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ABSTRACT

One of the major objectives of this study was to obtain an estimate of the reading skill level an individual would need in order to be able to read and understand the training and job materials in his Air Force career ladder. A methodology developed by Mockovak (1974) for comparing training and job reading requirements was used to calculate the reading requirements levels for 56 career ladders. The application of the reading requirement methodology was accomplished by Air Force subject matter specialists (SMS) in each of the 56 career ladders. After collecting all of the relevant reading material in a career ladder, the SMS then randomly selected 150 word samples from the materials. The FORCAST readability formula was then applied to obtain an estimated grade level difficulty, and trainee and job incumbent scores were converted to estimated reading grade levels using a validated conversion procedure. The results indicated that both reading skills and requirements varied widely between career ladders, that materials in many career ladders were not written to the reading skill level of the user, and that, although the average reading ability level of personnel dropped in many career ladders, the reading demands often did not drop accordingly. (WR)

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AIR FORCE HUMAN RESOURCES LABORATORY

LITERACY SKILLS AND REQUIREMENTS IN AIR FORCE CAREER LADDERS

By
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TECHNICAL TRAINING DIVISION
Lowry Air Force Base, Colorado 80230

December 1974
Final Report for Period January 1973 – September 1974

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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This technical report has been reviewed and is approved.

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Technical Training Division

Approved for publication.

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

In a previous study (Mockovak, 1974b), a methodology for estimating the reading demands of training literature, as well as the average reading ability of groups of airmen, was demonstrated in five technical training areas. The methodology was designed to be objective, inexpensive, not overly time consuming, and simple enough to be accomplished by Air Force subject matter experts.

In the present study, this methodology was applied to 56 career ladders by Air Force subject matter experts in an effort to determine. (1) the reading demands of different career ladders, (2) the average reading grade level of personnel in those ladders, and (3) the reading demands of different training materials (CDCs, TOs, and resident training literature).

Item 20 (continued)

In general, the results indicate a wide variation in both reading skills and requirements, within, as well as between career ladders.

SUMMARY

Problem

Since the inception of the all-volunteer force, the potential has existed for significant changes in the educational characteristics of new Air Force accessions. Although educational levels may worsen or improve, the need exists for some objective means of comparing training and job reading requirements with the reading skills of Air Force personnel. To address this problem, Mockovak (1974b) demonstrated one possible methodology in five technical courses. The results supported the feasibility of the approach, therefore, the primary purpose of this study was to apply the methodology in an operational Air Force environment.

Approach

The methodology utilized in this study was chosen because it was found to be objective, inexpensive, not overly time consuming, and simple to understand and apply. The methodology was applied in 56 Air Force career ladders, representing 35 career fields, by Air Force subject matter experts and their assistants. The sample of career ladders was chosen to be as representative as possible of the spectrum of Air Force career ladders. The methodology, itself, consists of two basic steps: (1) subject matter experts performed a readability analysis of random samples of reading material from their specialties using the FORCAST readability formula, and (2) trainee and job incumbent AQE scores were converted to estimated reading grade levels using a validated conversion procedure (Madden & Tupes, 1966).

Results

In general, it was revealed that both reading skills and requirements varied widely between career ladders. It was also discovered that in many career ladders, materials were not written to the reading skill level of the user, and, more importantly, as the average reading ability level of personnel dropped in different career ladders, the reading demands imposed on trainees and job incumbents often did not drop accordingly.

Across all 56 career ladders, it was found that reading requirement levels (RRL) varied from a low of 10.6 in the Cook career ladder to a high of 14.0 in the Telephone Switching Equipment Repairman ladder (average = 12.3). Reading grade level varied from an average of 9.1 in the Aircraft Pneudrahc Repairman specialty to 14.6 in the Programming Specialist ladder. For personnel in all 277 Air Force career ladders, the estimated average reading grade level is 10.8.

In terms of the relative difficulty of different types of reading materials, technical orders were more difficult on the average, but the extreme variability between career ladders makes such an overall comparison essentially meaningless.

Discussion

The reading requirement levels (RRL) obtained in this study are statistical estimates of the reading skill levels required by Air Force personnel to read and understand the written material in their specialties. It should be emphasized, however, that the RRLs are only general estimates of reading demands. It was not possible within the constraints of this study to determine what effect job experience had on reducing a job's reading demands, or to estimate the relative importance of reading ability in disparate career ladders. Obviously, reading skills are more important in certain career fields than others. RRLs, as well as estimates of average reading ability of personnel, should be combined with the practical experience of training managers in determining if job and training materials are being written at the proper readability level for the intended user. Nevertheless, the data presented in this study allow comparisons to be made between career ladders in terms of reading demands, and more importantly, if reading problems exist, a determination can be made if the problems are the result of poorly written reading materials, inadequate reading skills of personnel, or a combination of both factors.

PREFACE

This technical report is the final report dealing with Air Training Command RPR 72-35, "Determining Reading Skills and Requirements of Air Force Career Ladders." The data presented represent the cumulative efforts of numerous Air Force subject matter experts, however, special thanks are due Maj C. Wayne Shore (ATC/XPT) and Capt Les G. Redmann (ATC TTSL) for their unqualified assistance in planning and coordinating ATC support. Computer support was made possible through the cooperation of Mr James D. Souter (AFHRL SMA) and, in addition, I would like to gratefully acknowledge the assistance and constructive criticism provided by Dr Ronald Burkett, Maj Philip DeLeo, and Dr Marty Rockway (AFHRL/TT) throughout the duration of this project and in the preparation of this final report.

TABLE OF CONTENTS

LIST OF TABLES

LITERACY SKILLS AND REQUIREMENTS IN AIR FORCE CAREER LADDERS

I. INTRODUCTION

Reading problems have always existed to varying degrees in the Air Force, either as a result of overly difficult job and training materials, or the inadequate reading skills of individual airmen. In response to these problems, the Air Force has pursued two general courses of action. First of all, an attempt has been made to simplify or modify written materials so that they are easier to use, such as in the job performance aid (JPA) approach (Hoehn & Lumsdaine, 1958). The other approach, instead of lowering the difficulty level of materials, has attempted to raise the reading skills of individuals to job requisite levels through literacy training programs. (McGaff & Harding, 1974, Mockovak, 1974a). Despite past efforts, however, feedback from training managers and supervisors indicates that the reading problem persists. There are several possible reasons for this, but the most likely is that poor reading skills remain a common problem in those civilian educational institutions which serve as the primary source of manpower for the Air Force. Reading problems are also aggravated by the fact that the Air Force is tasked with the responsibility of training thousands of individuals each year for a myriad of career fields which in many cases demand sophisticated technical skills.

Despite the general concurrence among training managers that inadequate reading skills are a serious problem, and conclusions such as that of the 1972 and 1974 Air Force World-wide OJT conferences, namely, that reading problems existed which were proving detrimental to the conduct of the on-the-job training program, very little quantitative information exists concerning the scope and degree of Air Force reading problems. For example, are reading problems concentrated in those career fields which have low entry level requirements, or is a greater diversity of career fields affected? Also, are Air Force publications such as technical orders (TO), career development courses (CDC), manuals, and resident training materials being written for the target population which will be using them? Finally, how does average reading ability vary within the 277 Air Force career ladders, and even more importantly, how does it compare with the reading difficulty of material in those ladders?

The answers to questions such as these are essential if rational and viable solutions are to be pursued for dealing with existing reading problems. Some preliminary steps have been taken, for example, Mockovak (1974a) surveyed Air Force reading improvement programs in an attempt to determine, (1) how many airmen participated in reading improvement programs on a yearly basis, (2) what the most common reading problems encountered among Air Force personnel were, and (3) which career fields contributed the largest number of people to reading improvement programs. However, no analysis of individual career ladders had yet been undertaken to determine (1) what the reading demands imposed on trainees were, (2) how different publications within a given career ladder compared in terms of readability, and (3) how reading ability varied within a career ladder.[1]

The purpose of this study, therefore, was to address these issues and several related questions in a large scale field study encompassing 56 career ladders representative of 35 Air Force career fields.

II. APPROACH

One of the major objectives of this study was to obtain an estimate of the reading skill level an individual would need in order to be able to read and understand the training and job materials in his career ladder. For example, it would be helpful to know if this level were a 10th grade reading level in the cook's career specialty, but a 12th grade reading level in an electronic specialist's career area. Unfortunately, although numerous techniques or methodologies exist for estimating this figure, they are limited by their validity and cost (Mockovak, 1974b).

[1] This was, however, accomplished for career fields, see Madden and Tupes (1966).

