University of Central Florida

STARS

Derivation Of New Readability Formulas (Automated Readability Index, Fog Count And Flesch Reading Ease Formula) For Navy Enlisted Personnel

1-1-1975

J. Peter Kincaid

Robert P. Fishburne Jr.

Richard L. Rogers

Brad S. Chissom

Find similar works at: https://stars.library.ucf.edu/istlibrary

University of Central Florida Libraries http://library.ucf.edu

Recommended Citation

University of Central Florida

STARS

Showcase of Text, Archives, Research & Scholarship

NAVAL TECHNICAL TRAINING COMMAND

RESEARCH BRANCH REPORT 8-75

DERIVATION OF NEW READABILITY FORMULAS (AUTOMATED READABILITY INDEX, FOG COUNT AND FLESCH READING EASE FORMULA) FOR NAVY ENLISTED PERSONNEL

FEBRUARY 1975

CHIEF OF NAVAL TECHNICAL TRAINING

NAVAL AIR STATION MEMPHIS – MILLINGTON, TN

DERIVATION OF NEW READABILITY FORMULAS (Automated Readability Index, Fog

Count and Flesch Reading Ease Formula) FOR NAVY ENLISTED PERSONNEL

by

J. Peter Kincaid   Lieutenant Robert P. Fishburne, Jr.

Georgia Southern College   MSC, USNR

Richard L. Rogers   Brad S. Chissom

Georgia Southern College   Georgia Southern College

Submitted by

N. J. Kerr, Ed.D., Head, Research Branch

Approved by

T. F. MULLANE, Captain, USN
Assistant for Training Methods, Research, and Evaluation

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Chief of Naval Technical Training	Unclassified
	2b. GROUP

3. REPORT TITLE

Derivation of New Readability Formulas (Automated Readability Index, Fog Count and Flesch Reading Ease Formula) for Navy Enlisted Personnel

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

J. Peter Kincaid, Robert P. Fishburne, Jr., LT MSC USNR, Richard L. Rogers, and Brad S. Chissom

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
February 1975	46	16

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
N61339-74-D-0082	
b. PROJECT NO.	RBR 8-75
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Chief of Naval Technical Training

13. ABSTRACT

Three readability formulas were recalculated to be more suitable for Navy use. The three formulas are the Automated Readability Index (ARI), Fog Count, and Flesch Reading Ease Formula. They were derived from test results of 531 Navy enlisted personnel enrolled in four technical training schools. Personnel were tested for their reading comprehension level according to the comprehension section of the Gates-McGinitie reading test. At the same time, they were tested for their comprehension of 18 passages taken from Rate Training Manuals. Scores on the reading test and training material passages allowed the calculation of the grade level of the passages. This scaled reading grade level is based on Navy personnel reading Navy training material and comprehending it. Thus, the three recalculated formulas (derived using multiple regression techniques) are specifically for Navy use. Furthermore, the formulas are directly interchangeable because they were all calculated using the same data base. That is, the ARI can be used when new material is being written, as the new material is usually typed anyway. The Flesch Formula is preferable when the Automated Flesch Count machine is available and existing material is being graded for reading difficulty. The Fog Count can be used when no equipment is available to aid the count. The use of these readability formulas should help the understanding of Navy training material when this material must be read by enlisted personnel.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
ARI (Automated Readability Index)						
Cloze Test						
FJP (Farr-Jenkins-Paterson)						
Flesch Formula						
Fog Count						
FORCAST Formula						
Readability						
Reading Comprehension						
Reading Level						
Technical Publications						

ACKNOWLEDGMENTS

SUMMARY

Three readability formulas were recalculated to be more suitable for Navy use. The three formulas are the Automated Readability Index (ARI), Fog Count, and Flesch Reading Ease Formula. They were derived from test results of 531 Navy enlisted personnel enrolled in four technical training schools at two Navy bases: Naval Air Station at Memphis, and Great Lakes Navy Training Center. Personnel were tested for their reading comprehension level according to the comprehension section of the Gates-McGinitie reading test. At the same time, they were tested for their comprehension of 18 passages taken from Rate Training Manuals. The average General Classification Test Score of the sample (54.7) is very close to the average GCT of the entire population of Navy enlisted personnel (54.3) indicating that the results should generalize to the entire population of Navy enlisted personnel. Scores on the reading test and training material passages allowed the calculation of the grade level of the passages. This scaled reading grade level is based on *Navy personnel reading Navy training material and comprehending it*. Thus, the three recalculated formulas (derived using multiple regression techniques) are specifically for Navy use. Furthermore, the formulas are directly interchangeable because they were all calculated using the same data base. That is, the ARI can be used when new material is being written, as the new material is usually typed anyway. The Flesch Formula is preferable when the Automated Flesch Count machine is available and existing material is being graded for reading difficulty. The Fog Count can be used when no equipment is available to aid the count. A simplified equation was calculated for both the ARI and Flesch Formula. Their use gives almost exactly the same result as the more complex formulas, and because they are easier to use, they should be preferable. Actually, there is only an error of about .1 grade level in using the simplified formulas and this is trivial.

A number of recent studies have suggested that readability formulas for military use should contain only a word difficulty measure, such as average word length or average syllables per word. Results of the present study indicate that a sentence difficulty measure adds accuracy in predicting how difficult a piece of Navy training material is to comprehend. Thus, the recommended formulas also contain a measure of sentence difficulty (average sentence length).

The use of these readability formulas should help the understanding of Navy training material when this material must be read by enlisted personnel. Currently, such material is written at a level well above the reading ability level of the personnel that must read it. Estimates of the average reading ability level of Navy enlisted personnel range between the ninth and tenth grades. Readability level of the material should be kept at the reading ability level of the personnel using it.

TABLE OF CONTENTS

INTRODUCTION

The ability of military personnel to understand narrative technical material has for many years been a problem. Studies conducted by all three military services have verified that the material that must be comprehended to do the job is written at a level of difficulty well above the reading ability of the man reading the material (Kincaid, 1967; Smith & Kincaid, 1970; Klare, 1963; Caylor, Sticht, Fox & Ford, 1972; Carver, 1973a, Duffy & Nugent, 1974). The effects of faulty communication are well known and disastrous. One recent Air Force study (Johnson, Relova & Stafford, 1972) has traced many costly errors to the reading difficulty level of the instructions in manuals to be followed. The more difficult the material, the more mistakes were made.

There are two basic ways to improve comprehension of written material by Navy personnel. The first is to improve the reading ability of the man using the material either by remedial instruction or by selecting men who have high reading ability. Remedial instruction requires a great deal of effort for significant gains in reading ability to be achieved. Selecting personnel with high reading abilities is getting progressively more difficult both because the average high school graduate is not reading as well as ten years ago and because of the new all-volunteer concept in the military services. Carver (l973b) estimates that the average reading ability of Navy enlisted personnel is about the ninth grade. Pinning (1974) estimated this reading ability to be 10.0 and projected that it would fall to 9.0 by the 1979-1982 time-frame. Duffy and Nugent (1974) measured the reading ability of 3,565 June, 1974, enlistees at San Diego. The mean reading ability according to the Gates-McGinitie Reading Test, Form D (for grades 4-6) was 9.8.

The other basic method of dealing with the problem is by making the material easier to read. One way of doing this is by using readability formulas. Readability formulas have been used as a method of estimating reading according to a grade level measure. The Army and Air Force have used these to good advantage in making technical material easier to read. Kincaid, Yasutake and Geiselhart (1967) and Smith and Kincaid (1970) validated one readability formula, the Automated Readability Index (ARI) for use with Air Force technical material. Air Force enlisted personnel found technical material written at the eighth grade level of difficulty according to the ARI easier to understand. This validation was used as the basis for requiring that all narrative sections of the C-5A Technical Orders be written at no more than the tenth grade level of difficulty according to the ARI.

