This wide distribution serves to lump all of the middle group's ranking means into the center of the scale.

The only feature in the middle group which did not receive a wide range of responses under the individual flight situations was "Audio Warning." "Audio Warning"'s mean rating and ranking were in the middle group because this was the only feature to be rated and ranked differently across the different flight situations. Figure 5 shows this variation across questions. The response to "Audio Warning" was quite high in all flight situations except the third (Blunder Prevention), and the sixth (ATC Verification). The explanation for this is straightforward: for blunder prevention (defined as avoiding a second encounter while maneuvering away from an initial one), and for ATC verification, the pilot has other means by which he or she can be alerted to the encounter, and so does not need an audio warning. Omitting situations 3 and 6, and recalculating the means of the rankings and ratings, results in "Audio Warning" moving from the middle group to the high group. This is shown in Figure 6.

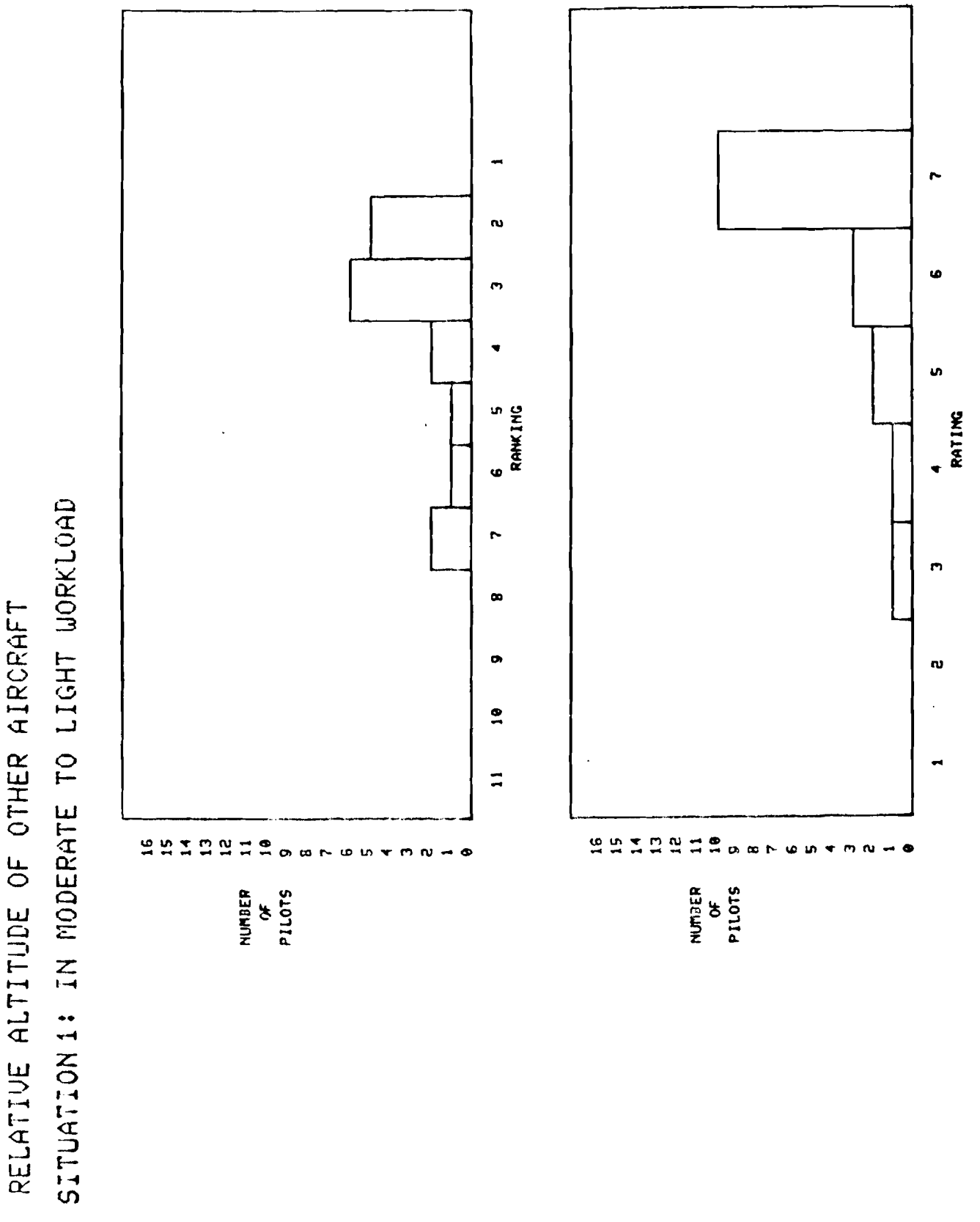

FIGURE 2 - EXAMPLE OF PILOT RESPONSE TO A FEATURE FROM THE "HIGH" CATEGORY

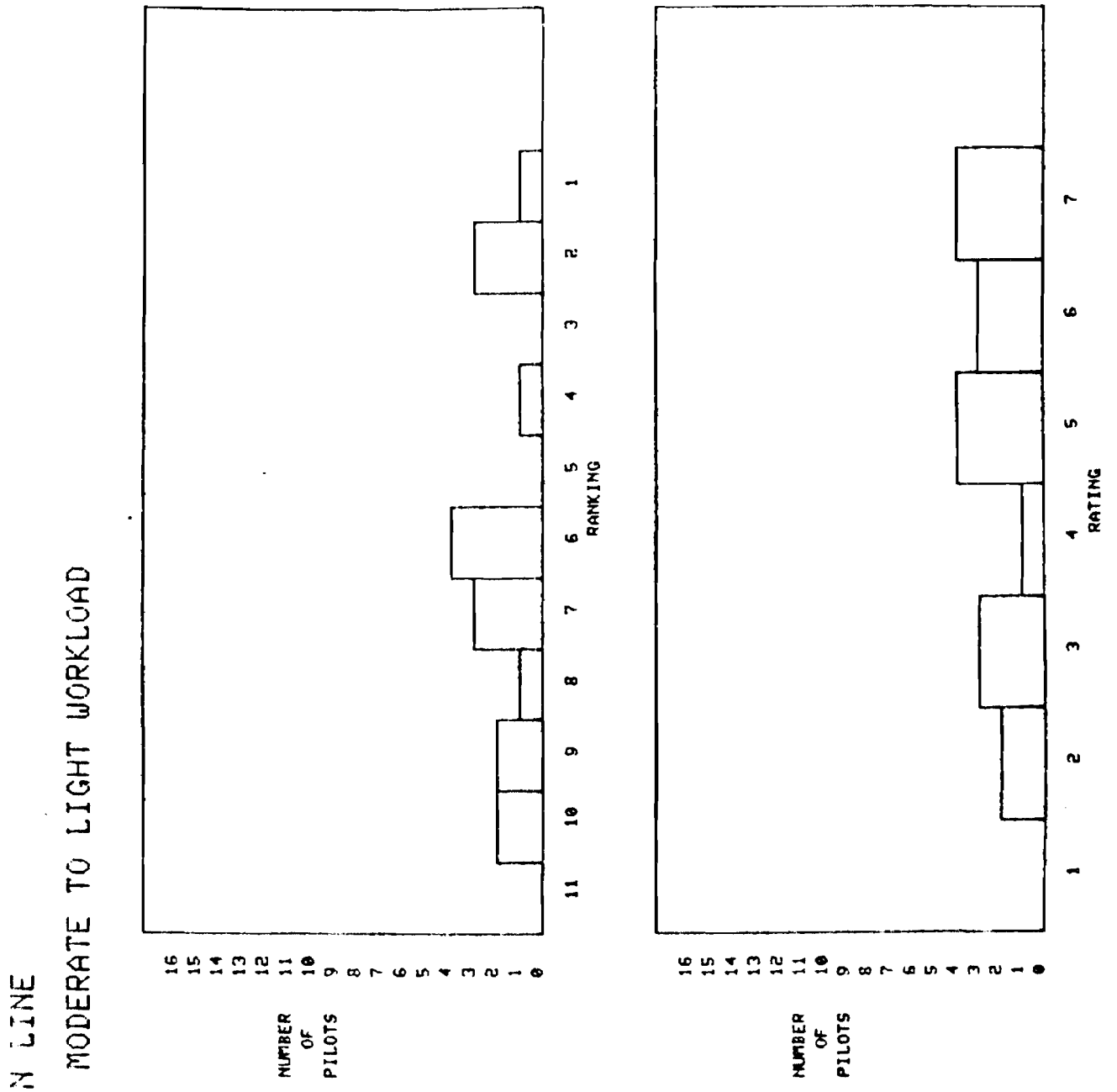