For example, the most valid methodology for determining the reading grade level ability a person needs to perform satisfactorily on job reading tasks is the Job Reading Task Test (JRTT) approach developed by Sticht, Caylor, Kern, and Fox (1971) Simply, this approach involves the development of a job reading task test for a specialty area which consists of important and frequently performed reading tasks from that specialty Individuals of varying reading ability are then tested on the JRTT in order to determine what minimum functional literacy level is required for a specified level of performance on the JRTT For example, if the functional literacy level is defined as that point at which 80% of the individuals are expected to get 70% or more of the JRTT items correct, and if individuals can be categorized in terms of their measured reading grade level (measured by USAFI Achievement Test III) then that grade level at which 80% of the people score 70% or higher is the functional literacy level. Using this decision rule, Sticht et al found that functional literacy in the Army varied from the 7 to 7.9 reading grade level (RGL) for cooks, to 8 to 8 9 for repairmen, and 12 to 12.9 for supply specialists. Of course, it should be emphasized that these functional literacy levels are not absolute. If it was decided that 90% of the individuals should be able to read 70% of the materials, then functional literacy levels would have to be established at a higher point

Although the JRTT approach gives valid estimates of the functional literacy level for a career area, it is extremely time consuming and expensive. Therefore, it was decided that it was not feasible for the purposes of this study. In a recent effort, Mockovak (1974b) reviewed several methodologies in addition to the JRTT approach which could be used to determine the reading skills and requirements of Air Force career ladders. One such methodology was demonstrated in a pilot study, and it produced realistic estimates of the reading requirement levels (RRL) and reading ability levels of personnel in 5 disparate technical areas Simply described, this methodology relies on the application of a readability formula (FORCAST) to the reading material in a career ladder in order to arrive at an overall assessment of the reading requirement level. The reading grade level of an individual, on the other hand, is estimated from AQE scores through regression formulas developed by Madden and Tupes (1966). It was decided that this methodology would be utilized in the field study because (1) it was relatively inexpensive, and (2) although somewhat time consuming, it could easily be applied by Air Force subject matter specialists in the field without demanding any special expertise. Initially, 84 career ladders, representing 42 career fields were to be included in this study. These career ladders were chosen to be as representative as possible of Air Force career ladders in general, however, this figure was reduced to 56 career ladders, representing 35 career fields, due to personnel limitations and the inaccessibility of materials in many of the career ladders. Reading requirement levels were therefore calculated for only 56 career ladders; however, the sample was still large enough to adequately represent the spectrum of Air Force career ladders. It was possible, on the other hand, to obtain AQE scores for all Air Force career ladders since these data were accessible in existing computer files.

Reading Requirement Methodology

The actual application of the reading requirement methodology was accomplished by Air Force subject matter specialists (SMS) in each of the 56 career ladders. Each of the SMSs was responsible for collecting all of the reading materials utilized by an airman as he progressed through his career. These materials were then subdivided into 3 major classifications, (1) technical training materials (study guides, workbooks, AFMs, etc.), (2) Career Development Course (CDC) material, (3) and technical orders. After collecting all of the relevant reading material in a career ladder, the SMS then randomly selected 150 word samples from the materials. Depending on the amount of reading material in a career ladder, the actual number of samples collected ranged from 30 to 303 with a mode of about 60. Once the samples had been selected, the SMS then applied the readability formula to them in order to obtain an estimated grade level difficulty. The readability formula utilized in this study was the FORCAST formula which was developed using Army technical training material and normed using adult Army personnel (Caylor, Sticht, Fox, & Ford, 1973). It has been found to correlate .92 and .94 with the Flesch and Dale-Chall readability formulas which, in the past, have been the most commonly used formulas. The FORCAST formula,

$$\text{Reading Grade Level} = 20 - \frac{\text{Number of 1 syllable words}}{10}$$

provides an estimated reading grade level difficulty based on a syllable count from a 150 word sample. For example, the FORCAST is used to estimate the readability of a given passage and a 10th grade level is obtained, technically, that means that at least 50% of the population with a 10th grade reading level (as determined by USAFI Achievement Test III) would be expected to score 35% correct on a five-cycle cloze test of the material (Caylor et al., 1973). A cloze score of 35% corresponds to roughly 70% on a multiple choice comprehension test of the same material.

After calculating the readability of all the samples in his career ladder, the SMS placed them in a cumulative distribution table. For purposes of this study, the RRL of a career ladder was defined as that point *below* which 75% of the materials were written. The selection of this point was essentially an arbitrary decision, since more or less stringent levels could have been chosen. Also, it should be emphasized that the RRL is a statistical estimate of the functional literacy level, rather than the type of determination that could be obtained using the JRTT approach. It was not possible within the constraints of this study to obtain actual functional literacy levels for different career ladders. Moreover, if an individual's reading grade level is not equal to the RRL for his specialty, it does not necessarily mean that he will fail technical training, on-the job training (OJT), or receive lower evaluations than a counterpart whose reading grade level exceeds the RRL. Further, due to errors of measurement associated with statistical estimation, this methodology is not sensitive to individual differences, and therefore, it should not be used with individual airmen. However, for a large sample of individuals and materials it will indicate if materials are being properly prepared for the general population which will be using them.

In summary then, although the RRL is not a direct estimate of the minimum literacy level required by an individual to deal with the reading materials in his career ladder, it is nevertheless a good *general* indicator of the level of literacy skills necessary. One can be relatively assured that if an individual's reading grade level equals or exceeds the RRL, the probability is extremely low that any performance difficulties will be the result of inadequate literacy skills. When used as general indices, RRLs can therefore permit one to compare different career ladders in terms of the reading demands imposed on airmen, and even more importantly, RRLs of materials can be contrasted with the reading ability of personnel in order to ascertain if materials are being written for the user population. The presence of a "literacy gap" (difference between RRL and reading ability of personnel) could result in increased training costs and higher failure rates, especially if it is excessively large. This point will be discussed in detail in a subsequent section.

III. RESULTS

Reliability of Methodology

A question of paramount concern to individuals using this methodology deals with its reliability. That is, if the procedures for determining the RRL were repeated, would comparable RRLs be obtained? Because of the large number of career ladders included in this study, it was not feasible to determine the RRL a second time, however, it was possible to indirectly assess the reliability using the following logic which is somewhat analagous to the split-half technique of determining test reliability. First of all, since all of the samples within a career ladder were random samples, it was assumed that the averages of the odd and even numbered samples would each provide an independent estimate of the RRL. Correlating the odd and even estimates across the 56 career ladders should therefore provide an estimate of the reliability of the methodology. This analysis was accomplished for all 56 ladders, and a reliability of .92 was obtained which is quite satisfactory for the purposes of this study.

Reading Requirement Levels of Materials and Literacy Gaps

Table 1 (column 2) presents the RRLs determined for each of the 56 career ladders included in this study. Once again, the RRL was determined by combining samples from all publications (TOs, CDCs, etc.) and calculating that reading grade level below which 75% of the samples were written. Across all 56 career ladders, the average RRL obtained was a 12.3 reading grade level (standard deviation = .69). The range varied from a low of 10.6 in the 622X0 career ladder (cook), to a high of 14.0 in the 362X1 ladder (telephone switching equipment repairman).

Table 1 Reading Requirement Levels

Career Ladder	Reading Rq Level	Literacy Gap	Average Difficulty All Materials	Mean Reading Ability
421X1	12.4	3.3	10.8	9.1
461X0	13.4	3.3	12.4	10.1
535X0	12.7	3.2	12.0	9.5
605X0	12.8	3.1	12.1	9.7
581X0	12.3	3.0	11.3	9.3
361X4	12.2	2.9	11.3	9.3
811X0	12.7	2.9	12.1	9.8
605X1	12.8	2.9	11.8	9.9
542X0	13.1	2.6	11.4	10.5
362X1	14.9	2.3	12.9	11.6
563X0	12.3	2.3	11.5	9.9
631X0	12.0	2.3	11.4	9.7
547X0	11.9	2.3	11.1	9.6
421X3	11.6	2.3	11.0	9.3
647X0	12.2	2.2	11.5	10.0
571X0	11.7	2.2	10.7	9.5
551X0	11.7	2.2	10.7	9.5
812X0A	12.4	2.0	11.5	10.4
552X5	11.8	1.9	11.2	9.9
432X0	11.4	1.9	10.8	9.5
702X0	12.2	1.9	11.2	10.3
276X0	13.7	1.7	12.7	12.0
363X0	13.0	1.5	12.2	11.5
462X0	11.7	1.4	11.1	10.3
472X1B	11.3	1.4	10.4	9.9
404X0	11.7	1.3	10.8	10.4
645X0	12.5	1.1	11.6	11.4
612X0	12.6	1.1	11.7	11.5
732X0	12.8	1.1	12.0	11.7
705X0	12.5	1.0	11.2	11.5
291X0	12.8	1.0	12.1	11.8
391X0A	12.4	0.9	11.4	11.5
303X2	13.2	0.7	12.0	12.5
622X0	10.6	0.7	9.7	9.9
322X1	13.0	0.6	12.2	12.4
391X0B	12.4	0.5	11.5	11.9
651X0	12.5	0.4	11.8	12.1
671X1	13.3	0.4	12.4	12.9
326X1	13.0	0.3	11.7	12.7
204X0	12.6	0.2	12.0	12.4
316X0G	12.5	0.1	11.8	12.4
328X2	12.6	0.1	12.0	12.5
985X0	12.5	0.1	11.9	12.4
304X4	12.5	0.0	11.6	12.5
751X2	12.3	0.0	11.6	12.3
913X0	11.9	+0.2	11.3	12.1
253X0	12.8	+0.2	12.0	13.0
902X0	11.8	+0.4	10.9	12.2
671X3	12.6	+0.4	11.8	13.0
981X0	11.5	+0.7	11.0	12.2
511X0	12.3	+0.9	11.5	13.2
982X0	11.0	+1.2	10.4	12.2
223X0	10.7	+1.3	9.9	12.0
221X0	11.1	+1.4	10.4	12.5
252X1	12.0	+2.1	11.5	14.1
511X1	12.4	+2.2	11.6	14.6

Note. — Column 3 is the difference between columns 2 and 5.