Most readability formulas have been derived and validated on the general population. The Flesch Reading Ease Formula, the most widely validated and used of all readability formulas, has never been validated for use by military personnel. Caylor, *et al*., (1972) state that existing readability formulas have validity coefficients of about .70 for predicting the performance of school children on reading comprehension tests. Thus, they account for about 50 percent of the variability and this figure is probably lower with Navy enlistees reading and comprehending Navy training material. Prior to this study, we simply did not know how appropriate this readability formula or a number of others may be for Navy reading material with its characteristic style, format, and heavy use of technical words. It appears likely that the repeating of technical words in Navy technical material would tend to inflate the computed readability level beyond the actual difficulty experienced by the technician or technical training student reading the material.

A unique approach to the problem of deriving readability formulas specifically for military populations was undertaken by HumRRO (Caylor *et al*., 1972), who developed the FORCAST formula for the Army. This formula was derived from the testing of Army enlisted personnel. It does not offer the advantages of easy automation because it is based on a count of one-syllable words in a passage which is done most easily by hand. However the criterion measure approach used in the study can be used to recalculate existing readability formulas. In the study, a sample of training material was selected representing essential job reading material. Then a 395 subject sample of enlisted personnel was tested with a standardized reading test to assess the grade level of reading ability of each subject. The particular reading test used was the USAFI Reading Achievement Test III, Form A, Abbreviated Edition (a special printing of the Metropolitan Achievement Test, Advanced Battery). These same subjects were tested for their understanding of the selected reading passages using the cloze procedure. Every fifth word was left out and the subject's task was to fill it in. A passage was assigned a particular grade level in the case in which 50 percent of the subjects reading at that particular grade level scored 35 percent or better on the cloze test. Once the passages were graded, the multiple regression technique was used to derive a new readability formula specifically for Army use.

Readability researchers using multiple choice items have employed a criterion of 75 percent correct to indicate that a passage has been comprehended (e.g., Flesch, 1948). Rankin, and Culhane (1969) have shown that a score on the cloze test of 35 – 40 percent is comparable to a score of 75 percent on multiple choice questions. Since the cloze test is objectively prepared while the multiple choice items are at least partly subjectively chosen, the cloze method offers a real advantage.

The purpose of the present research project is to modify three readability formulas to correspond with Navy needs. Each is potentially useful in grading the reading difficulty of Navy narrative materials under varying conditions. Using the criterion approach developed by Caylor, et al., (1972), the ARI Fog Count and Flesch Reading Ease Formulas can be modified by recalculating new regression formulas. As a result, the three formulas will grade a given Navy narrative passage nearly the same and can be used interchangeably. This is an important result because the three formulas have varying degrees of usefulness in varying situations. For example, the ARI can be used when draft material is being typed or computer processed. Klare, Rowe, St. John, and Stolurow (1969) also have developed computer programs for calculating the Flesch Reading Ease Formula and the Fog Count. The count of syllables, used in both of these formulas, is accurate to within one percent. The ARI is calculated using a modified typewriter and a typed copy is produced as the formula factors are gathered. The Flesch Reading Ease Score and Fog Count can be calculated without special equipment. While the Flesch Reading Ease score has been more widely used, it takes longer to take the counts, if done manually, than the Fog Count according to Thomas, Hartley, and Kincaid (in press). However, Kincaid and McDaniel (1974) have developed a new machine automating the Flesch count. This machine cuts the time to take Flesch counts almost in half as compared with the manual taking of the count (McDaniel, 1974). Also the accuracy of the Automated Flesch Count as inferred from reliability is better than the manual method according to this study. The taking of both Flesch and Fog Counts does not require any special skills, such as proficiency in typing as is required to use the ARI. Also, the Fog Count does not require any special equipment which means the man

4

in the field can calculate the readability of existing material in the field situation using it. The

formula for the Flesch Count is quite complex and is best calculated either using a calculator or

by using conversion charts. The Flesch Reading Ease formula has associated with it a test-retest

reliability of .79 according to one study (Thomas, *et al.* in press). This same study indicates

test-retest reliabilities for the ARI and Fog Count to be much higher, .99 and .96 respectively.

Certainly the difficulty of calculating the Flesch Formula is a significant contributing factor.

Thus, there is a need to simplify the Flesch Formula for Navy use.

METHOD

Subjects

The sample consisted of 569 subjects from four schools at two Navy bases. Thirty-eight subjects were eliminated from the sample because of failure to follow instructions, illness, or because no GCT score was available leaving 531. Great Lakes Naval Training Center provided the following subjects: 191 BE/E students, 78 of which were in a remedial class, and 78 GM students from "A" and "C" schools. The Naval Air Station, Memphis, provided the following subjects: 242 ADJ students, and 246 AVA students. The subjects were predominantly new enlistees with less than six months in the Navy. Most were recent high school graduates. A small number of marines and several women were included in the sample. Testing was conducted in September and October 1974.

Subjects were chosen to be representative of the Navy enlisted population. The most important matching variable was GCT score. Pinning, (1974) reported the mean GCT of the Navy enlisted population to be 54.3 as of 1973. Standard deviation of the test is supposed to be 10. The average GCT of the sample used in the present study was 54.7, with a standard deviation of 8.03. Thus, the match was very close and the sample is representative of the population of Navy enlisted personnel. The mean ARI score for the sample was 52.8 with a standard deviation of 8.16.

Test Materials and Procedures

Eighteen passages of material totaling 3,067 words were used. Mean passage length was 170 words. Passages were selected from Rate Training Manuals deemed by specialists engaged

in the writing of these manuals to be representative. Manuals were chosen to represent ratings characterized by a full range of GCT scores. Also a number of manuals were chosen that deal with basic military requirements. However, no manuals dealing with electronics were chosen because for the most part, these manuals were classified.

Twenty-three passages were originally chosen from the manuals and pretested on a class of 30 students enrolled in an advanced undergraduate psychology class at Georgia Southern College. Every fifth word of each passage was deleted and a line of standard length was inserted for the subject to write his answer. On the basis of this pretesting, five passages were eliminated as being either too easy or too difficult. A number of others were shortened so that they could be completed faster.

Table 1 contains a list of the 18 passages, the manual from which they were selected, and their readability passages according to three standard formulas. Note that the average difficulty of the passages is about the twelfth grade. Appendix A contains the 18 passages and indicates which words were deleted for the cloze test.

Two forms of the Gates-McGinitie Reading Test were used to assess reading ability: Form E (intended for grade levels 7-9) and Form F (intended for grade levels 10-12). Subjects with GCT scores of 55 and above were administered the more difficult test and those with GCT scores below 55 were administered the easier test. Only the comprehension section of the test was given because this section directly measured the pertinent variable: comprehension of narrative material. The raw score on the test was converted to a grade level by interpolating from tables in the "Technical Supplement" to the reading tests.

3.