FIGURE 3 - EXAMPLE OF PILOT RESPONSE TO A FEATURE FROM THE "MIDDLE" CATEGORY

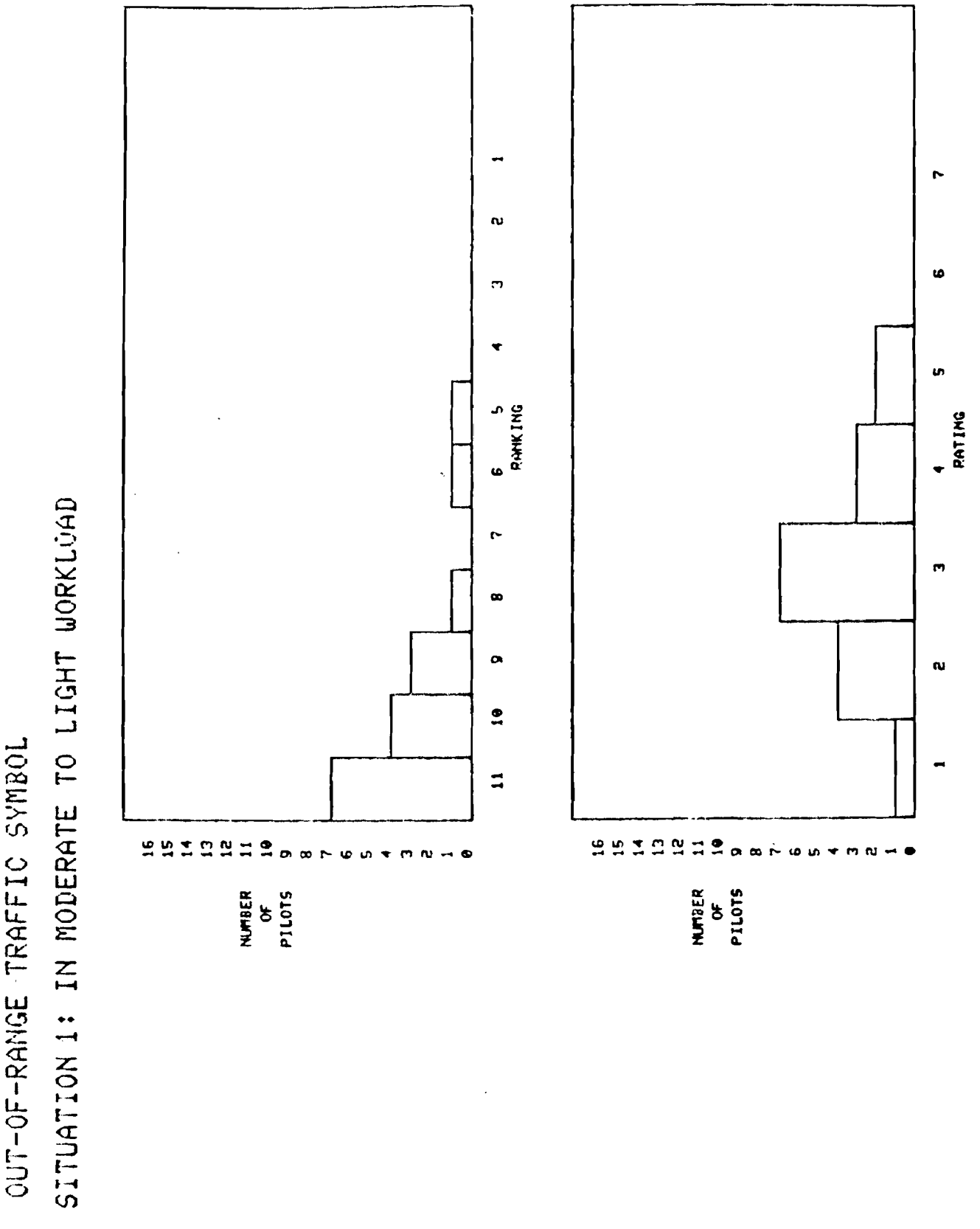

FIGURE 4 - EXAMPLE OF PILOT RESPONSE TO A FEATURE FROM THE "LOW" CATEGORY

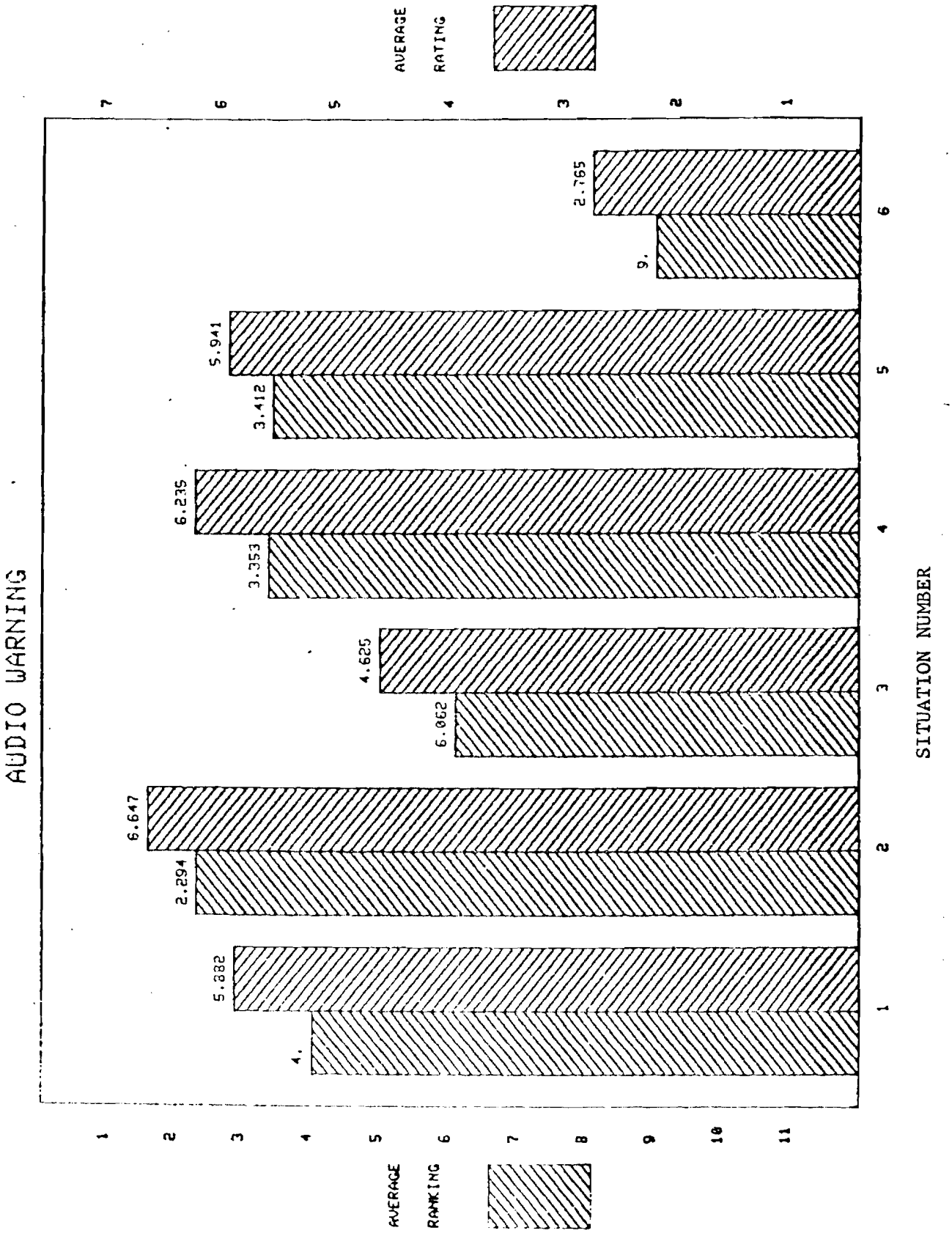

FIGURE 5 - VARIATION OF RATING AND RANKING OF "AUDIO WARNING" ACROSS FLIGHT SITUATION NUMBER

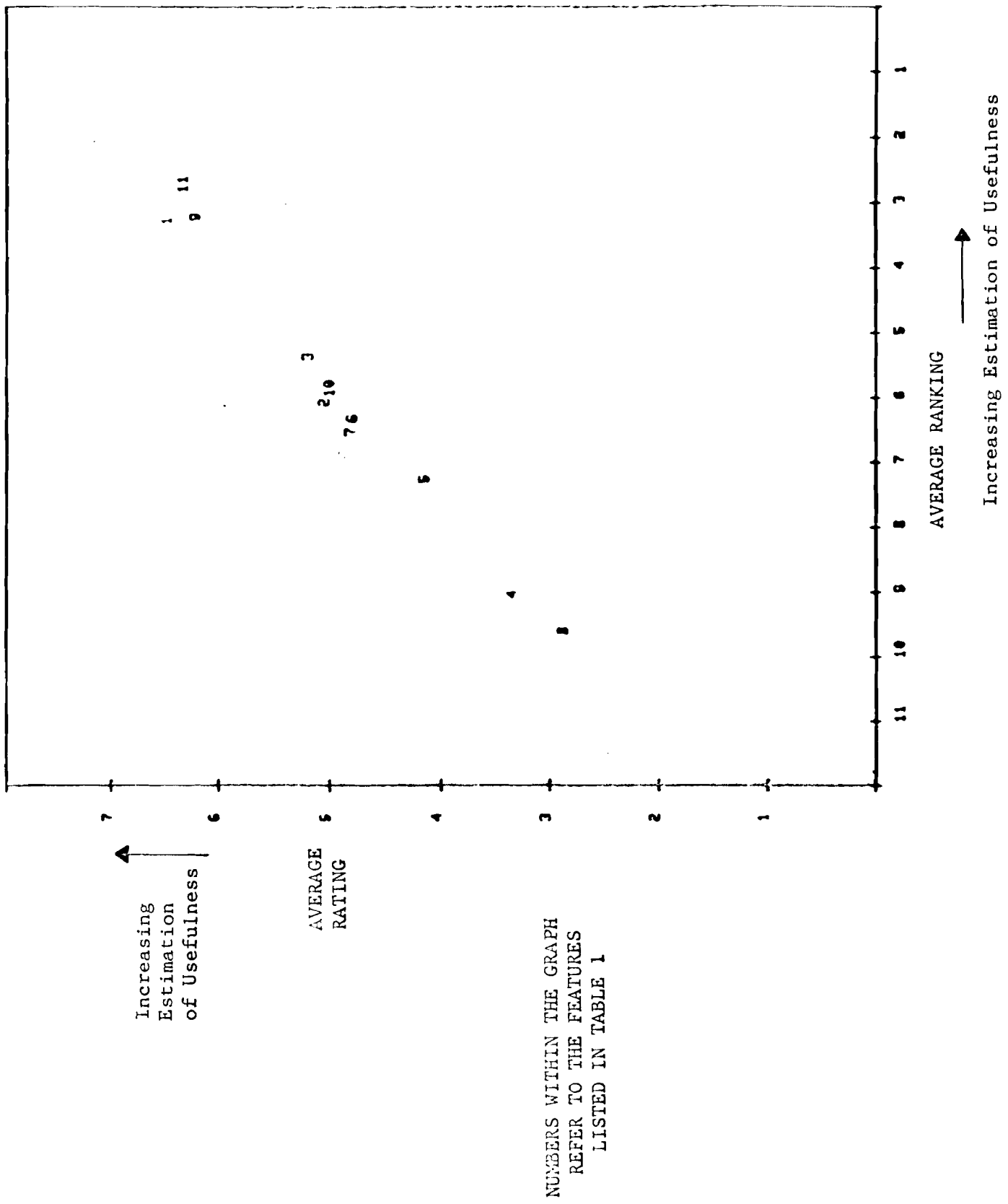

FIGURE 6 - PLOT OF AVERAGE RATING AND RANKING FOR EACH DISPLAY FEATURE OVER ALL FLIGHT SITUATIONS EXCEPT BLUNDER PREVENTION (#3) AND ATC VERIFICATION (#6)

From Figure 6 it is clear that the features "Relative Bearing of the Other Aircraft," "Relative Altitude of the Other Aircraft," and "Audio Warning" are of most importance to the pilot, that is, the awareness of the existence of other aircraft and the other aircraft's position relative to the own aircraft. The two features at the low end of the scale are "Own Aircraft Heading" and "Out-of-Range Traffic Symbol." "Own Aircaft Heading" is essentially information that the pilot already knows, though some symbol is always necessary to locate the own aircraft on the display. The consistently low rating and ranking of "Out-of-Range Traffic Symbol" may be some indication that aircraft at the extreme range of the display are of little or no interest to the pilot.