For comparative purposes, it is interesting to note that recent reading requirement research in the Army's cook specialty area (Sticht et al., 1971) has indicated, using the Job Reading Task Test approach, that a minimum functional literacy level of 7 to 7.9 is necessary for adequate performance on job reading tasks. Since it is a fair assumption that cook reading material and job tasks do not differ significantly between the Army and Air Force, and that the JRTT approach provides a more valid estimate of a job's reading demands, it appears that the RRL of 10.6 obtained using the present methodology overestimates the actual functional literacy level needed for adequate job performance. However, in the same study, Sticht et al., report a functional literacy level of 12 to 12.9 for Army Supply Specialists which compares favorably with the RRLs of 12.2 and 12.5 obtained in the Air Force counterparts (647X0 and 645X0, respectively). On the basis of these results, it is therefore necessary to interpret RRLs with caution and to realize that RRLs were obtained only from job reading materials and that they do not represent performance on actual job tasks. Furthermore, the RRL does not take job experience into consideration which has been shown to correlate significantly (Vineberg, Sticht, Taylor, & Caylor, 1971) with job performance and which indirectly lowers the literacy demands of a job, since a skilled job incumbent does not need to refer to reading materials as frequently to perform his work successfully. These limitations are not presented to negate the utility of RRLs, on the contrary, they only serve to emphasize that job performance is a complex skill which is affected by many different factors. RRLs are a measure of one such factor but they should only be used to supplement the knowledge and experience of training managers.

Column 5 of Table 1 contains the estimated average reading ability of personnel in each of the career ladders. This figure was compared with column 2 (RRL) to obtain an estimate of the literacy gap (column 3) existing in each career ladder. Column 4 is simply the average difficulty (50% point) of all the materials in the career ladder. For comparative purposes, the RRLs for the 56 career ladders were collapsed to obtain average RRLs for the 35 career fields presented in Table 2. In several instances, the RRL for a career field is simply the RRL of the career ladder sampled in that field (when only one ladder was sampled from the field). If relevant reading requirement data are required concerning a given specialty, the career ladder data should be utilized rather than attempting to generalize from the career field; however, Table 2 enables gross comparisons to be made between career fields when reading requirement data are not available for a particular ladder.

Reading Ability Levels of Personnel

Mockovak (1974b) compared two procedures for estimating reading grade level from standardized test scores such as the Airman Qualifying Examination (AQE) and the Armed Forces Qualification Test (AFQT). Neither one of these procedures provides accurate enough estimates to predict individual reading ability, however, when used with large sample sizes, estimates of sufficient accuracy for group comparisons can be obtained. On the basis of that study, it was concluded that the Madden and Tupes (1966) AQE procedure yielded the most accurate estimates, therefore, it was used to estimate the average reading ability of personnel in all Air Force career ladders including the 56 ladders in this effort. The data for the 56 career ladders are presented in Table 3 for two different time frames (1967–1968 versus 1972–1973) and for two skill levels as of June 1973. The time frame comparison was made to determine what effect, if any, the implementation of an all-volunteer military has had on the average reading ability of new accessions. To address this question, the AQE scores of Air Force enlistees were collected for the following time periods, (1) 1967-1968 enlistees on duty in June 1969, and (2) 1972–1973 enlistees on active duty in June 1973. This information was collected for the original 84 career ladders, representing 42 career fields, and it indicated that average reading ability did not significantly differ between the two groups. In addition, there was no difference between the average reading ability of 3 and 5 skill level personnel for the 1973 group. These results can be misleading, however, because there are significant differences within certain career ladders. For example, the 421X3 career ladder experienced a 2.1 reading grade level drop between June 1969 and June 1973, whereas, the 571X0 ladder experienced almost a grade level increase for the same time frame. Obviously, personnel and training managers interested in these data should concern themselves with individual career ladders or career ladders similar in terms of their entry requirements and skill areas.

Estimates of average reading ability in all 277 Air Force career ladders are presented in Appendix A. Estimates of the average reading ability of personnel in the career fields included in this study are presented in Table 4.

Table 2. Average Reading Requirement Levels for Career Fields

Career Field	Reading Rq Level	Literacy Gap	Average Difficulty All Materials	Average Estimated Reading Ability
53	12.7	−3.2	12.0	9.5
58	12.3	−3.0	11.3	9.3
60	12.8	−3.0	12.0	9.8
42	12.0	−2.8	10.9	9.2
54	12.5	−2.5	11.3	10.1
46	12.6	−2.4	11.8	10.2
56	12.3	−2.4	11.5	9.9
36	13.1	−2.3	12.1	10.8
63	12.0	−2.3	11.4	9.7
57	11.7	−2.2	10.7	9.5
55	11.7	−2.1	11.1	9.7
81	12.6	−2.0	11.8	10.6
43	11.4	−1.9	10.8	9.5
64	12.4	−1.7	11.5	10.7
27	13.7	−1.7	12.7	12.0
70	12.4	−1.5	11.2	10.9
47	11.3	−1.4	10.4	9.9
40	11.7	−1.3	10.8	10.4
73	12.8	−1.1	12.0	11.7
29	12.8	−1.0	12.1	11.8
39	12.4	−0.7	11.4	11.7
62	10.6	−0.7	9.7	9.9
30	12.9	−0.4	11.8	12.5
65	12.5	−0.4	11.8	12.1
32	12.9	−0.3	12.0	12.5
20	12.6	−0.2	12.0	12.4
31	12.5	−0.1	11.8	12.4
67	13.0	0	12.1	12.9
75	12.3	0	11.6	12.3
90	12.2	+0.2	11.4	12.3
91	11.9	+0.2	11.3	12.1
98	11.3	+1.0	10.7	12.2
25	12.4	+1.2	11.8	13.6
22	10.9	+1.4	10.2	12.3
51	12.4	+1.6	11.5	13.9

Note. — This table presents the same data as attachment 1 averaged by career field. There are some slight discrepancies due to rounding errors.

Table 3 Average Estimated Reading Ability by Career Ladder

Career Ladder	1967–1968		1972–1973		June 1973 Data			
	Av RGL	N	Av RGL	N	3 Skill	N	5 Skill	N
204X0	14.2	472	12.4	62	12.4	59	13.0	3
221X0	12.7	153	12.5	23	12.6	4	12.5	19
223X0	12.3	32	12.0	50	12.0	50	*	*
252X1	14.3	1,251	14.1	187	14.0	46	14.2	141
253X0	13.0	2	*	*	*	*	*	*
276X0	*	*	12.0	741	12.0	599	11.8	142
291X0	11.5	4,133	11.8	1,659	11.8	1,398	11.9	261
303X2	12.6	1,034	12.5	273	12.5	263	12.9	10
304X4	12.0	1,681	12.5	1,185	12.5	1,026	12.7	159
316X1	13.0	326	12.3	191	12.3	139	12.4	52
316X2	13.0	57	12.5	69	12.4	48	12.9	21
322X1	12.9	887	12.4	428	12.4	358	12.8	70
326X1	*	*	12.7	137	12.5	90	13.0	47
361X4	9.5	215	9.3	51	9.3	37	9.1	14
363X0	10.9	448	11.5	365	11.4	316	11.8	49
391X0A	*	*	11.5	22	11.3	14	11.7	8
391X0C	*	*	12.6	5	12.3	4	13.7	1
404X0	11.1	42	10.4	51	10.4	45	10.2	6
421X2	10.1	1,354	9.1	691	8.9	533	9.7	158
421X3	11.4	2,333	9.3	1,046	9.1	651	9.6	395
432X0	9.7	4,675	9.5	2,292	9.4	1,664	9.9	628
461X0	11.3	3,532	10.1	1,081	10.0	849	10.5	232
462X0	11.3	4,672	10.3	2,914	10.2	2,094	10.7	820
472X0	10.1	242	9.9	49	9.9	42	9.8	7
511X0	*	*	13.2	254	13.0	161	13.8	93
511X1	*	*	14.6	111	14.6	60	14.7	51
535X0	10.7	657	9.5	286	9.3	189	9.9	97
542X0	10.7	751	10.5	187	10.3	120	10.9	67
547X0	9.7	704	9.6	222	9.4	121	9.8	101
551X0	9.1	820	9.5	384	9.3	195	9.7	189
552X5	9.5	699	9.9	257	9.8	152	10.0	105
563X0	9.8	542	9.9	146	9.9	78	9.8	62
571X0	9.1	1,853	10.0	1,184	9.9	687	10.4	497
581X0	10.0	341	9.3	74	9.1	26	9.4	48
605X1	9.9	1,272	9.9	636	9.7	328	10.2	308
622X0	10.4	2,267	9.9	827	9.9	732	9.9	95
631X0	10.0	2,034	9.7	712	9.6	528	9.8	184
645X0	11.5	6,008	11.4	3,606	11.3	2,037	11.6	1,569
647X0	9.8	4,126	10.0	736	10.0	476	10.0	260
651X0	13.0	289	12.1	147	12.1	103	12.1	44
671X1	12.8	471	12.9	188	12.8	126	13.0	62
671X3	13.2	757	13.0	545	12.9	309	13.0	236
702X0	10.5	10,928	10.3	4,848	10.2	3,753	10.5	1,095
705X0	12.1	33	11.5	86	11.6	60	11.4	26
732X0	11.8	3,393	11.7	1,419	11.6	1,051	11.9	368
751X0	12.9	188	12.6	38	12.4	26	13.0	12
811X0	10.8	15,176	9.8	5,697	9.8	3,468	10.0	2,229
812X0	*	*	11.5	2,129	11.4	900	11.5	1,229
902X0	12.2	2,782	12.2	1,162	12.2	798	12.5	364
905X0	13.2	105	12.4	137	12.4	92	12.4	45
913X0	12.6	56	12.1	11	12.2	6	12.0	5
981X0	12.3	963	12.2	499	12.1	358	12.3	141
982X0	12.1	118	12.2	70	12.0	48	12.8	22