TABLE 1

GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH OLD FORMULAS

Passage Number	Name of Manual (Title of Passage)	NAVTRA No.	ARI	Fog Count	Flesch
1	Hull Maintenance Tech 3 + 2 (Temporary Repairs)	10573	10.6	12.4	8-9
2	Hull Maintenance Tech 3 + 2 (Preheating for Welding)	10573	20.3	15.9	16+
3	Ship's Serviceman 1 + C (Distribution and Ownership)	10287-E	13.3	12.9	13-16
4	Ship's Servicemen's Handbook (Washing)	10292-A	8.8	7.8	8-9
5	Petty Officer 3 + 2 (Personal Appearance of Petty Officers)	10056-C	9.5	8.0	8-9
6	Journalist 1 + C (Communiqués)	10295-A	12.4	12.8	13-16
7	Aerographer's Mate 1 + C (Wind Velocity and Fog)	10362-A	12.7	13.1	13-16
8	Aerographer's Mate 1 + C (General Circulation of Air Currents)	l0362-A	16.4	17.9	13-16
9	Fireman (Operating the Globe Valve)	10520-D	9.7	10.4	7
10	Aerographer's Mate 3 + 2 (Sea Wave Observations)	10363-D	13.1	14.4	13-16
11	Petty Officer 3 + 2 (Obtaining Water)	10056-C	7.8	7.0	8-9
12	Seaman (Rope Construction-Fiber Rope)	10120-F	16.7	16.0	10-12
13	Machinery Repairman 3 + 2 (Truing and Dressing the Wheel)	10530-D	13.4	12.5	10-12

TABLE 1 (Continued)

GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH OLD FORMULAS

Passage Number	Name of Manual (Title of Passage)	NAVTRA No.	ARI	Fog Count	Flesch
14	Machinery Repairman 1 + C (Cleaning Metals for Spray Metalizing)	10531-C	12.0	13.7	13-16
15	Petty Officer 3 & 2 (Role of the Navyman)	10056-C	9.7	11.6	8-9
16	Military Requirements for P01 & C (Operational Orders & Plans)	10057-C	13.5	14.0	16+
17	Basic Military Requirements (When to Salute)	10054-D	10.4	10.4	10-12
18	Basic Military Requirements (Uniforms of the Day)	10054-D	10.9	7.2	11.7
		$\bar{X} =$	12.3	12.1	11.7

Each subject received nine of the eighteen passages, the particular nine passages being assigned according to a Latin Square design.

Testing of subjects was done in groups, either in the classroom or in larger rooms with combined classes and took two hours. The reading test was administered first and this required 25 minutes. Each subject then proceeded to the cloze passages. In almost all cases, subjects had an opportunity to finish all nine cloze passages. Cloze tests were scored according to a strict criterion, that is, only minor misspellings were allowed. Otherwise the word was scored as being wrong.

RESULTS

Table 2 contains the scaled reading grade level for each of the eighteen test passages. These grade levels were calculated in the same way employed by Caylor, et al., (1972), That is, 50 percent of subjects with a reading ability at a particular grade level had to score 35 percent or better on the cloze test. Note the range of scaled reading grade levels to be. 5.5 to 16.3. This wide range results from the wide range of reading ability scores according to the two forms of the Gates-McGinitie Reading Test: from grade levels 6 to 16. It appears likely that the use of only the comprehension sections of the tests resulted in higher estimates of reading ability than would have resulted from the use of the entire test. However, comprehension rather than vocabulary and speed versus accuracy (the other two sections of the test) reflects most what this study addresses: that is, improving comprehension by Navy enlisted personnel of technical and training material read on the job.

A multiple regression statistical procedure was applied with scaled reading grade level for each of the passages serving as the criterion measure and the various formula factors serving as predictor variables. In the case of the three formulas to be recalculated, there was both a word difficulty factor and a sentence difficulty factor. The sentence difficulty factor for each of the ARI, Fog and Flesch Formulas is sentence length. The word difficulty factor for the Fog and Flesch Formulas is a syllable count. For the ARI, average strokes per word is the word difficulty measure.

Multiple regression techniques could not be applied to recalculate the Fog Count because the formula is not in the proper format. However, it can be noted that the original Fog Count tends to overestimate grade level of difficulty. the mean grade level of difficulty of the eighteen

TABLE 2

GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH NEW
FORMULAS, AND SCALED READING GRADE LEVEL OF TEST PASSAGES

Passage Number	Scaled RGL	ARI	Fog Count	Flesch Formula
1	6.9	8.5 (8.5)*	10.9	9.7 (9.7)*
2	16.1	18.3 (18.3)	14.4	16.7 (16.9)
3	16.0	12.4 (12.4)	11.4	12.7 (12.8)
4	10.9	7.9 (7.8)	7.3	8.2 (8.3)
5	7.0	8,6 (8.4)	7.5	7.1 (7.1)
6	16.0	11.3 (11.3)	11.2	12.3 (12.4)
7	12.0	11.3 (11.4)	11.6	11.7 (11. 8)
8	16.3	14.7 (14.9)	16.4	14.7 (14.9)
9	7.8	8.0 (7.9)	8.9	8.0 (8.0)
10	8.9	11.9 (11.6)	12.9	11.7 (11. 8)
11	9.0	7.0 (6.7)	6.5	8.1 (7.8)
12	16.1	12.6 (12.8)	13.5	11.8 (11.9)
13	8.9	11.5 (11.6)	11.0	10.0 (10.1)
14	10.8	10.6 (10.6)	12.2	12.5 (12.7)
15	5.5	7.7 (7.6)	10.1	8.4 (8.5)
16	11.8	12.7 (12.8)	12.5	13.8 (14.0)
17	5.8	10.2 (10.1)	9.9	9.3 (9.4)
18	9.8	10.6 (l0.5)	6.7	6.6 (6.7)
$\overline{X}$	10.9	10.9 0.0.9)	10.8	10.7 (10.8)

*Note: Grade levels in parentheses are calculated with simplified formulas.

12

passages is 12.1 as seen in Table 1. The mean scaled reading grade level of these passages is

10.9. The recalculated Fog Count takes this overestimation into account. The recalculated

Flesch and ARI formulas derived from multiple regression procedures, and the recalculated Fog

Count are shown in Table 3. The original Fog Count tended to overestimate the scaled grade

level of difficulty of the passages by about 1.5 grade levels. The new recalculated Fog Count

takes this into account by containing a correspondingly larger subtracted constant.

Table 2 also shows the grade levels of each passage calculated with the new formulas.

Note that all of the new formulas predict a grade level for the test passages which is about one to

one and one-half grade levels below that of the original formulas. This can be seen by

comparing Tables 1 and 2.

Table 4 contains the intercorrelations of the three original formulas derived from the

eighteen test passages. It also contains correlations of the three recalculated formulas derived

from the eighteen test passages. Note that these intercorrelations are generally higher in the case

of the recalculated formulas. The correlation between the recalculated Flesch and ARI formulas,

which were calculated according to multiple correlation techniques, is considerably higher than

the correlation obtained by using the old formulas (.87 versus -.74). This negative correlation

between the old formulas results because the original Flesch Reading Ease Formula uses a

Reading Ease score which is inversely proportional to grade level.

Two other formulas were recalculated as a part of this study. These were the Farr-Jenkins-

Paterson (FJP) adaptation of the original Flesch Reading Ease Formula (Farr, Jenkins, &

Paterson, 1951) and the FORCAST Formula (Caylor *et al*., 1972).

TABLE 3

EXISTING AND RECALCULATED READABILITY FORMULAS FOR THE
ARI, FOG COUNT, AND FLESCH FORMULAS

Automated Readability Index

  Old: GL* = 0.50 (words/sentence) + 4.71 (strokes/word) − 21.43

   New: GL = 0.37 (words/sentence) + 5.84 (strokes/word) − 26.01

 Simplified: GL = .4 (words/sentence) + 6 (strokes/word) − 27.4

Fog Count

   Old:
$$GL = \frac{\text{easy words} + 3 \text{ (hard words)}}{2 \text{ (sentences)}}, \text{ if Average Fog Count*** } \geq 20$$

$$GL = \frac{\dfrac{\text{easy words} + 3 \text{ (hard words)}}{\text{sentences}}}{2} - 2, \text{ if Average Fog Count } < 20$$

   New:
$$GL = \frac{\dfrac{\text{easy words} + 3 \text{ (hard words)}}{\text{sentences}}}{2} - 3$$

Flesch Reading Ease Formula

   Old: RE*** = 206.835 − 1.015 (words/sentence) − .836 (syllables/100 words)

  New: GL = .39 (words/sentence) + 11.8 (syllables/word) − 15.59

   Simplified: GL = .4 (words/sentence) + 12 (syllables/word) − 16

*GL is grade level.