One result of the ATARS Pilot Utilization Study (Reference 1) was that the pilots were able to make fairly stable judgements of the relative value of the various display features on their first experience. Specifically, it was found that the ranking of the average rating of each display feature did not vary significantly from the first to the sixth experience with one exception. The exceptional feature "Resolution Advisory" lost favor quickly and moved to fifth place by the end of the fourth flight. Since the "Resolution Advisory" display feature was not of interest in this study (it is no longer a part of the ground system) and all of the interviewed pilots were thoroughly familiar with the display and its operational use, it is expected that assessments of the TAS

made by the pilots are mature. It is further noted that the pilots opinion explored in the following section are completely consistent with the results of the Pilot Utilization report (Reference 1).

The pilot was asked to rate the usefulness of a TAS working together with the current level of ATC involvement (advisories supplied to VFR aircraft on a work-permitting basis), and when working together with two hypothetical levels of ATC involvement (1. Mandatory advisories for all VFR aircraft within nautical mile of one another, 2. No advisories for VFR aircraft), using the same 7-point scale that was used to rate the individual features. Table 2 gives the means and median values for each of these three conditions.

	MEAN	MEDIAN
Mandatory	4.41	5
Work-permitting	5.29	5
No ATC	6.00	6

TABLE 2

MEANS AND MEDIANS OF TAS ASSESSMENT WITH ATC

An examination of the means of the pilots' responses shows that even in the hypothetical case of mandatory advisories the usefulness of a TAS was rated quite highly. This indicates a high degree of pilot satisfaction with the concept of a traffic situation display.

Dependence of Results on Background

The collection of 17 pilots interviewed in this study had a great breadth of background and experience. Their ages varied from 33 to 62 and seven of the pilots were professional pilots. The total number of years as a pilot varied from 3 to 41 and the number of flight hours as Pilot-in-Command (PIC) varied from 170 to 12000. The consistency and credibility of the pilots' assessments of the service and the relationship with the pilot background and experience are examined in this section.

Although there was general uniformity across the six questions in the pilot's ratings and rankings of the display features, the assessment of the utility of the "Audio Warning" feature varied dramatically over the six situations on which assessments were made (Figure 5). It was, furthermore, found that the rating scales were applied differently to each of the six situations.

These facts suggest very clearly that the pilots made sharp distinctions in their rating and ranking. Additionally, it was noted that the pilots were consistent in their rankings and ratings and in only 26 cases out of 1122 did a pilot reverse the order of two features between the ratings and the rankings.

The ratings and rankings were further examined to determine what dependencies there were on the pilots' background or experience. This data was examined in both raw form and recoded into high, middle, and low categories. The following terminology is used:

RATING - Values 1 to 7 - raw ratings

RATE - Values 1 to 3 - (1) bottom 2 rated
(2) middle 3 rated
(3) top 2 rated

RANKING - Values 1 to 11 - raw rankings

RANK - Values 1 to 3 - (1) top 3 ranked
(2) middle 6 ranked
(3) bottom 2 ranked

These data were statistically examined with respect to the following background and experience data:

AGE - Age in years

FLTHR - Total hours as PIC

CCERT - Current certifications

NRYR - Number of years as a pilot

ATARS - Experience with ATARS or CDTI tesing

JBCLS - Job classification

ED - Level of education

ID - Pilots' identification number

For each of the above cases except ATARS and ID, the values were recoded to have a value of 1 if below the median, and 2 if above the median. This recoding was done to enhance the statistical analysis for the small samples involved.
It was found that the rating scale as used by each pilot was statistically, and practically, dependent on every experience and background factor. Additionally, the recoded rating scale (RATE) showed a similar dependence on background and experience. In contrast, it was found that the recoded ranking scale (RANK) was independent of all above listed background and experience factors. These results are consistent with other similar psychological studies (per discussion with Dr. Eugene Galanter, Columbia University Department of Psychology), where it has been found that predictors of opinion or rating and ranking behavior which are based upon background and experience data are not reliable.

PILOT COMMENTS

Eleven open-ended questions were answered by the seventeen pilots during the interview (see Appendix for interview form). Initially, pilot comments were catorgorized and grouped by system experience (ATARS or CDTI). With few exceptions the differences between the answers given for ATARS and CDTI were found to be negligible, therefore, most of the answers were grouped as a whole for ease of presentation.

The pilots' experience with the ATARS or CDTI systems is distributed as follows:

SYSTEM EXPERIENCE	NUMBER OF PILOTS
ATARS and CDTI	8
CDTI only	1
ATARS only	8

*Note: There were 16 pilots with ATARS experience and 9 with CDTI experience out of a total of 17 pilots.