Note.—Columns 2 and 4 represent data for 3 and 5 skill level personnel

*Data not available.

Table 4 Average Estimated Reading Ability by Career Field

Career Field	1967—1968		1972—1973		June 1973 Data			
	Av RGL	N	Av RGL	N	3 Skill	N	5 Skill	N
20	14.2	1,717	14 0	530	13.3	412	13.6	118
22	12.7	185	12.1	73	12 3	54	12 5	19
23	11.6	797	12 0	134	11.8	85	12.3	49
25	14.4	1,253	14 2	187	14.0	46	14.2	141
27	12 1	999	11.2	875	10.4	583	11.4	192
29	11 8	5,192	11 8	1,659	11.8	1,398	11.9	261
30	12.6	2,715	12 5	1,458	12.5	1,289	12.8	169
31	13.0	383	12.4	260	12.4	187	12.7	73
32	12.9	887	12.5	565	12.5	448	12 9	117
34	13.0	87	12 3	8	12.3	8	–	
36	10.8	663	11.6	416	10.4	353	10.5	63
39			11 7	27	11 8	18	12.7	9
40	10.7	92	10 4	51	10.4	45	10.2	6
42	11.4	3,687	9 1	1,737	9.0	1,184	9.7	553
43	10.2	24,439	9 9	9,986	9.6	6,776	10 1	3,210
44	10 4	758	9.7	460	9 6	297	9.8	163
46	12 0	8,204	10 6	3,995	10 1	2,943	10.6	1,052
47	9 9	1,717	10.1	332	10.0	203	10.0	129
51			13.8	365	13.8	221	14.3	144
53	10.7	712	9.5	288	9 7	191	9 9	97
54	10 4	1,455	9 9	409	9.9	241	10.4	168
55	9.3	1,429	9.7	641	9.6	347	9.9	294
56	10 6	701	10.2	161	11.16	84	11.0	77
57	9 1	1,853	10.0	1,184	9.9	687	10.4	497
58	9.8	510	9.1	138	8.9	71	9.4	67
60	9.6	2,923	9.7	1,538	9 7	1,177	10.1	361
61	11.3	343	9 8	239	10 0	233	10.8	6
62	10.4	2,390	9.9	882	9.8	782	9.6	100
63	10.0	2,034	9.7	712	9.6	528	9.8	184
64	10 9	10,134	11.2	4,342	10.7	2,513	10.8	1,82[illegible]
65	13.0	289	12 1	147	12.1	103	12.1	44
67	13.0	1,228	12 9	733	12.9	435	13 0	298
69	13.4	18	12 7	50	12.6	32	13.0	18
70	10.5	10,961	10 3	4,934	10.9	3,813	11.0	1,121
71	11.1	119	10 0	45	9.9	35	10.4	10
73	11 8	3,424	11 7	1,520	11.7	1,126	11.7	394
74	11.1	477	11 1	319	11.2	173	11.2	146
75	12 8	230	12 3	149	12.3	88	12.6	61
79			14.0	167	13.8	107	14.0	60
81	10.8	15,176	10.4	7,826	10.6	4,368	10.8	3,458
90	12.2	2,887	12.2	1,299	12.3	890	12.3	409
91	13 0	131	12.9	81	12.7	58	12.5	23
92	12.9	159	13 0	22	13.0	16	12.8	6
98	12.3	1,081	12 2	569	12.1	406	12.6	163

Readability of Different Publications

As an airman progresses through various stages of his career, he encounters different publications which he must read and understand if he is to be proficient in his job. In technical school, the airman is confronted with study guides, workbooks, programmed texts, Air Force manuals, etc., and in certain specialties even technical orders. On the other hand, an airman in the field must study and pass his CDCs in order to meet the knowledge requirements for his skill upgrading, and, in many cases, he must also closely follow the directives of TOs in order to accomplish his job. These various publications impose different reading requirements on the individual, and therefore, one of the objectives of this study was to compare these materials in terms of their readability as measured by the FORCAST formula. Table 5 (column 2) presents the average difficulty of reading materials typically used in resident courses. This figure can be compared with the average reading ability of the personnel in the career ladder (column 3), and with the average difficulty of all materials combined (column 4). Once again, it can be seen that there is a great deal of variability in difficulty levels which is not entirely content dependent. Tables 6 and 7 present similar data for technical orders and CDCs, respectively, so that it is possible for a given career ladder to compare the average difficulty levels of CDCs, TOs, and resident training materials with each other and with the average reading grade level of the personnel.

Table 8 collapses these data across all 56 career ladders and, in general, the data indicate that, on the average, technical orders are the most difficult, followed by resident course materials and CDCs. It is interesting to note, however, that the TOs had the greatest range, from 8.9 to 13.8 (standard deviation = 1.1). Obviously, if any comparisons are to be made, the data for individual career ladders should be compared.

There are also missing data in Table 8, particularly in the case of TOs, because in many career ladders they are not used to any appreciable extent, or are insignificant in number.

Decision Rules for Determining Literacy Gaps and Readability Specifications

As previously stated, one of the objectives of this study was to determine within individual career ladders if materials were being written at a difficulty level commensurate with the reading skills of individuals in those ladders. A problem arises, however, in determining what a commensurate level is. For example, is it necessary to have 100% of the personnel in a ladder able to read and understand 100% of the material? That is, operationally defined, none of the difficulty levels of the materials can exceed the reading grade level of the worst reader in the ladder. Obviously, this is an extremely conservative and probably unnecessary restriction which has interesting implications, since in the 542X0 career ladder, for example, it would require that all materials be written at a sixth grade level, or below, which is impractical and impossible to achieve. If a 100--100 decision rule is not practical, then, would a 50 50 rule be applicable? That is, at least 50% of the airmen could be expected to read and understand at least 50% of the material without any assistance, however, that also implies that 50% of the airmen may have difficulty with at least 50% of the material.

The problem of determining literacy gaps and specifications for individual career ladders, therefore, essentially reduces to the operational question of determining what percentage of airmen should be able to read and understand a given percentage of the materials in a career ladder. This question is further complicated by the obvious fact, however, that an individual does not learn only by reading. For example, in technical training the instructor gives lectures and performance demonstrations, he provides remedial instruction, and he also uses the technical vocabulary associated with the specialty. In addition, the airman is surrounded by fellow students who can answer questions and also serve as surrogate instructors. Therefore, in certain specialties, a student may actually have to read and understand very little on his own because he is able to acquire the information from other sources. Another factor which also influences job proficiency is simply experience, that is, the longer a person is on the job the more familiar he becomes with standard operating procedures, technical vocabulary, operating directives (TO), etc. Unfortunately, however, for those airmen with inadequate reading skills, job experience alone may not be sufficient to cope with the demands of CDC courses which must be passed for skill upgrading, as well as studied for promotion test purposes. Special emphasis must therefore be placed on adequate reading skills, since an "information overkill" situation does not exist on the job, as it does in resident technical training.