**Average Fog Count equals (easy words + 3 hard words) / sentences; easy words are 1 and 2 syllable words and hard words are words having more than 2 syllables.

***RE is Reading Ease; grade level is determined from a conversion table.

TABLE 4

INTERCORRELATIONS BETWEEN THE GRADE LEVELS PREDICTED BY RECALCULATED
ARI, FOG COUNT, AND FLESCH FORMULAS FOR 18 TEST PASSAGES

Formula	Fog	Flesch
ARI	.80 (.83)*	.87 (-.74)
Fog		.90 (-.71)

* Correlation coefficients in parentheses are for the original formulas.

The original and recalculated formulas are shown in Table 5. One interesting result was noted as result of the multiple regression derivation of the FJP formula. A formula was derived for the word factor alone (which is percent of one syllable words). This formula, which is shown in Table 5, is directly comparable to the FORCAST Formula. This previous study demonstrated that the addition of a word difficulty factor added very little to the ability of the formula to predict comprehension. This was not the case of the present study as the addition to the FJP formula of the sentence difficulty factor (average sentence length) added considerably to the multiple R (which was increased) from .646 to .749. Thus the coefficient of determination, which indicates the degree of shared variance between the predicted grade level and comprehension of the test passages, was increased from 41.6 percent to 57.6 percent. This 16 percent increase makes the use of the sentence difficulty factor very useful. Coefficients of determination (which is the square of the multiple R) were also calculated in the derivation of the ARI. For the formula containing only the word difficulty factor (strokes/word) it was 30.9 percent but when the sentence difficulty factor was added, it increased to 54.4 percent.

TABLE 5

EXISTING AND RECALCULATED FORMULAS FOR THE FJP AND FORCAST FORMULAS

Farr-Jenkins-Paterson   Adaptation of Flesch Formula.

Old: RE*   = 1.599 (% 1 syllable words)   – 1.015 (words/sentence) – 31.517

New: GL** = – .307 (% 1 syllable words) + .387 (words/sentence) + 22.05

FORCAST

Old: GL   = 20.43 – .11 (1 syllable words in 150 word sample)

New: GL   = 32.53 – .24 (1 syllable words in 150 word sample)

*RE is Reading Ease; grade level is determined from a conversion table.

**GL is grade level.

4.

DISCUSSION AND CONCLUSIONS

The main results of this study are the recalculated ARI, Fog and Flesch Formulas which are shown in Table 3. The recalculated ARI formula has a slightly lower weighting for the word length factor (.37 versus .50). The word difficulty factor (strokes/word) is weighted slightly heavier in the recalculated formula (5.84 versus 4.71). The subtracted constant in the re-calculated formula results in an estimate of grade level of difficulty over a grade lower than the original formula. This is consistent with the prediction that Navy personnel familiar with the vocabulary of Navy training documents should understand this material better than other types of narrative material. Other factors, such as content and familiar patterns of wording probably also contributed to this increased understanding.

The recalculated Fog Count is very similar to the original Fog Count. However, there is only one form of the new formula while there are two forms of the original formula, depending on whether the predicted grade level of difficulty is above or below the tenth grade level of difficulty. The new formula has only one form regardless of predicted grade level of difficulty. This makes it simpler to use. The use of a subtracted constant of three in the new formula (rather than 2 or 0 in the old formulas) results in a lowered estimate of readability. The new Fog Count was not calculated according to multiple regression procedures because it is not in the proper format. The new formula was changed simply to reflect a lowered grade level of reading difficulty of a little more than one grade level. However, it correlates very well with the recalculated ARI and Flesch Formulas (above .8 in both cases). This indicates that the recalculated Fog Count measures much the same thing as the recalculated ARI and Flesch Formulas.

The recalculated Flesch Formula has a different format than the original Flesch Reading Ease Formula. The original formula predicts "Reading Ease" which must be converted to grade level by means of a conversion table. An examination of this conversion table (Flesch, 1948) shows a linear relationship between Reading ease and grade level between grade levels 8 and 16. A slightly different slope exists for grade levels for the seventh grade and below but this is of limited concern because most Navy narrative reading material is above the seventh grade level of reading difficulty. The new Flesch Formula shown is a linear equation that directly predicts grade level. This eliminates a step which saves time and the possibility of error involved in an additional step.

Simplified ARI and Flesch Formulas which can be used in place of the recalculated formulas are also shown in Table 3. They are much simpler to use, particularly if the calculation of the equation is done by hand rather than with a calculating machine. Even if a calculating machine is available, however, a simple formula is preferable to a complex one. Thomas, Hartley and Kincaid (in press) reported results concerning re1i&bilities associated with the ARI, Fog Count and Flesch Formulas. A good deal of reliability was lost in the calculation of the original Flesch Reading Ease Score. This is a difficult equation as all of the constants are carried out to three decimal places. The recalculated Flesch and ARI Formulas contain constants that are carried out to only two decimal places which is an improvement because the additional decimal place would result in virtually no increase in accuracy. The simplified ARI and Flesch Formulas have either one or no decimal places in the constants which makes them still easier to use. While this results in about .1 grade level of error (as compared with the use of the recalculated formula) this can be an acceptable level of error in many circumstances. Actually,

5.

readability formulas are only accurate to within one grade level, so an error of .1 grade level is trivial. The new Fog Count is even easier to use and can be calculated entirely by hand.

Two recent readability formulas developed for military use, the RIDE (Carver, 1974a) and FORCAST (Caylor, et al., 1972) Formulas use only a word difficulty factor in the equations. Neither contains a sentence difficulty factor. This has certain advantages particularly when such formulas are used in the rewriting of existing material. It is fairly simple to simply cut sentences in two if a formula contains sentence length as a factor. The word length factor is much more difficult to mechanically manipulate as Caylor, et al., (1972) points out. Adding a sentence difficulty factor to the FORCAST Formula added almost nothing to the prediction of comprehension. This finding is in marked contrast to the results of the present study as is mentioned earlier in this report. The addition of the sentence difficulty factor in the present study added substantially to the ability of the equation to predict comprehension. Table 5 shows the FORCAST formula and the equation derived from the data of the present study which is equivalent. An equation was derived based solely on the word difficulty factor of strokes/word of the ARI, but the full ARI equation containing a sentence difficulty factor gives a better prediction of comprehension, also. This formula is as follows:

$$GL = 6.2 \ (strokes/word) - 20.68$$

The formula is provided for information only; its use is not recommended.

To be best understood, reading material should be written at a level of difficulty appropriate to the reading ability of those reading it. The formulas derived in this study, if properly applied, should make Navy material easier to understand.

REFERENCES

Carver, R. P. *Measuring the reading difficulty levels of Navy training manuals.* Washington, D. C.: American Institutes for Research, 1974. (a)

Carver, R. P. *Measuring the reading ability levels of Navy personnel.* Washington, D. C., American Institutes for Research, 1974. (b)

Caylor, J. S., Sticht, T. G., Fox, L. C., & Ford, J. P. *Methodologies for determining reading requirements of military occupational specialties.* Human Resources Research Organization Technical Report, 1972.

Duffy, T. M., & Nugent, W. Reading ability and attrition of June enlistees. Unpublished manuscript.

Farr, J. N., Jenkins, J. J., & Paterson, D. G. Simplification of Flesch Reading Ease Formula. *Journal of Applied Psychology*, 1951, 35, 333-357.

Flesch, R. F. A new readability yardstick. *Journal of Applied Psychology*, 1948, 32, 221-223.

Johnson, K. A., Relova, R. P. & Stafford, J. P. *An analysis of the relationship between Air Force Procedural Manuals and discrepancies involving noncompliance with the procedures,* M. A. Thesis, Air Force Institute of Technology, 1972 (AD 750 917).