In the remainder of this section each question is examined with respect to the number of pilots who made each comment and the percentage of all 17 pilots which this number represents.

How did you feel about the timing and distance thresholds used in the tests?

The basic range of displayed traffic for ATARS was 4 nautical miles (nm.) in the forward direction and 2 nm. to the sides and back. This was modified by the altitudes and closing rates of the other traffic. The range for CDTI was larger, sometimes displaying traffic as much as 8 nm. away. Because of this difference the data is divided into those pilots with ATARS experience and those with CDTI experience.

	All Pilots	Pilots/w CDTI	Pilots/w ATARS
Thresholds were satisfactory	12 (71%)	6 (67%)	12 (75%)
I would like to see more forward traffic	5 (29%)	3 (33%)	4 (25%)
	17 (100%)	9 (100%)	16 (100%)

There is no significant difference between the pilots with experience with ATARS and those with CDTI; the majority of pilots felt that the thresholds were sufficient. Coupling this with the extremely low ratings and rankings for the Out-of-Range Traffic Symbol (seen in "Assessment of the Displayed Information") suggests that the pilots' were not concerned with traffic outside of their immediate vicinity (>4 nm.).

How did you feel about the service as an aid to visual acquisition?

The pilots were asked to comment on the system as an aid to visual acquisition. All of the answers were positive resulting in a 100 percent response of "very useful."
All pilots felt that any kind of traffic situation display would be useful as an aid to visual acquisition.

What impressed you most about the service?

This question asked the pilots to think about their past experience with the system, how they used it and what they remembered as the most significant aspects of the traffic advisory service, whether it was ATARS or CDTI.

	Number of pilots
Knowing the relative position of the traffic	16 (94%)
The ability to display the traffic	1 (6%)

What impressed you least about the service?

This question brought out the pilots' dissatisfactions with the service. The comments concerned both system and display design. One pilot expressed dissatisfaction with targets that popped up without notice. This occurred when an intruder was outside of a proximate or priority range and then turned into the flight path of the subject aircraft thus popping up without notice and creating a conflict.

	Number of pilots
Reliability	8 (47%)
Tracker lag	5 (29%)
Clutter	2 (12%)
Targets popped up without notice	1 (6%)
No response	1 (6%)

Did you feel the service increased the cockpit workload?

The answer to this question was generally "No" or "Slightly" for VFR conditions, but the pilots felt that if the system were to be used in IFR conditions, the workload may be higher. It was reasoned that there would be an increase in workload for any new or added instrument in the cockpit, but that an advisory service would make any increase worthwhile.

	Number of pilots
Slight increase	9.5 (56%)
No increase	7.5 (44%)

To be most useful where should the display be located?

	Number of pilots
With primary instruments	6 (35%)
In center console	11 (65%)

Were there any times when you would have preferred an absolute altitude rather than a relative altitude indicator for the other aircraft?

It should be noted that the pilots experienced only relative altitude in the ATARS and CDTI flight testing.

	Number of Pilots
Relative	16 (94%)
Absolute	1 (6%)

Only one pilot said that absolute altitude would be preferable under certain circumstances, such as over mountains, or during climbing or descending maneuvers.

How do you see an automatic advisory service interfacing or contributing to the overall traffic situation?

Responses to this question generally concerned the pilot-ATC interface where ATC advisory workload can be shared by the VFR pilot.

	Number of pilots
Relieves ATC workload	7 (41%)
Supports and complements ATC	7 (41%)
Use as an advisory service	2 (12%)
Adds confusion to system	1 (6%)

In the time since your last participation in the evaluation of a traffic advisory service (ATARS or CDTI) have you wished you had the service when flying?

	Number of pilots
Yes; At busy airports (controlled and uncontrolled)	9 (53%)
Yes; Enroute(crosscountry)	3 (18%)
No	5 (29%)

Generally the areas where the pilots would have liked to have the system was in the terminal areas (high density) and at busy airports whether controlled, with tower or radar coverage, or uncontrolled with a high volume of general aviation traffic. Another area where the pilots would have liked to have the system was the enroute phase of a flight where there are long periods of inactivity.

Are there any other features, not listed here (in the rating and ranking), that the service should include in order to be of most use to the general aviation pilot?

Some features pilots would like to see added to the TAS are listed below:

* Ground speed of own aircraft
* Pictorial representation of aircraft
* A "system-working" indicator
* Visual alert indicator
* Time to closest approach countdown
* Pilot-selectable features (e.g. altitude and range filter)
* Resolution advisories

The following are some general comments that were made by the pilots. These comments were made by only one pilot each except for the first which was made by three pilots.

* The system would be too expensive for small aircraft
* The service should be implemented
* Make the display sunlight readable
* Combine the ATARS and CDTI systems
* The system does not contribute to aviation safety
* Keep the resolution service

CONCLUSIONS

1. The most important features of a traffic advisory \ service display are those that alert the pilot to the presence of nearby traffic (audio warning) and give its relative position (bearing and altitude).

2. Ranking scales tend to be independent of pilot background and experience. Rating scales do not have this same good quality; however, rankings based on mean ratings are comparable to ranking scales.

REFERENCES

1. Thedford, William A., et. al., Pilot Utilization of Automatic Traffic and Resolution Advisories, FAA Technical Center Letter Report CT-82-100-89LR, July 1982.