Table 5. **Readability Data for Training Manuals**
(Study Guides and AFMs)

Career Ladder	Averag Difficulty Training Manuals	Mean Reading Ability	Average Difficulty All Materials
361X4	12.6	9 3	11.1
535X0	12.2	9.5	12.0
461X0	12.5	10.1	12.4
605X0	12 1	9.7	12.1
811X0	12.1	9.8	12.1
605X1	12.0	9.9	11.8
432X0	11 5	9.5	10.8
421X3	11 2	9.3	11.0
647X0	11.8	10.0	11.5
563X0	11.6	9.9	11.5
547X0	11.2	9.6	11.1
542X0	12.0	10.5	11.4
421X2	10.5	9.1	10.8
552X5	11.3	9.9	11.2
571X0	10 8	9.5	10.7
551X0	10.8	9.5	10.7
812X0A	11.7	10.4	11.5
702X0	11.3	10.3	11.2
362X1	12.5	11.6	12.9
276X0	12.8	12.0	12.7
363X0	12.2	11.5	12.2
732X0	12.4	11.7	12.0
812X0	12.1	11.5	11.7
291X0	12.4	11.8	12.1
391X0A	11 8	11.5	11.4
462X0	10.6	10.3	11.1
622X0	10.2	9.9	9.7
326X1	12.8	12.7	11.7
645X0	11.4	11.4	11.6
391X0B	11.8	11.9	11.5
705X0	11.4	11.5	11.2
204X0	12.0	12.4	12.0
905X0	12.0	12.4	11.9
404X0	10.0	10.4	10.8
651X0	11.5	12.1	11.8
671X1	12.2	12.9	12.4
316X0G	11 7	12.4	11.8
221X0	11.7	12.5	10.4
913X0	11.3	12.1	11.3
982X0	10.3	12.2	10.4
328X2	11 6	12.5	12.0
671X3	11.9	13.0	11 8
253X0	11.9	13.0	12.0
304X4	11 4	12.5	11.6
981X0	11.0	12.2	11.0
902X0	10.9	12.2	10.9
511X0	11.6	13.2	11.5
252X1	11.5	14.1	11.5
511X1	11.8	14.6	11.6

Note. — The career ladders are ranked in terms of the difference between columns 2 and 3.

Table 6. **Readability of Technical Training Materials**

	Median	Mean	SD	Range Low	Range High	N
All Reading Materials	11.5	11.5*	.64	9.7	12.9	56
Career Dev. Courses	11.3	11.2*	.73	9.3	13.2	54
Technical Orders	12.1*	11.8	1.1	8.9	13.8	28
Training Manuals (Study Guides & AFMs)	11.8	11.7*	.64	10.0	12.8	51

* Best estimate based on distribution.

Table 7. **Readability Data for Technical Orders**

Career Ladder	Average Difficulty Technical Orders	Mean Reading Ability	Average Difficulty All Materials
462X0	13.8	10.3	11.1
421X2	12.4	9.1	10.8
535X0	12.1	9.5	12.0
563X0	12.5	9.9	11.5
461X0	12.5	10.1	12.4
631X0	12.0	9.7	11.4
581X0	11.5	9.3	11.3
647X0	12.2	10.0	11.5
276X0	13.8	12.0	12.7
421X3	11.1	9.3	11.0
362X1	13.3	11.6	12.9
361X4	10.8	9.3	11.1
605X1	11.2	9.9	11.8
472X1B	11.1	9.9	10.4
645X0	12.5	11.4	11.6
432X0	10.6	9.5	10.8
363X0	12.6	11.5	12.2
551X0	10.5	9.5	10.7
571X0	10.5	9.5	10.7
404X0	10.9	10.4	10.8
322X1	12.5	12.4	12.2
651X0	12.0	12.1	11.8
316X0G	12.3	12.4	11.8
328X2	12.1	12.5	12.0
304X4	12.1	12.5	11.6
542X0	8.9	10.5	11.4
303X2	11.5	12.5	12.0
326X1	11.7	12.7	11.7

Note. — Career ladders are ranked in terms of differences between columns 2 and 3. Not all career ladders use TOs to a significant extent, therefore, only 28 ladders are represented in this table.

Table 8. **Readability Data for Career Development Courses**

Career Ladder	Average Difficulty Career Dev Courses	Mean Reading Ability	Average Difficulty All Materials
811X0	12.4	9.8	12.1
542X0	12.8	10.5	11.4
605X0	11.9	9.7	12.1
421X3	11.3	9.3	11.0
361X4	11.1	9.3	11.1
421X2	10.8	9.1	10.8
362X1	13.2	11.6	12.9
5535X0	11.1	9.5	12.0
461X0	11.6	10.1	12.4
605X1	11.3	9.9	11.8
631X0	11.0	9.7	11.4
547X0	10.8	9.6	11.1
552X5	11.0	9.9	11.2
551X0	10.4	9.5	10.7
563X0	10.8	9.9	11.5
571X0	10.4	9.5	10.7
647X0	10.9	10.0	11.5
702X0	11.1	10.3	11.2
432X0	10.3	9.5	10.8
812X0A	11.0	10.4	11.5
462X0	10.9	10.3	11.1
363X0	12.0	11.5	12.2
404X0	10.7	10.4	10.8
472X1B	10.0	9.9	10.4
64X0	11.4	11.4	11.6
322X1	12.2	12.4	12.2
651X0	11.8	12.1	11.8
291X0	11.5	11.8	12.1
303X2	12.2	12.5	12.0
671X1	12.5	12.9	12.4
705X0	11.0	11.5	11.2
812X0	11.0	11.5	11.7
905X0	11.8	12.4	11.9
622X0	9.3	9.9	9.7
316X0G	11.8	12.4	11.8
204X0	11.8	12.4	12.0
276X0	11.3	12.0	12.7
751X2	11.6	12.3	11.6
782X0	10.5	12.2	10.4
253X0	12.1	13.0	12.0
304X4	11.6	12.5	11.6
391X0A	10.5	11.5	11.4
732X0	10.6	11.7	12.0
981X0	11.0	12.2	11.0
328X2	11.3	12.5	12.0
391X0B	10.5	11.9	11.5
671X3	11.5	13.0	11.8
326X1	11.1	12.7	11.7
511X0	11.4	13.2	11.5
223X0	9.9	12.0	9.92
221X0	10.2	12.5	10.4
252X1	11.4	14.1	11.5
511X1	11.4	14.6	11.6

Note. — Career ladders are ranked in terms of the difference between columns 2 and 3.

From the preceding discussion, it should be obvious that the use of a decision rule to determine a literacy gap is not a straightforward matter. For example, if a 2 grade level difference is found between the reading requirement level and the reading ability level of the students, what in fact does that mean in terms of training costs student failure rates, student attitudes, etc.? As interesting as this question is, it could not be addressed in this study because of: (1) a lack of adequate measures of cost and performance factors, and (2) the methodological problems associated with determining the relative contribution of reading ability to job performance. Without an answer to the preceding question, however, the establishment of a decision rule becomes essentially an arbitrary decision based on expert opinion and, hopefully, sound experience. It is important to emphasize, however, that guidelines of some sort are necessary if only to increase the awareness of Air Force technical writers to an important educational characteristic of their user population. For example, Sticht, Caylor, Kern, and Fox (1971) discovered that if written materials are too difficult, there is a tendency for individuals not to use them. Also, of special importance, is the finding that for poor readers the frequency of listening to obtain job information, relative to reading, was higher in those job areas with more difficult materials. The implication of these results is simply that as the gap widens between the reading ability of an individual and the reading requirements of his job, the individual must seek access to other sources of information if he is going to be able to acquire those job knowledges necessary for successful performance and skill upgrading. There should, therefore, be a concerted effort to insure that materials are presented in as clear and concise a manner as possible, and in order to accomplish this, guidelines such as AFP 13-2, *Guide for Air Force Writing,* are necessary.

In this study, 4 different decision rules were compared to determine "literacy gaps." The gaps resulting from these 4 decision rules were collapsed across all 56 career ladders and the results are presented in Table 9. To reiterate, a 75–50 rule, for example, means that an "average" individual in a ladder should be capable of reading and understanding 75% of the reading material he encounters without any assistance. It is obvious from the table that as a decision rule becomes more stringent, the resulting literacy gap increases in size, therefore, the perceived mismatch between men and materials appears worse when actually the same career ladders are being described. Unfortunately, what can operationally be defined as a "critical" gap under each of the decision rules, that is, where performance and training problems can be expected, has not yet been experimentally determined.

Table 9. **Literacy Gaps Resulting from Different Decision Rules**

Decision Rule	Median	Mean	SD	Range		N
				Low	High	
50–50	– .3*	– .2	1.4	–2.5	3.0	54
75–50	–1.1	–1.1	1.4	–3.3	2.2	56
50–85	–1.6*	–1.5	1.5	–4.0	2.4	54
75–85	–2.5	–2.3	1.6	–4.8	1.6	54

*Best estimate based on distribution.

For the purposes of this study, the 75–50 decision rule was utilized as a measure of the mismatch between men and materials because it offered an acceptable alternative to the extremes of 50–50 and 75–85. The resulting literacy gaps are presented in Tables 1 and 2 and it is interesting to note that those career ladders with the lower average reading grade levels (personnel) do not necessarily have the lower reading requirement levels.

