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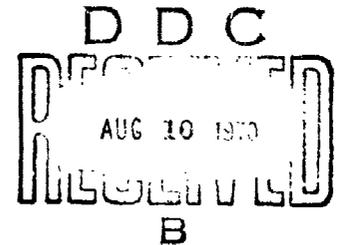
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Readability, Reading Ability, and Readership

by

Richard P. Kern, Thomas G. Sticht, and Lynn C. Fox

Presentation at the
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Prefatory Note

This paper was presented at the 15th Annual Army Human Factors Research and Development Conference, held at the U.S. Army Training Center, Infantry, in Fort Ord, California, in November 1969. The paper was presented at the session titled, "Behavioral Science Research and Development in Support of Army Training Center Operations." Dr. Kern presented the paper.

Research reported in the paper was performed under Work Unit REALISTIC, Determination of Reading, Listening, and Arithmetic Skills Required for Major Military Occupational Specialties, at the Human Resources Research Organization, Division No. 3, Presidio of Monterey, California.

READABILITY, READING ABILITY, AND READERSHIP

Richard P. Kern, Thomas G. Sticht, and Lynn C. Fox

This paper will describe some of the research under HumRRO Work Unit REALISTIC, which is concerned, in general, with the evaluation of literacy requirements of Army military occupational specialties. Two different approaches for determining literacy requirements of Army jobs are being taken. In one, we are comparing the performance of job incumbents on reading, listening, and arithmetic tests with their performance on job sample tests. From these comparisons, we hope to identify literacy skill levels adequate for performing at various levels of job proficiency. (This approach and the data obtained will be recorded in a future report.)

In our second approach for evaluating literacy requirements of different jobs, we are determining tasks that job incumbents perform using either reading or arithmetic materials. Samples of these materials are examined and classified with regard to the literacy or arithmetic skills needed. At the present time, our scheme for classifying materials according to their literacy requirements is being developed. However, one component that is presently available and useful in determining the degree of difficulty of the literary stype of printed materials is the "readability formula." In this paper we will present the results of an assessment of reading requirements for five MOSs as indicated by the readability of publications used in the MOSs. We will also compare the readability of the publications with the reading abilities of men working in the five MOSs. Data concerning the actual usage of printed material on the job by individuals at different reading ability levels will also be given.

THE MEASUREMENT OF READABILITY

The term "readability" refers to the comprehensibility of a publication—how easy it is to read and to understand. Generally speaking, indices of readability are established by following three basic steps. First, a number of style factors, such as average sentence length, number of syllables per word, and number of words occurring with low frequencies in general English usage, are identified. Second, the number of occurrences of such factors in selected reading passages is correlated with performance on comprehension tests based on the passages. Third, regression equations are derived which state the functional relationships between the style factors and performance on the comprehension tests.

In the analyses described in this paper, a modification of a formula devised by Flesch in 1948 (1) for the assessment of reading difficulty

of Army publications was used. The raw score indices obtained with the Flesch formula were converted directly into school grade equivalents by means of a specially prepared table (1).

The Readability of Key Publications in Five MOSs

Estimates were obtained of the reading difficulty of major publications in MOSs 11E, Armor Crewman; 63C, General Vehicle Mechanic; 76Y, Unit and Organizational Supply Specialist; 91A, Medical Corpsman; and 94B, Cook. These were selected for study because of our activities in HumRRO Work Unit UTILITY where job performance data are being collected for Category IV and non-Category IV personnel¹ in these combat and combat support MOSs. Data concerning literacy skills of these personnel are being collected under Work Unit REALISTIC. With information about personnel literacy skills and information concerning the readability of materials in these MOSs, it is possible to determine to what extent discrepancies exist between personnel reading skill levels and the reading skill levels required for satisfactory comprehension of the job publications.

Criteria for the study of MOSs 11E, 63C, 76Y, 91A, and 94B in both Work Units UTILITY and REALISTIC include the following:

(1) These MOSs are high density for Category IV personnel, and adequacy of literacy and arithmetic skills are of special concern for these lower aptitude men.

(2) These MOSs have a degree of generality across the various Armed services and civilian occupational specialties.

(3) These MOSs represent a wide range of military skill areas (e.g., Combat, Clerical, Technical, Mechanical) and literary and arithmetic requirements as provided in Army Regulation 611-201 (2).

The publications evaluated in each MOS were designated as either key publications, basic and essential to the adequate performance of the job, or as publications of general use to job personnel. This designation was determined by Army personnel serving as content experts for the preparation and administration of job performance tests in Work Unit UTILITY.