APPENDIX

This appendix contains the interview form used to collect the data from the seventeen pilots. This form was completed by the interviewer as the pilot answered the questions orally.

TRAFFIC ADVISORY SERVICE
PREVIOUS EXPERIENCE QUESTIONNAIRE

The information contained in this questionnaire will not be associated with your name: All data will be used for statistical purposes only. Please answer all questions as accurately and as honestly as possible.

1. Name:_____

2. Routine Symbol:_____ 3. Bld. #:_____ 4. Extension:_____

5. Current Certifications:

Private	[ ]	CFI	[ ]
Commercial	[ ]	CFIi	[ ]
Multi	[ ]	ATP	[ ]
Instrument	[ ]	Heli	[ ]
Seaplane	[ ]	Glider	[ ]

6. Total number years as a pilot: _____

7. Number Hours PIC:_____

8. Number Hours Multi:_____

9. Total number Hours:_____

Hours Flown last 6 Months:

10. Single:_____

11. Multi:_____

12. Commercial:_____

13. Military:_____

In which experiment did you participate?

14. ATARS [ ] 15. when? _____

16. CDTI [ ] 17. when? _____

How many missions did you fly?

18. ATARS_____

19. CDTI_____

The followins questions concern sour backsround. Your responses will be kept strictly confidential and used for research purposes only.

20. Age: _____

21. Type of Work:

Tech. Management	[ ]
Ens. Management	[ ]
Engineering	[ ]
Administration	[ ]
Aircraft Mechanic	[ ]
Automotive Mechanic	[ ]
Technical	[ ]
Clerical	[ ]
Data Processing	[ ]
Medical	[ ]
Prof. Pilot	[ ]
Other	[ ]

Specify: _____

Title: _____

22. Number of Years with the FAA: _____

23. Education:

Less than 12 years	[ ]
High School Grad (or equivalent)	[ ]
Some Undersrad College	[ ]
2sr College Grad	[ ]
Trade or Voc. School	[ ]
BA, BS Desree	[ ]
Some Grad. Study	[ ]
MA, MS, MBA	[ ]
LL.D., Ph.D., Ed.D.	[ ]

24. Number sears: _____

25. Are you currently a member of an aviation club or society?

YES [ ]

NO [ ]

26. Do you own or have part ownership in an aircraft?

YES [ ]

NO [ ]

If YES, what type aircraft(s)?

_____

_____

27. If NO, have you ever held ownership or part ownership in an aircraft?

YES [ ]

NO [ ]

If YES, types of aircraft(s)?

_____

_____

During the past year, what types of aircraft flown most often?

_____

_____

_____

These questions concern your overall impressions of the service used in the test flight(s) in which you participated.

What impressed you most about the service? (specify which service if you participated in both tests)

_____

_____

_____

_____

What impressed you least about the service? (specify which service if you participated in both tests)

_____

_____

_____

_____

Did you feel the service increased the cockpit workload? How much? Was it acceptable? Please explain.

_____

_____

_____

_____

In the following exercises you will receive a deck of cards, each of which contain a feature you might find in the ATAS service. Please sort them with the first card feature being the most useful and the last card being the least useful in providing information as an aid to maintaining separation. After each sort of the cards enter the position of the card beside the feature and rate the feature according to its usefulness.

Rating Scale

7 - This feature would be of utmost use
6 -
5 - This feature would be very useful
4 -
3 - This feature would be somewhat useful
2 -
1 - This feature would be of no use at all.

A. Conflicting aircraft in moderate to light workload situations.

Feature	Order	Rating
Relative altitude of other aircraft	28. [ ]	29. [ ]
Vertical speed of other aircraft	30. [ ]	31. [ ]
Traffic course track	32. [ ]	33. [ ]
Own aircraft course track	34. [ ]	35. [ ]
Ground speed of other aircraft	36. [ ]	37. [ ]
Range ring (2 mile)	38. [ ]	39. [ ]
Point of closest approach	40. [ ]	41. [ ]
Out-of-range traffic symbol ( )	42. [ ]	43. [ ]
Audio warning	44. [ ]	45. [ ]
Relative motion line	46. [ ]	47. [ ]
Relative bearing of other aircraft (shown by + symbol)	48. [ ]	49. [ ]

B. Conflicting aircraft in heavy workload situations.

Feature	Order	Rating
Relative altitude of other aircraft	50. [ ]	51. [ ]
Vertical speed of other aircraft	52. [ ]	53. [ ]
Traffic course track	54. [ ]	55. [ ]
Own aircraft course track	56. [ ]	57. [ ]
Ground speed of other aircraft	58. [ ]	59. [ ]
Range ring (2 mile)	60. [ ]	61. [ ]
Point of closest approach	62. [ ]	63. [ ]
Out-of-range traffic symbol ( )	64. [ ]	65. [ ]
Audio warning	66. [ ]	67. [ ]
Relative motion line	68. [ ]	69. [ ]
Relative bearing of other aircraft (shown by + symbol)	70. [ ]	71. [ ]

Ratings Scale

7 - This feature would be of utmost use
6 -
5 - This feature would be very useful
4 -
3 - This feature would be somewhat useful
2 -
1 - This feature would be of no use at all.