Kincaid, J. P., & Delionbach, L. J. Validation of the Automated Readability Index: A follow-up. *Human Factors*, 1973, 15, 17-20.

Kincaid, J. P., & McDaniel, W. C. *An inexpensive automated way of calculating Flesch Reading Ease scores.* Patent Disclosure Number 031 350, United States Patent Office, April 29, 1974.

Kincaid, J. P., Yasutake, J. Y. & Geiselhart, R. *Use of the Automated Readability Index to assess comprehensibility of Air Force technical orders.* SEC-TR-67-47. Wright-Patterson AFB, Ohio: Aeronautical Systems Division, 1967.

Klare, G. R. *The measurement of readability.* Ames, Iowa: Iowa State University Press, 1963.

McDaniel, W. C. *Inter-analyst reliability and time measures for the Automated and Manual Flesch Counts.* M. A. Thesis, Georgia Southern College, 1974.

Pinning, J. Proposed training specifications for new weapon systems procurement and relationship to technical manuals. In C. R. Vest (Ed.), *Naval education and training: a symposium* (January 10-11, 1974; Pensacola, FL). Pensacola, FL: National Security Industrial Association and Chief of Naval Education and Training, 1974.

Rankin, E. F., & Culhane, J. O. Comparable cloze and multiple-choice comprehension test scores. *Journal of Reading*, 1969, 13, 193-198.

Smith, E. A. & Kincaid, J. P. Derivation and validation of the Automated Readability Index for use with technical materials. Human Factors, 1970, 457-464.

Thomas, G., Hartley, R. D., & Kincaid, J. P. Test-retest and inter-analyst reliability of the Automated Readability Index, Flesch Reading Ease Score, and the Fog Count. *Journal of Reading Behavior*. (In Press)

Appendix A

Eighteen Test Passages Taken

From Rate Training Manuals

Passage 1 (RGL =6.9)

TEMPORARY REPAIRS

Temporary repairs are usually made by securing some type of patch over the damaged section of pipe. The material used for the patch depends upon the type of piping that is being repaired. A good general rule to go by is to make the temporary patch from the same type of material that is used for the flange gaskets in the system. Back up the patch with a piece of sheet metal, and secure the sheet metal to the pipe with bolted metal clamps or similar devices. A sealing compound may be applied between the patch and the pipe to help seal the patched area. For low pressure salt water piping, a satisfactory patch can be made from red lead putty wrapped with canvas and served with marlin or friction tape.

Small holes in some piping may be temporarily repaired by drilling and threading and inserting a screw.

Passage 2 (RGL =16.1)

PREHEATING FOR WELDING

Preheating involves raising the temperature of the base metal or a section of the base metal above the ambient temperature before welding. Preheat temperatures may vary from as low as room temperature (70° F) when welding outdoors in winter to as high as 600° and 1200° F when welding highly hardenable steels and ductile cast iron respectively.

Preheating is a very effective means of reducing weld metal and base metal cracking. Preheating may improve weldability generally but has two major beneficial effects when it retards the cooling rates in the weld metal and heat-affected base metal, and reduces the magnitude of shrinkage stresses. However, when welding quenched or age-hardened materials, the effects of preheating can be detrimental unless controlled within allowable limits.

Passage 3 (RGL =16.0)

DISTRIBUTION AND OWNERSHIP

The defense supply centers control the wholesale distribution of stock among the four services. Wholesale stock is material owned by the integrated manager. Retail stock is material owned by the military services. Use is made of the facilities, regardless of military department ownership, that are best suited to meet the requirements of the services and the area served. These facilities are operated with administrative support furnished by the service that owns the facility. When a center is the principal user of the facility, however, and has management jurisdiction, the center provides the administrative support to the other tenants.

All stocks, both operating and reserves, under the control of a defense supply center are owned by the center and financed by a separate fund, the Defense Stock Fund.

Passage 4 (RGL =10.9)

WASHING

To conserve fresh water <u>supplies</u> it may be necessary <u>on</u> occasions that you use <u>sea</u> water for washing. When <u>this</u> is necessary, use Type <u>II</u> Detergent. Two formulas are <u>presented</u> which have been tested <u>for</u> effective salt water washing.

<u>Even</u> though you must use <u>sea</u> water for washing, use <u>fresh</u> water for the last <u>two</u> rinses.

Generally, you will <u>not</u> wash woolen clothing in <u>the</u> ship's laundry. Men should <u>be</u> instructed not to put <u>their</u> blues into the laundry <u>because</u> of the danger of <u>their</u> accidentally getting in with <u>cottons</u> and being ruined. You <u>may</u> find it necessary, however, <u>to</u> wash blankets or other <u>woolens</u>. If so, proceed as <u>prescribed</u> by the recommended formula.

<u>Water</u> at tap temperature will <u>not</u> damage wool fibers. Hold <u>mechanical</u> agitation to a minimum <u>to</u> prevent shrinkage. This is <u>why</u> you should stop the <u>machine</u> when filling and draining <u>water</u>, and run it at <u>low</u> speed and for short <u>periods</u>.

Passage 5 (RGL =7.0)

PERSONAL APPEARANCE OF PETTY OFFICERS

The uniform worn is <u>the</u> uniform of the day <u>with</u> SP brassard, web belt, <u>nightstick</u>, and whistle. Do not <u>swing</u>, twirl, or play with <u>the</u> nightstick. Keep it attached <u>to</u> your belt, ready for <u>quick</u> release. Sidearms are worn <u>only</u> under special circumstances.

Members <u>of</u> the shore patrol are <u>expected</u> to maintain the highest <u>standards</u> of personal appearance and <u>military</u> bearing. You must always <u>be</u> in a correct, clean, <u>and</u> neat uniform; have your <u>hair</u> neatly trimmed; be freshly <u>shaven</u>; and have shoe shined <u>and</u> hat squared. Servicemen are <u>quick</u> to notice and criticize <u>faults</u> in the uniform and <u>behavior</u> of the shore patrol.

Passage 6 (RGL =16.0)

COMMUNIQUES

The communiqué is a <u>special</u> form of an official <u>news</u> release giving a straight <u>forward</u> account of daily combat <u>operations</u>.

As a command's official <u>battle</u> report to the public, <u>its</u> preparation requires maximum care <u>and</u> attention to ensure quality <u>and</u> accuracy. Adequate time must <u>be</u> allotted to draft and <u>coordinate</u> the release.

The communiqué <u>covers</u> the broad tactical and <u>operational</u> picture with little emphasis <u>on</u> isolated engagements. If an <u>action</u> deserves special attention, it <u>calls</u> for a separate release. <u>While</u> a release of this <u>type</u> does not attempt to <u>go</u> into detail, it should <u>contain</u> enough data to give <u>newsman</u> a well rounded account of the whole battle area. <u>Correspondents</u> see only a

small section of the day's fighting and depend heavily on the communiqué and news briefing to round out their stories.

Passage 7 (RGL =12.0)

WIND VELOCITY IS A IN FOG FORMATION

Wind velocity is an important consideration in the formation of fog and/or low ceiling clouds. The horizontal motion of the air next to the earth's surface produces friction, which, in turn, causes the air near the ground to tumble, setting up eddy currents. The size of the eddy currents vary with the wind speed and the roughness of the terrain. Lower wind currents produce more shallow eddies, and stronger wind currents produce eddies up to several hundred feet and higher.

When the temperature and dewpoint are close at the surface and eddy currents are 100 feet or more in vertical thickness, adiabatic cooling in the upper side of the eddy could give the additional cooling needed to bring about saturation. Any additional tooling would place the air in a temporary supersaturated state. The extra moisture will then condense out of the air, producing a low ceiling cloud. Adiabatic heating on the downward side of the eddy will usually dissolve the cloud particles. If all cloud particles dissolve before reaching the ground, the horizontal visibility should be good. However, if many particles reach the ground before evaporation, the horizontal visibility will be restricted by a moderate fog condition.