In evaluating the reading difficulty of each publication, a 10% sample of the pages in each of the selected publications was taken. For instance, if a publication contained 100 pages, every tenth page was included in the sample. Only those pages that contained at least one sample of a 100-word section of connected discourse were used. Thus, if the tenth page was an illustration, one of the adjacent pages containing a 100-word sample of discourse was evaluated.

For each publication, the average grade level of difficulty was computed. The average of these averages was then computed for each MOS. Table 1 presents a summary of the readability analyses (for a

¹Armed Forces Qualification Test scores: Category I (93-99); Category II (65-92); Category III (31-64); Category IV (10-30); the new standards men (10-15).

Table 1
Readability Scores for Selected Publications in Five Army MOSs

MOS	Number of Publications	Number of Pages Sampled	Range of Flesch Readability Levels - (SGE)*	Average Readability (SGE)*
76Y Unit and Organizational Supply Specialist	11	64	8.5 - 16+	16+
94B Cook	6	93	7.0 - 16+	12.5
11E Armor Crewman	5	87	6.0 - 16+	11.0
91A Medical Corpsman	3	55	6.0 - 16+	10.0
63C General Vehicle Mechanic	3	100	7.0 - 16+	14.5

*SGE = School Grade Equivalent

more complete report, see Sticht (3), in preparation). This table shows the total number of publications and pages sampled in each MOS, the range of reading difficulty levels found over all pages, and the average grade level of readability of materials in the MOS.

The data of Table 1 show a wide range of difficulty levels for the materials in each MOS. Additional analyses indicated that of the 11 publications studied in the Supply MOS (76Y), eight had average readability scores of 16+, with the remaining three scoring at grades 14.5 or 15 on the average. Next to Supply, the Mechanic (MOS 63C) publications were most uniformly difficult, with all three examined publications showing an average readability score of 14.5. The MOS having the lowest difficulty level material was MOS 11E, Armor Crewman. Two training circulars in this group had average readability scores of 7.0. These circulars were produced from prototype materials developed by HumRRD to be especially effective for slow learners.

Readability and Reading Ability

The averages from Table 1 are shown graphically in Figure 1. In this figure, the average grade level of readability of materials is indicated, as is an indication of the average reading grade level scores of a sample of Army personnel working on jobs within each of the MOSs. Reading ability was assessed by means of the Survey of Reading Achievement, Junior High Level, California Test Bureau. The reading ability data are provided separately for lower aptitude men in Mental Category IV and non-Category IV men. The Figure 1 "New Standards" column presents the median reading ability of 46,000 new standards men (i.e., men accessed under Project 100,000 with AFQT scores in the 10-20 range). The label "Control," Figure 1, presents the median reading ability of non-new standards men. These reading ability data are from the OASD/M&R report (4) which summarized data concerning Project 100,000. These reading scores were obtained using a different test (Metropolitan Achievement Test - Intermediate Level) than used in the present research to assess the skill levels of the men in various MOSs. The similarity of assessed reading skill levels obtained with the two different tests under widely differing circumstances