C. Blunder prevention when maneuvering to maintain separation from the immediate situation when other aircraft are in close proximity. (The possibility of turning into another maneuvering situation)

Feature	Order	Rating
Relative altitude of other aircraft	72. [ ]	73. [ ]
Vertical speed of other aircraft	74. [ ]	75. [ ]
Traffic course track	76. [ ]	77. [ ]
Own aircraft course track	78. [ ]	79. [ ]
Ground speed of other aircraft	80. [ ]	81. [ ]
Range ring (2 mile)	82. [ ]	83. [ ]
Point of closest approach	84. [ ]	85. [ ]
Out-of-range traffic symbol ( )	86. [ ]	87. [ ]
Audio warning	88. [ ]	89. [ ]
Relative motion line	90. [ ]	91. [ ]
Relative bearing of other aircraft (shown by + symbol)	92. [ ]	93. [ ]

D. Reduced visibility.

Feature	Order	Rating
Relative altitude of other aircraft	94. [ ]	95. [ ]
Vertical speed of other aircraft	96. [ ]	97. [ ]
Traffic course track	98. [ ]	99. [ ]
Own aircraft course track	100. [ ]	101. [ ]
Ground speed of other aircraft	102. [ ]	103. [ ]
Range ring (2 mile)	104. [ ]	105. [ ]
Point of closest approach	106. [ ]	107. [ ]
Out-of-range traffic symbol ( )	108. [ ]	109. [ ]
Audio warning	110. [ ]	111. [ ]
Relative motion line	112. [ ]	113. [ ]
Relative bearing of other aircraft (shown by + symbol)	114. [ ]	115. [ ]

Rating Scale

7 - This feature would be of utmost use
6 -
5 - This feature would be very useful
4 -
3 - This feature would be somewhat useful
2 -
1 - This feature would be of no use at all.

E. Heavy traffic areas.

Feature	Order	Rating
Relative altitude of other aircraft	116. [ ]	117. [ ]
Vertical speed of other aircraft	118. [ ]	119. [ ]
Traffic course track	120. [ ]	121. [ ]
Own aircraft course track	122. [ ]	123. [ ]
Ground speed of other aircraft	124. [ ]	125. [ ]
Range ring (2 mile)	126. [ ]	127. [ ]
Point of closest approach	128. [ ]	129. [ ]
Out-of-range traffic symbol ( )	130. [ ]	131. [ ]
Audio warning	132. [ ]	133. [ ]
Relative motion line	134. [ ]	135. [ ]
Relative bearing of other aircraft (shown by + symbol)	136. [ ]	137. [ ]

F. Coordination with ATC (Verification of ATC advisories).

Feature	Order	Rating
Relative altitude of other aircraft	138. [ ]	139. [ ]
Vertical speed of other aircraft	140. [ ]	141. [ ]
Traffic course track	142. [ ]	143. [ ]
Own aircraft course track	144. [ ]	145. [ ]
Ground speed of other aircraft	146. [ ]	147. [ ]
Range ring (2 mile)	148. [ ]	149. [ ]
Point of closest approach	150. [ ]	151. [ ]
Out-of-range traffic symbol ( )	152. [ ]	153. [ ]
Audio warning	154. [ ]	155. [ ]
Relative motion line	156. [ ]	157. [ ]
Relative bearing of other aircraft (shown by + symbol)	158. [ ]	159. [ ]

To be most useful, where should the display be located in the cockpit?

_____

161. What size should the display be? (present size 5in.x 5in.)

[ ] larger
[ ] same size
[ ] smaller

162. Are there any features, not listed here, that the service should include in order to be of most use to the general aviation pilot? Explain.

NO [ ]

YES [ ]

_____

_____

_____

_____

Were there any times when you would have preferred an absolute altitude indicator rather than a relative altitude indicator for the other aircraft?

_____

_____

_____

_____

Given the following possible ATC regulations for general aviation, how would you rate the usefulness of ATAS in collision avoidance and in maintaining separation.

162. Mandatory ATC advisories for all VFR aircraft within 1 nautical mile of each other.

no use		little use		very useful		utmost use
_____	_____	_____	_____	_____	_____	_____

163. ATC advisories for VFR aircraft provided on a "work-permitting" basis (current ATC practice).

no use		little use		very useful		utmost use
_____	_____	_____	_____	_____	_____	_____

164. No ATC advisories for VFR aircraft.

no use		little use		very useful		utmost use
_____	_____	_____	_____	_____	_____	_____

165. In your opinion ATC advisories should be:

[ ] mandatory

[ ] provided on a "work-permitting" basis

[ ] not provided

for all VFR aircraft.

If ATC advisories were _____ for all VFR aircraft (answer from previous question), how would you see an automatic advisory service interfacing or contributing to the overall traffic situation?

_____

_____

_____

166. In the time since your last participation in the evaluation of a traf advisory service (ATARS or CDTI) have you wished you had the service when flying.

YES [ ]

NO [ ]

If yes, please explain the circumstance(s) _____

_____

_____

Are there any other points or comments you wish to make concerning ATARS or CDTI that were not covered in this interview?

_____

_____

_____

_____

167. Would you be willing to flight test the ATAS in the near future?

YES [ ]

NO [ ]

How did you feel about the timing and distance thresholds

used in the tests?_____

_____

_____

How did you feel about the service as an aid to visual acquisition?

_____

_____

_____