Passage 8 (RGL =16.3)

GENERAL CIRCULATION 'OF AIR CURRENTS

Hemispheric differences in general decrease with increasing altitude. All the jet streams of the Northern Hemisphere have their southern analogues. Southern jets are more intense on the average with smaller amplitudes, reflecting the greater zonal indices (over double in magnitude) of this hemisphere. The stratospheric cyclone of the polar night transforms into the anticyclone of the polar day in both hemispheres, but the explosive warming prior to the onset of the polar day has not yet been observed over the Antarctic.

Blocks are comparatively rare and occur southeast of continents in late winter and early spring, and drift slowly eastward again emphasizing the importance of middle latitude continents on features of the general circulation.

There is some doubt as to whether counterparts of the Aleutian and Icelandic lows exist in the mean circulation of the Southern Hemisphere. If they do, they are located in the Ross and Weddell Sea areas, on the edge of Antarctica, and are most sharply defined at about 700 millibars. Navy meteorologists with experience in those areas indicate that many lows undergoing cyclolysis move into these regions but disappear rapidly at low levels, retaining their identity as cold lows aloft for longer periods.

Passage 9 (RGL =7.8)

OPERATING THE GLOBE VALVE

The valve should never be jammed in the open position. After a valve has been fully opened, the hand wheel should be turned toward the closed position one-half turn. Unless this is done, the hand wheel is likely to freeze in the open position, and it will be difficult to close the valve. Many valves have been damaged in this manner. Another reason for not leaving globe valves fully open is that it is sometimes difficult to tell if a valve is open or closed. If a valve is jammed in the open position, the stem may be damaged or broken by someone who thinks that the valve is closed, and tries to force it open. Valves that are exceptions to the above rule are called back seating valves. Sometimes the operation of a back seating valve will require that it be fully opened. Whenever this is so, special instructions to that effect will be given. These are designed so that when fully open, the pressure being controlled cannot reach the valve stem packing, therefore eliminating possible leakage past the packing.

Passage 10 (RGL =8.9)

SEA WAVE OBSERVATIONS

Accurate sea condition observations are necessary if the forecaster is to be expected to provide accurate sea condition forecasts for operational use.

When a breeze comes up, the sea surface will instantaneously become covered with tiny ripples which form more or less regular arcs of long radius. They increase rapidly in height until they attain a maximum steepness where the pointed crests take on a smooth glassy appearance, indicating small breaking processes. As the wind continues to blow over the sea, it drags over the surface producing increasingly larger waves. The wind acts in a manner similar to a paddle rhythmically stroking the water. There is, however, one difference. The wind is constantly making small changes in direction and speed. The result is that the wind is acting like many different paddles stroking the sea in different directions and at different speeds. This produces many different wave trains in the sea, all with different directions, all with different periods, and all at the same given point in the ocean.

If all the different wave trains generated are considered to be sine waves with different heights, directions, and periods., the sum of the heights of the sine waves at a given instant is the mechanism that produces the irregular appearance of The sea. The various waves which comprise the sea surface are commonly referred to as either sea waves or swell waves.

Passage 11 (RGL =9.0)

OBTAINING WATER

Before describing chemical means of obtaining water, let's first <u>discuss</u> some natural sources of <u>fresh</u> water, of which rain <u>is</u> the most common.

Never <u>discard</u> any article that will <u>hold</u> water. When it rains, <u>every</u> container that can possibly <u>hold</u> water will be invaluable. <u>To</u> assist you in filling <u>the</u> containers, a rain-catcher tube is attached to the lifeboat <u>canopy</u>. Even in a light <u>rain</u>, some water will drain <u>from</u> the canopy down through <u>the</u> tube. After filling all <u>available</u> containers, stow them carefully <u>so</u> as not to lose <u>any</u> water. Cover all open <u>containers</u> to retard evaporation, and <u>use</u> those containers first. During <u>the</u> rain drink all you <u>can</u> hold.

In polar areas, <u>fresh</u> water can be obtained <u>from</u> old sea ice. This <u>ice</u> is bluish, splinters easily, <u>and</u> is nearly free from <u>salt</u>. New ice is milky <u>in</u> color, hard, and salty. <u>Fresh</u> water may also be <u>obtained</u> from icebergs, but use caution. As the berg's underwater <u>portion</u> melts, it gets top heavy <u>and</u> can capsize without warning.

Passage 12 (RGL =16.1)

ROPE CONSTRUCTION - FIBER ROPE

Any rope that is <u>not</u> wire is fiber rope. <u>Except</u> in a few instances <u>where</u> it is put to <u>certain</u> special uses, fiber rope <u>is</u> never called anything but <u>line</u> aboard ship. For example, <u>there</u> are fiber manropes on <u>gangways</u>; foot ropes on hammocks (<u>and</u> formerly on the yards <u>of</u> sailing ships); bolt ropes <u>on</u> sails and other canvas; <u>ridge</u> ropes on awnings but <u>they</u> are usually of wire); <u>dip</u> ropes for passing some <u>object</u> under, outside of, or <u>around</u> another; and bull ropes <u>for</u> heavy heaving without benefit <u>of</u> a purchase (tackle).

Some <u>small</u> craft have fiber wheel ropes <u>running</u> from wheel to rudder, <u>although</u> these, again, are more <u>likely</u> to be of wire. There are other exceptions as <u>well</u>, but all the exceptions <u>merely</u> go to prove the <u>strict</u> general rule that aboard <u>ship</u> a line is never <u>called</u> a rope.

In the <u>manufacture</u> of line, the fibers <u>of</u> various plants are twisted <u>together</u> in one direction to <u>form</u> yarns; the yarns are <u>twisted</u> together in the opposite <u>direction</u> to form strands; then <u>the</u> strands are twisted together <u>in</u> the opposite direction to <u>form</u> the line. In the <u>days</u> when ships swung to <u>fiber</u> anchor cables, three or four lines were twisted together, again in the opposite direction, to form the cable.

TRUING AND DRESSING THE WHEEL

Grinding wheels, like other <u>cutting</u> tools, require frequent reconditioning <u>of</u> cutting surfaces to perform efficiently. Dressing is the term <u>used</u> to describe the process of cleaning the periphery of <u>grinding</u> wheels. This cleaning breaks <u>away</u> dull abrasive grains and <u>smoothes</u> the surface so that there are no grooves. Truing <u>is</u> the term used to <u>describe</u> the removal of material <u>from</u> the cutting face of <u>the</u> wheel so that the <u>resultant</u> surface runs absolutely true <u>to</u> some other surface such <u>as</u> the grinding wheel shaft.

If grinding wheels get out <u>of</u> balance because of out <u>of</u> roundness, dressing the wheel <u>will</u> usually remedy the condition. <u>A</u> grinding wheel can get <u>out</u> balance by being <u>left</u> with part of <u>the</u> wheel immersed in the <u>coolant</u>; if this happens, the <u>wheel</u> should be removed and <u>dried</u> out by baking. If <u>the</u> wheel gets out of <u>balance</u> axially, it probably will <u>not</u> affect the efficiency of <u>the</u> wheel on bench and <u>pedestal</u> grinders. This unbalance may <u>be</u> remedied simply by removing <u>the</u> wheel and cleaning the <u>shaft</u> spindle and spindle hole <u>in</u> the wheel and the <u>flanges</u>.