Readability of Publications in Use in Various MOSs

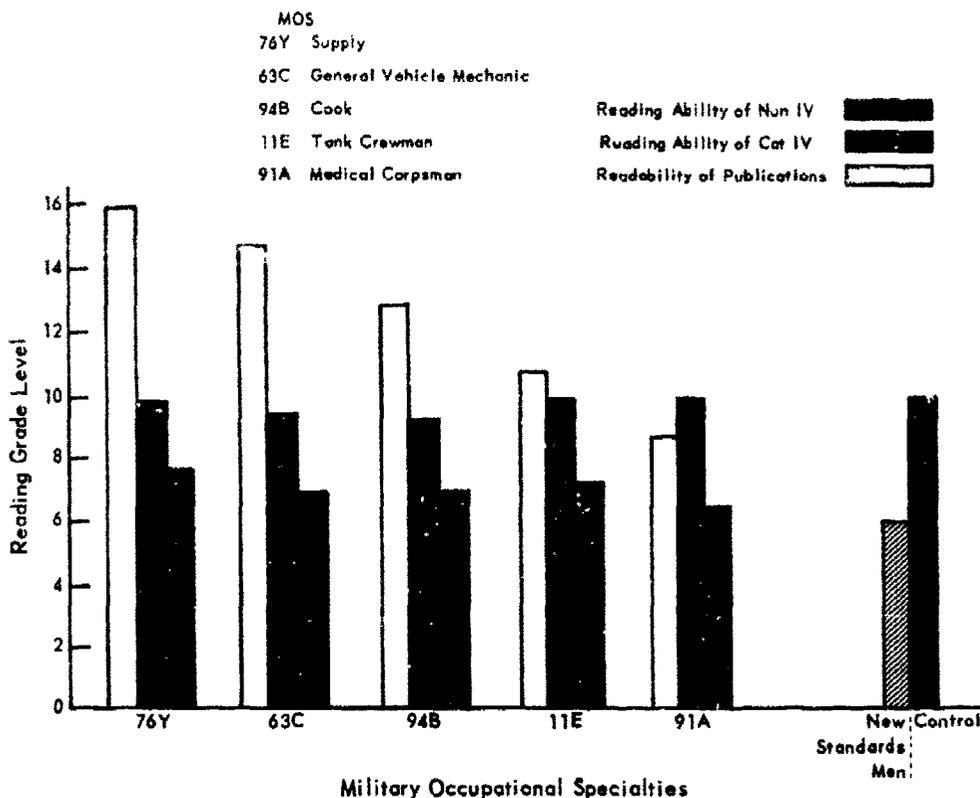


Figure 1

suggests that the estimates of reading skills for each MOS presented in Figure 1 are accurate estimates.

Of particular interest in Figure 1 are the discrepancies between the reading abilities of the personnel in a given MOS and the readability of the related publications. If the readability formula provides even a roughly accurate index of the difficulty of the material, then it is suggested by Figure 1 that Army personnel would have considerable difficulty in reading and comprehending the materials in MOS 76Y, Supply; 63C, Mechanic; and 94B, Cook.

In general, the greater the gap between readability and reading ability, the less comprehensible the materials are likely to be for the man on the job. It is also quite possible that the gap between the reading ability of the men in an MOS and the readability of materials may influence the extent to which, or the way in which, men attempt to

use job-related printed materials. Information bearing on the relationships between reading ability, readability, and readership, that is, extent and nature of use of printed materials by men on the job, is also being collected in Work Unit REALISTIC. Some early data analyses bearing on the relationships between reading ability and readership have been developed.

READING ABILITY AND READERSHIP

Our studies of readership are concerned with three MOSs: Unit and Organizational Supplyman, Cook, and General Vehicle Mechanic. The material presented in the remainder of this paper will deal with on-the-job reading behaviors of General Vehicle Mechanics.

We collected data on the reading behaviors of mechanics through administration of a structured interview. This interview was individually administered to 137 mechanics assigned to 66 different unit motor pools of a mechanized infantry division. Mechanics were selected for interview on the basis of three criteria: AFQT scores, total months of job experience in the MOS duty position, and reading achievement test scores. Interviewees were selected to form two levels on AFQT (Category IV vs. Categories I-III), three levels of job experience (0-8, 9-18, and 19 months or more), and three levels of reading achievement test scores (Reading grade levels 4-6.9; 7-8.9; and 9.0 and over). Table 2 shows the resulting 2 X 3 X 3 matrix.

Cell entries in Table 2 represent the number of mechanics interviewed in that particular subcategory. We had set a goal of obtaining 10 mechanics for interview in each cell. We experienced our greatest difficulty in finding individuals at the low reading achievement level who also scored 30 or above on the AFQT. And as would be expected, our next greatest problem was finding individuals at the high reading level who, at the same time, scored below 30 on the AFQT. Difficulties in filling these cells were not unexpected, of course, since we have found that correlations between AFQT and reading achievement scores range around .60 to .70.

After identifying mechanics for interview on the basis of these scores, research staff members went into the motor pools and carried out a structured interview with the man in his work area. Each man was asked to give five examples of times during the previous month when he had used printed material in connection with carrying out a

Table 2
Criteria Used to Select General Vehicle Mechanics for Readership Study^a

Reading Grade Level	Mental Aptitude Category					
	Category IV			Non-Category IV		
	Time on Job (months)					
	0-8	9-18	19+	0-8	9-18	19+
4 - 6.9	9	11	7	5	1	0
7 - 8.9	7	9	14	10	8	13
9.0+	5	5	3	8	7	15

^aCell entries indicate number of mechanics interviewed for that subcategory.

job. In each case he was asked to describe the job he had been performing and what information he had been seeking when he went to the printed material. He was also asked to secure a copy of the printed material involved in each example. When this was accomplished, he was asked to show the interviewer the specific parts of the material he had used and where he had finally obtained the information he was seeking. Other questions were also asked during the course of the interview.