It is also interesting to note what happens when the 75–50 decision rule is applied to career fields with known reading problems. For example, in a previous study, Mockovak (1974c) identified 10 career fields which accounted for approximately 84% of the enrollment in base reading improvement programs. The literacy gaps in these fields using the 75–50 rule are presented in Table 10. The average literacy gap for

Table 10. Literacy Gaps in 10 Career Fields with Reading Problems

Career Field	Average Literacy Gap	Range of Average Reading Ability
60	-3.0	9.0 – 10.7
42	-2.8	8.7 – 11.1
54	-2.5	9.4 – 11.3
63	-2.3	9.9
55	-2.1	8.0 – 12.5
81	-2.0	10.0 – 11.4
43	-1.9	8.6 – 10.5
64	-1.7	9.9 – 12.0
70	-1.5	10.3 – 12.1
62	-0.7	9.8 – 11.0
Average	-2.1	

the 10 fields is -2.1 which is a full grade level more than the average for all 56 ladders of -1.1 (Table 8). In fact, only one career field (62) does not exceed this average. Therefore, it appears quite reasonable that overly difficult reading materials may be contributing to the reading problems of these personnel, although the ranges (column 3) of average reading ability for the 10 fields are also quite low, which suggests that some reading problems would exist despite the readability of the materials.

A final question which was of concern in this study concerned the establishment of readability specifications for Air Force career ladders, that is, what grade level difficulty should Air Force technical writers attempt to achieve. Although the 75–50 decision rule could have been utilized to determine this figure, it was decided to use the 50–85, instead, because it would be somewhat easier for Air Force writers to arrive at an average difficulty level, rather than a 75% point. Simply, the 50–85 rule implies that the average difficulty of the material should not exceed the reading ability of 85% of the people in a ladder. This figure was calculated for the 56 career ladders, and it is presented as the "ideal" readability specification in Table 11, column 2 (also, column 4, Appendix A). It is considered "ideal" because in many cases it is too low to be practically achieved. For example, the 361X4 ladder would require an average difficulty of 7.7 (estimated by FORCAST) which is, for all practical purposes, quite unrealistic, a fact which anyone who has attempted to write to those levels will readily acknowledge. Therefore, Table 11 (column 3) also contains a recommended difficulty level which should be more practically attainable. It may appear that the range presented is too restricted but actually it has the advantage of providing the Air Force technical writer with a great deal of flexibility since he would then be able to vary his style based on the content of his material. For example, if a simple procedure is being described, an 8th grade level difficulty would be appropriate, however, if the discussion involves nuclear fusion, then a 12th grade level would probably be more suitable. The important consideration, and the value of column 2, is that the technical writer is made aware of an important educational characteristic of his intended audience.

As a concluding remark concerning the complex problem of establishing readability specifications, it is a foregone conclusion that a literacy gap will exist for a certain percentage of personnel in almost every career ladder. In the majority of career ladders, however, it appears that supplements to reading, such as instructor lectures, remedial sessions, audio-visual aids, fellow airmen, performance demonstrations, etc., will be sufficient to insure that the trainee acquires necessary job information. Nonetheless, there will be cases where the literacy gap is so severe that these additional sources of information will not be adequate for the low ability reader; therefore, training and job performance problems will result and solutions to these problems must be found.

Table 11 Readability Specifications for Career Ladders

Career Ladder	Ideal Average Difficulty Level	Recommended Average Difficulty Level
204X0	11.4	11.4
221X0	11.3	11.3
223X0	10.2	10.5
252X1	12.9	12.0
253X0	12.8	12.0
276X0	11.0	11.0
291X0	10.2	10.5
303X2	11.5	11.5
304X4	11.5	11.5
316X0G	11.5	11.5
32X1	11.4	11.4
326X1	11.6	11.6
328X2	11.5	11.5
361X4	7.7	10.5
362X1	*	*
363X0	10.2	10 5
391X0A	10.9	10.9
391X0B	10.9	10.9
404X0	9.0	10.5
421X2	7.6	10.5
421X3	7.6	10.5
432X0	8.0	10.5
461X0	8.7	10.5
462X0	8.8	10.5
472X1B	8.0	10.5
511X0	11.9	11.9
511X1	14.0	12.0
5535X0	8.0	10.5
542X0	8.9	10.5
547X0	8.0	10.5
551X0	7.9	10.5
552X5	8.5	10.5
563X0	8.2	10.5
571X0	8.6	10.5
581X0	8.0	10.5
605X0	8.7	10.5
605X1	8.7	10.5
622X0	8.5	10.5
631X0	8.3	10.5
645X0	10.2	10.5
647X0	8.6	10.5
651X0	11.0	11.0
671X1	11.9	11.9
671X3	12.1	12.0
702X0	8.8	10.5
705X0	10.2	10.5
732X0	10.5	10.5
751X2	11.2	11.2
811X0	8.6	10.5
812X0	9.7	10.5
812X0A	9.7	10.5
902X0	11.0	11.0
905X0	11.3	11.3
913X0	11.1	11.1
981X0	11.1	11.1
982X0	11.0	11.0

*Data not available.

IV. CONCLUSIONS AND RECOMMENDATIONS

On the basis of the data obtained in this study, it appears that meaningful discussions of Air Force reading problems should be directed towards individual career ladders or fields, but not the training environment as a whole. The variability in both reading skills and requirements between career ladders emphasizes the necessity for isolating reading problems, as well as their causes, since in every situation the causes will not be the same. For instance in the 432X0 career ladder, one obvious cause of reading problems is the low average reading ability of the personnel (9.5). However, the average difficulty level of resident training materials is 11.5 (Table 4) which aggravates the situation. On the other hand, in the 421X2 ladder the personnel have an even lower average reading grade level of 9.1, but their most difficult reading materials are technical orders, which have an average readability level of 12.4 (Table 6). In both of these examples, marginal reading skills can be expected to cause problems, but the situation is aggravated by overly difficult job reading materials.

It is also interesting to note that the 421X2 ladder has a RRL of 12.4 which is identical to the RRL in the 511X1 ladder. However the average reading ability level of the personnel in the 511X1 ladder is 14.6. Therefore, even though the average reading ability of personnel in the 421X2 ladder is more than 5 grade levels lower than the reading ability of personnel in the 511X1 ladder, airmen in both ladders are faced with reading materials which require approximately the same literacy skills. Obviously, reading materials are not being written to the literacy level of the user, and as shown in Figure 1, this appears to be true across the 56 ladders sampled in this study.

Figure 1 shows how RRLs vary across a range of reading ability for different Air Force career ladders. If materials were being written for the intended user, a monotonic relationship could be expected, that is, as reading ability levels drop, the RRLs should also drop. Obviously, this is not the case, and it is a situation which should not be allowed to persist.

One solution to the problem of overly difficult job reading materials is material modification which is an expensive, laborious, and time consuming process. It appears that major benefits from this approach could be expected in those areas which have large literacy gaps, and generally, personnel with low average reading levels. It also appears that material modification should have a significant favorable impact on OJT, where the individual is almost totally dependent on his own reading ability for obtaining job relevant information. It should be emphasized that material modification does not refer solely to the rewriting or reformatting of relevant job information, such as in the JPA approach (Folley & Munger, 1961). Instead, other means of supplementing the textual material are also included, such as audio supplementation (Sellman, 1970).

Since reading is only one means of obtaining job information, it appears that in certain circumstances, that is, where average reading ability is extremely low, a massive redesign of the training environment may be justified. Such an approach has been demonstrated in Automated Apprenticeship Training (AAT) (Pieper, Catrow, Swezey, & Smith, 1973) which utilizes audio-visual materials to replace much of the written material in a course. Essentially, therefore, the literacy demands of training are reduced by doing away with much of the reading in a course. The AAT approach has been successfully demonstrated in the Air Force Security Police Law Enforcement and Security Specialists career ladders, and its concepts offer potential benefits in both resident and on-the-job training.

The final alternative for dealing with inadequate reading skills is one with which the Air Force has had a certain amount of experience. Literacy training, or reading improvement courses, have been in existence on a large scale basis since the mid 1960s. however, despite their relatively high costs, their overall benefits have been somewhat questionable (Mockovak, 1974c). There are many possible reasons for the limited effectiveness of literacy training efforts, but the most likely reason is that they employ essentially the same training techniques which have already proven ineffective for problem readers during 12 years of prior schooling. In addition, many Air Force reading improvement programs in both basic training and out in the field are quite short in duration, and appear to have unrealistically low graduation goals in terms of the reading requirements found to exist in Air Force specialties. Probably the most serious problem encountered, however, involves the motivation of individuals exposed to reading improvement courses. Besides the resentment at being placed in such courses, participants must also bear the stigma attached to anyone associated with "remedial" programs. Supervisors tend also to resent the courses because they keep scarce manpower from performing a variety of necessary functions, and the trainees themselves must continually deal with the labels of inadequacy so often attached to course participants.