Passage 14 (RGL =10.8)

CLEANING METALS FOR SPRAY METALIZING

In order to ensure a solid bond between the <u>sprayed</u> coating and the base <u>material</u> to which it is <u>applied</u>, the areas to be <u>metalized</u> and the adjacent areas <u>must</u> be free from such <u>contaminants</u> as oil, grease, water, <u>paint</u>, and other foreign matter. <u>To</u> thoroughly clean these surfaces, <u>a</u> suitable chemical solvent (or <u>heat</u>) and wire brushing (or <u>sandblasting</u>) must be used. If <u>the</u> surface to be metalized <u>is</u> of a porous material, <u>it</u> must be heated sufficiently <u>to</u> drive out any oil <u>or</u> other contaminant. Generally a <u>temperature</u> of 400 to 500° F <u>is</u> satisfactory. (For some surfaces, <u>a</u> chemical cleaning may be <u>necessary</u> before heating.) Carbon formed <u>by</u> the heating operation may be removed from the surface <u>by</u> sandblasting. The final cleaning <u>is</u> accomplished by applying the chemical cleaning solvent with a clean brush.

Passage 15 (RGL = (7.6)

ROLE OF THE NAVYMAN

You may well be <u>wondering</u> where you fit in <u>the</u> picture. True, you may <u>be</u> only one small cog <u>in</u> the huge wheel of <u>the</u> Navy, but everyone <u>is</u> important. If enough cogs <u>break</u> down, the wheel won't <u>turn</u>. If enough men fail <u>to</u> perform their duties properly, <u>the</u> ship may be endangered. <u>Our</u> Navy is great because <u>the</u> personnel in it make it so.

As a <u>sailor</u>, you represent the Navy <u>to</u> the people at home; <u>in</u> foreign countries you also represent the United States government. <u>People</u> form their opinion of <u>the</u> Navy on your appearance <u>and</u> action, so wear your <u>uniform</u> with pride and conduct <u>yourself</u> in a manner that will reflect credit on <u>you</u> and on the Navy.

When <u>overseas</u>, you must be especially careful of your conduct. If <u>foreigners</u> visited your home town <u>and</u> treated the people as <u>though</u> they were inferior, got <u>drunk</u> in public, damaged property, <u>or</u> just made a general <u>nuisance</u> of themselves, you would <u>naturally</u> be resentful and have <u>a</u> poor opinion of them. <u>The</u> people of other countries <u>are</u> no different. Remember, when <u>you</u> are overseas you are <u>the</u> foreigner. Many of their <u>customs</u> will be unfamiliar and <u>may</u> seem strange to you, <u>but</u> they are their customs <u>and</u> you must abide by <u>them</u>, and by local laws.

<div align="center">Passage 16 (RGL =11.8)</div>

<div align="center">OPERATION ORDERS AND PLANS</div>

An operation order is <u>intended</u> for a specific, relatively <u>short</u> operation. An operation plan <u>is</u> designed for operations extending <u>over</u> a large geographic area <u>and</u> usually covering a considerable <u>period</u> of time. A plan <u>also</u> is used to cover <u>contingency</u>, for example, an attack <u>on</u> a particular area. It <u>is</u> prepared well in advance <u>and</u> specifies when it will <u>become</u> effective (on signal, time). <u>For</u> our purpose we discuss <u>the</u> operation order.

An operation <u>order</u> is composed of the <u>heading</u>, body, and ending, plus <u>such</u> annexes and appendices as <u>the</u> originator deems necessary.

The <u>heading</u> shows the title of <u>the</u> issuing headquarters, name of <u>the</u> flagship or headquarters ashore, <u>geographical</u> location (or latitude and <u>longitude</u>) of the originator, security <u>classification</u> of the order, copy <u>number</u>, and date-time group. In <u>the</u> absence of any other instruction, the date-time group <u>is</u> the effective time.

The <u>body</u> of an operation order <u>consists</u> of a description of <u>the</u> task organization, five numbered <u>paragraphs</u>, and instructions for acknowledging.

<div align="center">Passage 17 (RGL =9.9)</div>

<div align="center">WHEN TO SALUTE</div>

Juniors always salute first, <u>and</u> hold the salute until <u>it</u> is returned or acknowledged <u>by</u> the officer saluted. Persons <u>not</u> covered do not salute, <u>except</u> to avoid embarrassment or <u>misunderstanding</u>.

Aboard ship you need <u>not</u> salute officers after the <u>first</u> daily meeting, except that <u>the</u> following officers must be <u>saluted</u> on every meeting: the <u>commanding</u> officer, officers senior to him, visiting officers, officers making <u>inspections</u>, and any officer you <u>are</u> being addressed by or addressing.

There are several things <u>you</u> should keep in mind <u>about</u> saluting. If possible, always <u>use</u> your right hand. If your <u>right</u> hand is injured <u>or</u> occupied, then you may <u>use</u> your left hand, unless <u>you</u> are in civilian clothes.

Accompany your salute with a cheerful respectful greeting; for example: "Good morning, sir," "Good afternoon, Commander," "Good evening, Chaplain."

Always salute from the position of attention. If walking, you need not stop, but hold yourself erect and square. If on the double, slow to a walk when saluting.

Look directly into the officer's eyes as you salute.

If you are carrying something in both hands, and cannot render the hand salute, take the position of attention, look at the officer as though you were saluting and greet him.

Remove a pipe, cigar or cigarette from your mouth before saluting.

Salute an officer even if he is uncovered or his hands are occupied. He will acknowledge your salute by saying: "Good morning," Good afternoon," or something similar.

Passage 18 (RGL =6.7)

UNIFORMS OF THE DAY

Basically four uniforms may be prescribed: service dress, full dress, tropical, and working. A white hat, black shoes and socks, and, as appropriate black or white web belts are worn.

The service dress blue uniform ("dress blues") consists of dress blue jumper, blue trousers, the neckerchief, and ribbons. Service dress whites are white trousers, white undress jumper, neckerchief and ribbons.

Full dress is the same as service dress except that medals, rather than ribbons are worn.

There are three tropical uniforms: white long, white, and khaki. Tropical white long (the one usually prescribed) consists of white trousers, and white short sleeve shirt. Ribbons usually are prescribed. Tropical white substitutes white shorts and knee length white socks for the white trousers and black socks. Tropical khaki consists of khaki shorts with black shoes and socks and an undershirt. (An undershirt is worn with all uniforms.)

Appendix B

Instructions for Calculating Readability

Using the Recalculated ARI, Fog

Count, and Flesch Formulas

Instruction for Recalculated Automated Readability Index (ARI)

The Automated Readability Index (ARI) is a method for determining the difficulty of written material. The ARI utilized three measures that are recorded on a counter as you type. The three measures are the number of strokes, the number of words, and the number of sentences. Only minor changes from standard typewriting are necessary. The following instructions will aid you in arriving at the ARI.

I.   Typing Instructions

1. When you have completed typing you must end with three measures:

   A.   THE NUMBER OF STROKES
   B.   THE NUMBER OF WORDS
   C.   THE NUMBER OF SENTENCES

2. Getting the number of strokes is a simple task since every time you use a key a stroke is registered on the counter. Letters, symbols, and punctuation marks are included in the count of strokes. The spelling of a word is immaterial as long as it contains the proper number of letters.

   REMEMBER: YOUR TASK IS TO OBTAIN COUNTS AND ONLY THE
                        COUNTING IS IMPORTANT.

3. Counting the words is done by counting the number of times the space bar is used. A few simple changes in typing are required for this.

   A.   DO NOT DOUBLE SPACE AFTER A SENTENCE.
   B.   DO NOT INDENT NEW PARAGRAPHS.
   C.   ALWAYS SPACE AFTER THE LAST WORD ON A LINE.

   REMEMBER: THE RESULTS MUST BE ACCURATE. DON'T BE AFRAID TO
                        START OVER IF SOMETHING GOES WRONG. IF YOU
                        START OVER, RESET THE COUNTER OR YOUR FINAL
                        MEASURES WILL NOT BE ACCURATE.