The major aspects of the interview data presented here are concerned with readership of printed job materials. In other words, "Who reads the printed material?" and "To what extent do they use it?" As indicated, each individual was encouraged to recall five different instances during the preceding month when he had used printed material in connection with job duties. When the interview procedure was designed, five instances of the use of printed material had not seemed to be a very stringent requirement even for poor readers who might have difficulty in utilizing printed materials. Therefore, we were surprised that very few individuals could recall five different instances of the use of printed material—most were able to cite only one or two. Many indicated that they rarely used printed materials and that the one or two instances they cited were the only times they had used printed materials while on the job.

On the basis of our interview procedure, we assumed that the number of instances cited of use of printed material reflected the relative extent to which our different sub-groups used printed materials on the job.

These data are presented in Figure 2 for Category IV and non-Category IV personnel separately. The number of instances of the use of printed material is shown as a percentage of the total number the particular sub-group could have given if each individual had reported the full five instances requested.

Reported instances of use of printed material increase in number as one moves from the low reading achievement group to the high group. This trend appears most pronounced among Category IV personnel. Simple analyses of variance were carried out separately for the Category IV and non-Category IV groups. These analyses support the interpretation of the trend shown in Figure 2 for Category IV personnel. The analyses do not support the trend suggested in Figure 2 for the non-Category IV personnel.

In other words, the tendency for Category IV personnel to use printed material on the job is greatly enhanced if they can read at or beyond the ninth-grade level. For non-Category IV personnel differences in reading achievement levels do not appear to appreciably influence their tendency to use printed material.

We also examined our data to see whether increased job experience influenced extent of usage of printed materials. Separate analyses of variance for the Category IV and non-Category IV personnel were carried out. In neither case is there evidence to support the notion of a direct relationship between job experience and extent of usage of printed material.

Comparison of the Readability of Job Materials for Men of High and Low Aptitude

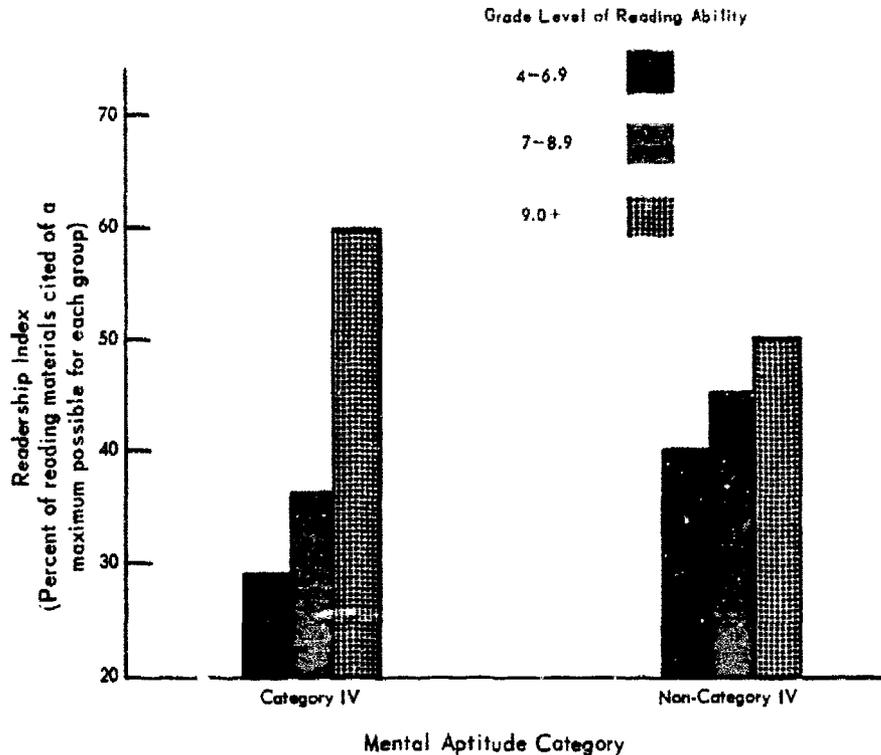


Figure 2

These readership data can be summarized by emphasizing two points. First, there appears to be a relationship between reading achievement level and usage of printed materials only among Category IV personnel.

Second, I would like to point out that our data suggest a low extent of usage of printed materials by all personnel interviewed. Earlier in this paper findings are reported that describe the average reading difficulty levels of mechanics' manuals as being approximately five to six achievement grade levels above the reading achievement levels of the personnel. It is reasonable to assume that if personnel find printed material too difficult to read, they will avoid using it. It is also generally recognized that the types of difficulty men encounter in attempting to use their printed MOS materials are not restricted simply to sentence and word length problems.