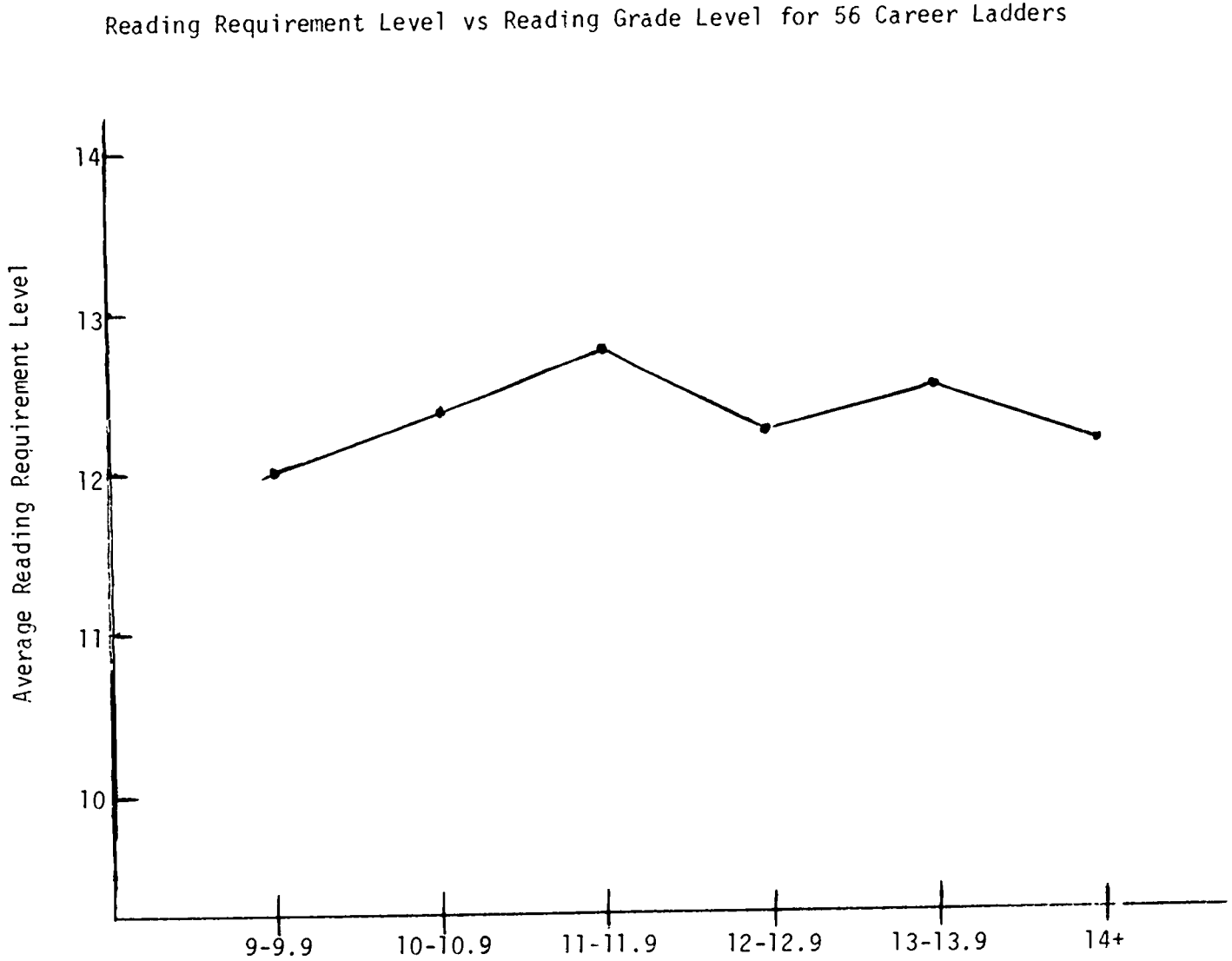

Figure 1. **Average reading grade level of personnel**

In light of these considerations, it appears necessary that a new philosophy of reading training be implemented in the Air Force, especially with respect to the unique problems associated with adult education. Such a philosophy has been suggested and is currently being demonstrated in an operational program at Ft Ord, California (Sticht, 1973). The approach has been referred to as Job-Specific Literacy Training or Job-Oriented Reading Training, and basically, it involves training directed towards improving those skills associated with the performance of job reading tasks. Utilizing such an approach, course materials consist almost entirely of job-related reading materials. In fact, actual publications from related career ladders may be used as instructional material. The reading skills in which an individual might receive training include, but are not limited to, such skills as the use of indexes, following procedural directions, extracting information from job manuals, locating job-related information, and technical vocabulary training. Empirical support for this approach has been provided by Sticht and Caylor (1973) who compared the performance of 2 groups of low-ability readers (5th RGL) on a Job Reading Task Test (JRTT). Of the 2 groups, one consisted entirely of new Army recruits, whereas, the second consisted of men who had previously undergone 8 weeks of job training in the areas represented by the JRTTs. Although both groups of men had the same reading ability level, the job-trained men performed significantly better on the JRTTs in 3 Army occupational specialties. This study indicates that job training can result in the improvement of certain job-related reading skills, while leaving "general" comprehension skills as measured by standardized reading tests, unaffected.

If, as the available research evidence suggests, it is possible to selectively improve job-related reading skills through a job-oriented reading improvement program, then one of the major problems facing existing Air Force reading improvement programs could be dealt with. Simply, "remedial" reading with all its negative connotations could be replaced by supplementary job reading training which carries no stigma whatever since the participant is actually training for his Air Force job. This would be especially true if the job-oriented reading training could be enclosed in self-contained modules which the student could proceed through at his own rate. Actually, reading improvement training could be divided into two phases. The first, job-oriented reading training, could be concerned with the improvement of job-related reading skills so that the individual would have the skills necessary for successful performance in OJT and on-the-job. A second phase, career reading improvement, could be concerned with the development of more general "comprehension" skills, and this phase could be much longer in duration, and having as one of its general goals a certain increase in an airman's scores on standardized reading measures. Based on available evidence (Mockovak, 1974a), it appears that this second phase of reading training could best be accomplished through Veteran's Administration (VA) funded programs arranged through base education offices. These programs would be entirely voluntary and could be terminated by the student at any time. VA funded programs are considered to be a viable alternative because sufficient money exists to attract qualified instructors familiar with adult reading problems. In addition, the airman's involvement in a VA program would also bring him into contact with other VA supported educational opportunities, therefore, the impetus may exist for the airman to continue his other career-oriented educational efforts. It is especially important to emphasize, however, that although the job-oriented reading training would be mandatory, it should not be referred to as "reading training" because its function would not be to replace general reading improvement training which is more long-term in nature (Phase II) and which should be conducted on a more voluntary basis. Practical experience has shown quite clearly that attempting to force a person to read is not only expensive and time consuming, it is also a wasted effort in the vast majority of cases.

The two phases of the suggested reading training program address 2 different sets of reading skills, but the key to success in either case is motivation. In Phase I, the motivation should result from an individual's involvement in his career specialty and his training for that specialty. In Phase II, the motivation must ultimately come from the individual himself and a desire on his part for self-improvement. A case in point concerns one voluntary enrollee in a base reading improvement program. This individual enrolled in the program because he wanted to read stories to his small child. Obviously, if the Air Force could generate similar enthusiasm in other individuals with poor reading skills, a great many reading problems could be resolved.

From the preceding discussion concerning possible solutions to the Air Force's reading problems, it appears obvious that any overall plan of action will require systematic, diverse, long-term solutions which are well coordinated between the various major commands. The purpose of the present study, however, was not to demonstrate a solution, but rather to demonstrate a methodology which could be used to determine the reading requirements imposed on Air Force personnel as they advanced through their Air Force careers. In addition, a related goal was to provide reliable estimates of the reading ability of personnel in different career ladders in order to establish realistic readability specifications that could be used by both civilian and military technical writers in the preparation of training materials.

On the basis of the results obtained in this study, it appears that the Air Force has significant literacy gaps in a number of career ladders. However, as was mentioned previously, a literacy gap of some extent will almost always exist for a certain percentage of individuals in *any* given career ladder. It should be emphasized that a literacy gap, per se, may not become a problem unless the additional burden placed on the training system is so severe that the system cannot cope with it. This situation has occurred more frequently in OJT than resident training simply because resident training courses are better equipped in terms of resources and personnel to provide supplemental sources of information to problem readers. At any rate, it is probably a fair assumption to say that literacy gaps reduce training effectiveness, and indirectly, if not directly, increase the costs associated with educating and training Air Force manpower.