4. Counting the sentences is done by pressing the right hand key on the top row (=). DON'T USE THIS KEY FOR ANY OTHER PURPOSE. When you have reached the end of a sentence, punctuate it according to the material being typed; then type =.

II.   Computation Instructions

1. On the Tabulation Sheet record the number of strokes, the number of words, and the number of sentences as shown on the counter. Subtract the number of sentences from the number of strokes to get proper stroke count.

.   33

2. Obtain the Average Sentence Length.

   Divide the number of words by the number of (sentences): $\dfrac{\text{(words)}}{\text{(sentences)}}$

3. Do computations to 2 decimal places. Obtain the Average Word Length.

   Divide the number of strokes by the number of words: $\dfrac{\text{(strokes)}}{\text{(words)}}$

4. Compute the Grade Level (GL) according to the following equation:

   GL = 0.37 (Average Sentence Length) + 5.84 (Average Word Length) − 26.01

5. If you want you may use instead a slightly less accurate but simpler equation:

   GL = 0.4 (Average Sentence Length) + 6 (Average Word Length) − 27.4

Instructions for Recalculated Fog Count

The Fog Count is a means of determining the difficulty of written material. Two measures must be recorded: (1) the number of easy words; and (2) the number of hard words (polysyllables). An easy word can be pronounced in one or two sounds, for example, "like" "riding." Hard words have more than two sounds. "Difficulty" and "hospital" are two examples of hard words. The following instructions will aid you in arriving at a Fog Count.

I.   HOW TO MAKE A FOG COUNT

1. Count the number of sentences.

Treat any complete statement or thought as a sentence. In some contexts one word can be a sentence, as here:
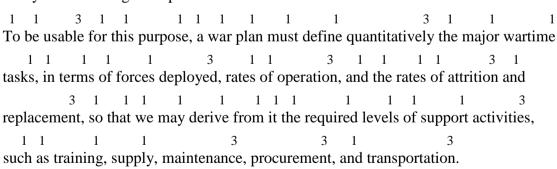
"Where's Tom?"
"Flying."

Don't rely on a period to tell you where a sentence ends. When taking a Fog Count, you may consider a semicolon as a period because it indicates the end of a complete thought; thus, the sentence that you are reading now may be counted as two sentences.

2. Count the number of easy words (1 and 2 syllables) and give them a value of 1.

3. Count the number of hard words (more than 2 syllables) and give them a value of 3.

6.   IMPORTANT: Mark the value (1 or 3) you assign a word above it.
REMEMBER: Every word must have a value.

Study the following example:

```
 1   1      3   1   1       1  1  1   1     1      1                3   1      1          1
To be usable for this purpose, a war plan must define quantitatively the major wartime
     1  1     1   1      1        3       1  1        3    1   1    1  1      3   1
tasks, in terms of forces deployed, rates of operation, and the rates of attrition and
          3   1    1  1     1      1    1  1 1     1     1  1      1        3
replacement, so that we may derive from it the required levels of support activities,
   1  1      1       1          3          3   1          3
such as training, supply, maintenance, procurement, and transportation.
```

4. Add the 1's and the 3's. This is the Total Fog Count.

So in the example above:

number of 1's = 41
number of 3's = 10 (10 X 3 = 30)
Total Fog Count = 41 + 30 = 71

35

5. <u>Find the Average Fog Count</u>.

   Divide the Total Fog Count (#4) by the number of sentences.

6. Convert to a Grade Level (GL).

   A. Subtract 3 from the Average Fog Count.
   B. Divide this by 2 to obtain the Grade Level.

7. The equation for calculating the Grade Level is as follows:

$$GL = \frac{\dfrac{\text{Easy Words} \; + \; 3\,(\text{Hard Words})}{\text{Sentences}} \; - \; 3}{2}$$

II. PROBLEMS IN MAKING A FOG COUNT

1. <u>Names of persons</u>. A proper name is only given the value of 1. Common titles (such as Mr., Miss, General) are considered part of the proper name and are not given a value. That is, the common title and the proper name are combined and receive a value of 1. Uncommon titles are considered apart from the proper name and receive a value of 3.

   Note the following examples:

   $$\overline{\underset{\text{Dave B. Lucas}}{\overset{1}{}}}$$

   $$\overline{\underset{\text{Miss Ruth Smith}}{\overset{1}{}}}$$

   $$\overline{\underset{\text{General Eisenhower}}{\overset{1}{}}}$$

   $$\overline{\underset{\text{Commissar}}{\overset{3}{}}} \; \overline{\underset{\text{Harry M. Raines}}{\overset{1}{}}}$$

2. <u>Numbers</u>. The Fog Count treats all numbers, regardless of size, as easy words. Therefore, all numbers receive a value of 1. Dollars, cent, and percent symbols are considered part of the number with which they are written. Study the following examples:

   $$\overline{\underset{38\%}{\overset{1}{}}}$$

   $$\overline{\underset{547}{\overset{1}{}}}$$

   . . .

   $$\overline{\underset{\$9.50}{\overset{1}{}}}$$

   $$\overline{\underset{\text{eighty-eight}}{\overset{1}{}}}$$

3. <u>Abbreviations</u>. Many abbreviations have gained wide use and acceptance among people. Such common abbreviations usually stand for an, easy word and receive a value of 1. Some examples: YMCA, USAF.

Instructions for Recalculated Flesch Formula

The Flesch Reading Ease formula is a method of determining the difficulty of written material. The Flesh Reading Ease formula uses two measures: (1) average number of words in a sentence; and (2) the number of syllables per word. Te following instructions will aid you in arriving at a Flesch Reading Ease Score.

1. Count the number of words.

   Count as a word any numbers, letters, symbols, groups of letters surrounded by white spaces. Hyphenated words and contractions count as one word. For example, each of the following count as one word:

   couldn't
   F.O.B.
   i.e.
   32,008
   second-grade

2. Count the number of sentences.

   Count as sentences each unit of thought that can be considered grammatically independent of anther sentence or clause. A period, question mark, exclamation point, semi-colon, and colon usually denote independent clauses. Sentence fragments and incomplete sentences are counted as a sentence.

   Study the following examples:

   "Where did he go?" "Home." (count as 2 sentences)

   The equipment is old because: a. It was issued several years ago.

   b. It needs constant repair.   c. We have no spare parts for it. (count as 3 sentences)

   But the following Sentence counts as 1 because the words after the colon are not complete sentences.

   Three ships met at the appointed hour: Cario, Scott Fitzgerald, and the William James.

3. Count the number of syllables.

   Count syllables the way you pronounce the word: for example.

   "row"   1 syllable
   "maintain"   2 syllables
   "dictionary"   4 syllables

With symbols and figures the syllables are known by the way they are normally pronounced, for example,

¢ (cent)	1 syllable
R.F.D.	3 syllables
1918 (nineteen eighteen)	4 syllables

if there is any doubt about syllables, consult a dictionary.

4.   Find the Average Sentence Length.

Divide the number of words by the number of sentences: $\dfrac{\text{(words)}}{\text{(sentences)}}$

5.   Find the Average Number of Syllables per word.

Divide the number of syllables by the number of words. $\dfrac{\text{(syllables)}}{\text{(words)}}$

6.   Compute the formula.

Combine the Average Sentence Length and the Average Number of Syllables per Word into the following equation:

The equation for calculating the Grade Level is as follows:

$$GL = .39 \text{ (Average Sentence Length)} + 11.8 \text{ (Syllables/Word)} - 15.59$$

7.   If you want, you may use a slightly less accurate but simpler equation.

$$GL = 0.4 \text{ (Average Sentence Length)} + 12 \text{ (Syllables/Word)} - 16$$