In addition to these factors, it appears to us that a description of the difficulty level of these materials must also consider content orientation and format as factors affecting comprehension and ease of retrieval of information likely to be sought by the man on the job.

With this more general definition of difficulty of material in mind, we are interested in developing a broader description of job reading behaviors of personnel. We are interested in describing both reading behaviors required by the materials and those performed by personnel who have different reading achievement levels. In this connection, we have developed a tentative list of descriptors or categories that we are currently attempting to use to describe both information sought by the user and content of the printed material. The present tentative version of these content-type categories is shown in Table 3.

Table 3

Definition of Content-Type Categories

1. **Standards and Specifications:**
Content setting forth specific rules or tolerances to which task procedures or the completed product must conform.
2. **Identification and Physical Description:**
Content attempting to symbolically represent an object via an identifying code (stock number, nomenclature) and/or by itemizing its distinguishing physical attributes.
3. **Procedural Directions:**
Content that presents a step-by-step description of *how* to carry out a specific job activity. Essential elements are equipment/materials/ingredients to be used, and how they are to be used, with presentation organized in a sequential step-wise fashion.
4. **Functional Description:**
Content that presents an operating (cause and effect, dependency relationships) description of some existing physical system or subsystem, or an existing administrative system or subsystem.
5. **Procedural Check Points:**
Content that presents a key word or highly summarized version of *what* should be done in carrying out a task rather than how it should be done. This content differs from the content classified under Procedural Directions in that it assumes the user knows how to carry out the steps once reminded that the step exists and/or reminded of the decision factors that determine whether the step is required.
6. **Theory:**
Content that describes a system of interrelationships among factors in a generalized physical subsystem or system (e.g., internal combustion engines), a generalized version of an administrative system, or in any type of abstract conceptual system.

These categories were chosen to reflect functional differences in the orientation of purpose of the content. Or, stated another way, when applied to printed material these categories attempt to identify the type of information the reader was apparently expected to extract. Thus, they should also be useful in describing information sought by the user when he enters printed material. We are interested in using the relationships found between type of information sought and type of content (along with type of format) to describe different job reading tasks.

The general notion of job reading tasks that we are using can be expressed by contrasting two examples of the use of printed material to obtain the same information. In the first example, an individual obtains the gap specification for a spark plug (Information sought: Standards and Specifications) from the context of narrative style material oriented toward describing the functioning of the ignition system (Content type: Functional description, narrative format). In contrast, consider the example of an individual who obtains the same information (Standards and Specifications) from a tabular display of ignition system specifications (Content type: Standards and Specifications, tabular format). These two individuals are performing job reading tasks that differ in nature. These two tasks quite likely require different reading skills and behaviors and probably also differ in difficulty if assessed by a performance test.

Another type of reading task that requires attention is the task imposed on the individual indexes such as those found in technical maintenance manuals. Psychologists have long been interested in group and individual differences in the ability to use abstract versus concrete category concepts in sorting or retrieving from given sets of cards, words, and objects. Indexes pose a similar task.

During the interviews we had the opportunity to observe each individual while he was attempting to locate information he had previously used in technical maintenance manuals. Our observations suggest that most of these men are able to find specific information in these manuals only after extremely diligent, time-consuming search. No doubt in most instances the information was subsumed in some fashion in the index and the man simply did not know how to use the index.

Most importantly, however, what we're probably observing is a version of the conceptual sorting task problem where trial and error sorting of a large mass of information must take place before a pattern of sorting rules begins to emerge and be recognized as such by the subject. This type of sorting problem, of course, is a very difficult conceptual task and poses a real obstacle for an on-the-job user. It would be likely to cause him to seek his information elsewhere or to do without it.

The studies of the performance of different AFQT and reading achievement groups on the various reading tasks we expect to identify will, I believe, result in knowledge directly relevant to the problem of designing more effective printed job materials and the problem of estimating reading skill requirements for jobs.

SUMMARY

We have presented data describing large discrepancies between the reading difficulty levels of printed materials used in certain MOSs and the relatively lower reading ability levels of men assigned to these MOSs. We have also given some initial data exploring the relationship between reading ability and utilization of printed materials on the job. We have suggested that the low level of on-the-job utilization

of printed materials found in the data is probably related to the difficulty of reading tasks these materials currently require of the reader. And, finally, we outlined an approach we are using for identifying on-the-job reading tasks and studying their reading skill requirements.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Armed Forces Qualification Test Scores						
Army MOS Publications						
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Literacy Skills						
Literacy Requirements						
Reading Achievement Levels						

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