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EFFECTS OF RETRIEVAL TERM SPECIFICITY ON INFORMATION RETRIEVAL FROM COMPUTER-BASED INTELLIGENCE SYSTEMS

Lawrence M. Potash

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This experiment assessed the impact of using two levels of retrieval terms on formulating and inputting query statements. One level used specific terms to retrieve one element of information; the other level used global terms to retrieve blocks of information that would otherwise require five to six specific terms.

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Participants in the study were enlisted personnel from Fort Belvoir, Va., with General Technical (GT) scores $\geq$ 110. Participants were assigned either to a specific group allowed to use only specific retrieval terms, or to a global-specific group allowed to use both global and specific retrieval terms. The retrieval terms and their definitions were listed in a data dictionary and were displayed on a data name chart.

After a 5-minute typing test, participants were given instructions on how to write query statements in the GIM II Query Language used in Army System for Standard Support Terminals (ASSIST).

Participants were then given a set of 48 problems. For each problem, the participants had to write and type a query statement that would satisfy the information requirements. An electric typewriter simulated the keyboard input of a computer terminal. Using a stopwatch, each participant recorded the time it took to write and type query statements.

After finishing the problems, each participant was given an ancillary learning test to assess how well specific terms had been learned.

Finally, participants rated the ease of use of the query language, indicated how they went about writing query statements, and rated the value of using global terms.

The opportunity to use global terms had no effect either on the time needed to write query statements or on the accuracy of typed query statements. Where the use of global terms was applicable, substantial savings in the time required to input query statements was shown. Except that the global-specific group reported that it made more use of the data name chart before using the data dictionary, the two groups indicated that they went about writing query statements in approximately the same way. Both groups gave high ratings to the value of using global terms.

Use of global terms is not recommended unless the specific items of information subsumed under the global term are normally retrieved together frequently.

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Technical Paper 379

EFFECTS OF RETRIEVAL TERM SPECIFICITY ON INFORMATION RETRIEVAL FROM COMPUTER-BASED INTELLIGENCE SYSTEMS

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FOREWORD

The Human Factors Technical Area is concerned with the human resource demands of increasingly complex battlefield systems for acquiring, transmitting, processing, disseminating, and utilizing information. The research focuses on the human performance problems of the man-system interface, on interactions with command and control centers, and on issues of system development. The research is concerned with such areas as tactical symbology, information management, user-oriented systems, staff operations and procedures, and sensor-systems integration and utilization.

One area of interest is the development of an approach to the design of the man-computer interface that is people-oriented rather than computer-oriented. Most existing query languages require the use of "specific" retrieval terms to request information from the data base of the system. The speed and ease of composing and entering query statements might be increased by adding "global" retrieval terms--terms that retrieve clusters of related data elements--to specific terms that retrieve only basic data elements. Decisions concerning the cost-benefits trade-off of using global terms require data on how the use of global terms will affect user performance.

This publication presents the results of an experiment assessing the effects of using global retrieval terms plus specific retrieval terms for formulating and inputting query statements. The results indicate that the primary effect of using global terms is reduced time required to input query statements, not reduced time required to formulate query statements.

Research in the area of man-computer synergism is conducted as an in-house effort augmented by contracts with organizations selected for their relevant capabilities and facilities. The present research was conducted by personnel from the Army Research Institute (ARI) and is responsive to the general requirements of Army Project 2Q762722A765 and to the special requirements of the Combined Arms Combat Development Activity. Special requirements are contained in Human Research Need 78-149, "Interactive Procedures for Data Inputting, Organization, Retrieval, and Purge." This research was made possible through the cooperation of the Intelligence Systems Support Detachment of OACSI and the Personnel Management Division, Fort Belvoir, Va.

JOSEPH ZEIDNER
Technical Director

EFFECTS OF RETRIEVAL TERM SPECIFICITY ON INFORMATION RETRIEVAL FROM COMPUTER-BASED INTELLIGENCE SYSTEMS

BRIEF

Requirement:

To assess the impact of using two levels of retrieval terms for formulating and inputting seminatural English query statements.

Procedure:

Thirty-six enlisted personnel with General Technical (GT) scores of at least 110 were randomly assigned to two groups. One group was allowed to use only specific terms for retrieving items of information (specific group). The second group was allowed to use both specific and global terms to retrieve blocks of information that would otherwise require use of several related specific terms (global-specific group).

Two or three participants were tested per day. Each participant was given a Data Element Dictionary containing the retrieval terms, a Data Name Chart displaying these retrieval terms and their interrelationships, and a test booklet appropriate to the group.

The retrieval terms and their definitions were based on those listed in the Ground Order of Battle File (GOBBA) in the "Data Base Specifications (DS), ASSIST CONUS TESTBED SYSTEM (ACTS)."