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APPENDIX A

Estimated Average Reading Grade Level of USAF Personnel by Career Ladder

Population Description - USAF Enlisted Personnel
(5 skill level and below) on Active Duty as of March 1974

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
200X0	1	15.0	15.0
202X0	1426	14.2	13.2
203X0	32	14.2	12.5
203X1	1934	14.4	13.6
204X0	571	12.8	11.6
205X0	301	14.3	13.6
206X0	537	14.2	13.0
207X1	1929	12.0	10.8
207X2	994	12.0	10.8
221X0	188	12.5	11.3
222X0	62	12.8	11.6
222X1	39	12.9	11.8
223X0	119	12.1	10.4
223X1	472	12.1	10.4
230X0	3	10.6	9.9
233X2	123	11.1	8.8
233X4	536	11.4	9.2
234X0	277	12.4	11.2
235X0	27	12.1	10.6
235X1	3	14.2	13.8
236X0	65	12.0	10.0
236X1	324	11.6	9.4
237X0	26	11.4	8.9
237X1	17	10.4	8.7
241X0	45	12.3	11.1
242X0	24	12.4	11.4
250X0	6	14.1	12.9
252X1	1204	14.3	13.4
253X0	20	14.2	13.0
270X0	11	12.5	11.3
271X0	1568	10.6	8.9
272X0	2066	12.4	11.2
274X0	478	12.2	11.0
276X0	2495	11.9	11.0
276X1	24	12.0	11.0
290X0	1	10.0	10.0
291X0	5538	11.5	9.7
293X3	1074	11.7	10.5
295X0	109	12.0	11.2
296X0	3	12.5	12.0
300X0	7	12.5	11.6

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
302X0	618	12.6	11.6
302X1	34	12.6	11.8
303X1	874	12.4	11.4
303X2	1594	12.4	11.3
303X3	695	12.4	11.3
304X0	2063	12.4	11.3
304X1	592	12.5	11.4
304X4	4096	12.4	11.3
304X5	138	12.1	10.6
304X6	68	12.2	11.0
305X4	1582	12.5	11.4
306X0	1361	12.6	11.6
306X1	396	12.7	11.8
307X0	1193	12.5	11.4
308X0	17	12.8	11.8
309X0	38	12.2	11.1
310X0	14	11.8	10.8
316X0	2020	12.4	11.3
316X1	779	12.4	11.4
316X2	258	12.5	11.4
317X0	445	12.6	11.5
320X0	12	11.6	10.1
321X0	462	12.5	11.5
322X1	1785	12.5	11.5
323X0	366	12.6	11.5
324X0	1363	12.8	11.9
325X0	942	12.4	11.4
325X1	1435	12.4	11.2
326X0	155	12.5	11.4
326X1	473	12.6	11.6
326X2	690	12.4	11.3
327X0	212	12.4	11.4
328X0	1337	12.3	11.3
328X1	1348	12.3	11.2
328X2	129	12.2	11.0
328X3	1288	12.4	11.4
328X4	1024	12.4	11.3
329X0	369	12.5	11.3
340X0	3	12.6	11.5
341X1	123	12.6	11.5
342X0	361	12.7	11.7
342X1	52	12.5	11.4
343X0	129	12.6	11.6
344X0	41	12.0	10.9
345X0	20	12.7	11.8

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
360X0	3	11.1	9.5
361X0	621	9.3	7.8
361X3	128	9.3	7.7
361X4	449	9.5	7.8
362X1	707	11.1	9.7
362X2	151	12.0	10.7
362X3	81	11.2	9.9
362X4	592	10.5	9.1
363X0	1289	11.4	10.1
390X0	1	12.3	12.3
391X0	449	12.1	11.0
400X0	5	10.8	9.5
403X0	54	11.9	10.6
404X0	216	11.0	9.5
404X1	95	11.3	9.9
420X0	23	8.7	7.4
421X1	375	9.4	7.9
421X2	1989	9.1	7.6
421X3	4315	9.7	7.9
422X0	97	10.6	9.2
422X1	1077	9.3	7.8
422X2	684	9.9	8.3
423X0	2040	10.2	8.5
424X0	1118	9.0	7.7
424X1	170	9.3	7.8
425X0	277	11.1	9.6
430X0	63	8.6	7.3
431X0	999	10.5	8.9
431X1	24844	9.9	8.4
432X0	6591	9.6	8.0
432X1	424	9.8	8.2
433X0	214	10.1	8.6
435X0	12	10.5	9.5
440X0	6	9.0	8.2
442X0	59	10.3	8.8
443X0	1293	10.0	8.4
460X0	1	12.1	12.1
461X0	2899	10.5	9.0
462X0	8245	10.5	8.9
463X0	1033	12.7	11.7
464X0	49	11.4	10.0
470X0	4	8.2	6.5
472X0	410	9.9	8.0
472X1	843	9.5	7.8
473X0	1585	10.0	8.2

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
473X1	305	9.6	8.0
510X0	3	13.0	13.0
511X0	1760	13.6	12.1
511X1	414	14.4	13.0
511X2	9	13.2	12.0
530X0	5	10.1	9.0
531X0	457	10.2	8.5
532X0	600	9.5	7.9
533X0	186	9.5	7.7
534X0	2052	9.6	8.1
535X0	945	9.7	8.0
536X0	347	11.2	9.5
540X0	5	11.2	9.3
541X0	464	11.3	9.6
542X0	1138	10.8	9.2
542X1	445	10.7	9.0
543X0	2019	9.7	8.0
544X0	226	9.8	8.4
545X0	1216	10.4	8.6
546X0	369	10.2	8.5
547X0	1261	9.4	7.7
550X0	1	8.0	8.0
551X0	1606	9.2	7.6
551X1	1306	9.4	7.8
552X0	1439	9.7	8.0
552X3	341	9.2	7.6
552X4	634	9.6	8.0
552X5	1099	9.4	7.7
553X0	372	12.5	11.5
554X0	226	12.4	11.3
555X0	325	10.1	8.4
563X0	743	9.4	7.8
566X0	237	12.0	10.6
571X0	4619	10.0	8.4
580X0	1	6.7	6.7
581X0	421	9.3	7.6
582X0	399	9.0	7.5
591X0	38	10.5	3.7
591X1	17	10.3	8.4
600X0	2	9.0	8.8
601X4	342	9.9	8.5
602X0	849	9.9	8.6
602X1	704	9.9	8.5
603X0	4671	9.4	7.7
605X0	1182	10.7	9.4
605X1	2476	9.8	8.3

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
607X0	382	10.4	8.9
611X0	752	10.1	8.5
612X0	95	10.2	8.6
620X0	1	10.0	10.0
621X0	265	9.8	8.4
622X0	3774	9.8	8.5
622X1	259	11.0	9.1
631X0	4381	9.9	8.5
640X0	3	12.0	11.3
645X0	10397	11.2	9.3
647X0	6184	9.9	8.5
648X0	253	12.0	10.2
650X0	2	11.3	11.2
651X0	414	12.0	10.9
671X1	1060	12.9	12.0
671X3	2786	13.0	12.1
672X0	75	12.9	12.0
673X0	3	13.8	13.5
690X0	2	12.8	11.5
691X0	179	12.8	11.7
700X0	5	10.6	9.0
701X0	375	12.1	11.0
702X0	18736	10.3	8.7
704X0	35	11.1	9.5
705X0	225	11.4	10.0
711X0	310	10.4	8.6
713X0	92	11.2	9.0
713X1	81	10.2	8.5
730X0	15	11.5	10.3
732X0	4305	11.6	10.3
732X1	217	11.7	10.4
732X3	23	11.9	10.8
732X4	111	11.7	10.4
733X0	6	12.5	11.6
733X1	22	12.6	11.6
734X0	116	11.5	9.8
741X0	687	10.7	8.9
741X1	462	10.7	8.9
742X0	81	12.3	10.7
751X0	189	12.4	11.1
751X1	336	12.0	10.4
751X2	378	12.2	10.8
751X3	16	12.9	11.6
753X0	194	12.1	11.0
753X1	3	9.5	8.7
790X0	1	14.5	14.5
791X0	520	14.1	12.7

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
791X1	131	13.2	11.9
811X0	17621	10.0	8.7
812X0	7237	11.4	9.6
812X1	28	11.3	9.2
821X0	25	13.0	12.0
871X0	717	12.2	10.2
871X1	71	13.0	11.6
900X0	202	12.4	11.4
901X0	420	12.3	11.2
902X0	5837	12.2	11.1
902X2	650	12.4	11.3
903X0	778	12.5	11.3
904X0	1138	13.0	11.7
904X1	33	12.8	11.5
904X2	20	12.9	11.8
905X0	409	12.5	11.3
906X0	2026	12.2	11.0
907X0	283	12.5	11.3
908X0	439	12.5	11.3
908X1	32	12.5	11.3
909X0	8	14.8	14.5
909X2	13	12.1	10.8
911X0	215	12.3	11.2
912X0	24	12.2	11.2
912X1	15	12.0	11.1
912X2	21	12.4	11.3
912X3	39	12.5	11.5
912X4	80	12.3	11.2
912X5	117	12.3	11.1
913X0	132	12.6	11.4
913X1	40	12.6	11.4
913X2	26	12.7	11.7
914X0	183	13.0	11.8
914X1	265	12.5	11.3
915X0	878	12.0	10.8
916X0	47	12.6	11.2
920X0	2	9.0	8.5
921X0	133	12.8	11.6
922X0	1313	10.4	8.8
923X0	187	12.5	11.2
981X0	1601	12.2	11.1
981X1	137	12.2	11.0
982X0	370	12.4	11.1
990X0	4111	11.4	8.9
990X5	28	11.7	9.4

* One standard deviation below mean

AFSC	N	Average Reading Grade Level	Reduced Reading* Grade Level
990X6	10	11.5	9.2
990X9	124	14.5	13.6
991X0	21	12.4	10.6
991X1	2	10.0	8.5
991X5	831	14.3	12.7
991X6	50	12.1	10.2
991X7	164	14.4	12.7
991X8	78	12.5	11.2

* One Standard deviation below mean

Average RGL for all personnel (272,720) is 10.8