Before the experiment, participants were given a 5-minute typing test. The participants then went through the instructional portion of the test booklet, which taught them a simplified version of the query language used in ASSIST and how to use both the dictionary and the name chart. Next, participants had to write and type query statements that would satisfy the information requirements of 48 problems. An electric typewriter simulated the keyboard input of a computer terminal. Using a stopwatch, each participant timed how long it took to (a) write and (b) type each query statement.

After finishing the performance section of the test, participants were tested for incidental learning of the retrieval terms. They were also asked to rate the ease of writing and typing query statements and the advisability of using global terms, and to indicate what strategies they used to write the query statements.

Results:

Opportunity to use global retrieval terms, typing speed, and GT scores had no significant effect either on the time required to write the query statements or on the number of query statements correctly written. However, where global terms were applicable, their use resulted in substantial saving in the time required to type query statements. Both specific and global-specific groups gave high ratings to the value of using global terms.

Utilization of Findings:

Based on these findings, the use of global terms is not recommended unless the specific items of information subsumed under the global term are normally retrieved together frequently.

EFFECTS OF RETRIEVAL TERM SPECIFICITY ON INFORMATION RETRIEVAL FROM COMPUTER-BASED INTELLIGENCE SYSTEMS

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EFFECTS OF RETRIEVAL TERM SPECIFICITY ON INFORMATION RETRIEVAL FROM COMPUTER-BASED INTELLIGENCE SYSTEMS

INTRODUCTION

In most data management systems, units of information are labeled by retrieval terms. When the user wants to retrieve the information, he or she incorporates the retrieval term(s) in the query statement. An example of a query statement in the GIM II language, used in the Army System for Standard Intelligence (ASSIST),[1,2] would be--

FOR GOBBA WITH UNIT EQ "12345" "56321" LIST COMMANDER #

"FOR GOBBA" refers to the data base for the ground order of battle. "COMMANDER" is the retrieval term. The output produced by this query statement would be the names of the commanders (and whatever else is stored in the designated data field) for the two units specified. One factor that would be expected to affect how efficiently such a retrieval language works is the size of the information unit that is retrieved by the retrieval term. In a number of situations, lumping together information previously keyed on different specific terms might be useful (or necessary), because the information to be retrieved could be labeled by a single term. Two such situations are as follows:

1. When the information should not be used by itself; that is, subsidiary units of information are necessary to qualify the primary unit of information (for example, whether the information has been validated, what units of measurement are, etc.).

2. When information logically goes together to make up the whole picture; that is, information that is related or is comprised of elements with a high probability of being used together. For example, for many purposes, all of the terms shown below could be combined into one information unit called COMBAT READINESS STATUS (which might be abbreviated as COMREDS).

   - CRCAT--Combat readiness category of unit.

   - CAT01--Time span required for the subject unit to reach full combat readiness.

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[1] TRW Systems Group. GIM II User Reference Manual, McLean, Va., January 1975.

[2] ASSIST DMS Elementary User's Guide with Sample Application. Prepared for U.S. Army Intelligence Support Detachment, OACSI, June 1976.

- CATO2--Unit of measurement.
- REASU--Reason (for lack of combat readiness) unknown.
- REAS1--Primary reason for lack of combat readiness.
- REAS2--Secondary reason for lack of combat readiness.
- REAS3--Tertiary reason for lack of combat readiness.

Use of clusters of information or macroelements (an ordered set of two or more elements used as a single data element) should enable the user to avoid stringing together a number of specific retrieval terms and may decrease--

1. The time required to look up retrieval terms.
2. The number of typographical errors and resultant error corrections needed.
3. The length of the query statement.
4. The inputting time once the query statement is formulated.
5. The possibility of omitting important information.

In this research, the term used to retrieve a macroelement is called a "global term." Regardless of the merits of using global terms, use of "specific terms" (the names or terms used for retrieval of individual data elements) is necessary because they allow the user to

1. Decrease the amount of extraneous categories of information (in some cases a global term may provide too much information).
2. Delimit the information requested (for example, you might want a list of certain categories of information for all units under two commanders, but in a language like GIM II there is no direct way to key in on the specific items wanted without using the specific term COMMANDER).

This research assessed the impact of using two levels of retrieval terms for formulating and inputting query statements in seminatural query languages where the categories of information have been previously derived.

Query systems can vary in several ways, including the type of language used in the man-computer dialogue (menu, seminatural English, natural English), whether a controlled or uncontrolled vocabulary is used, the means of inputting (typewriter keyboard, function keyboard, light pen). The boundary conditions for the current research are based on GIM II, as follows:

1. Vocabulary is assumed to be controlled. In this context, controlled vocabulary means that the MIS system will accept only a limited set of predefined terms.

2. Seminatural language is assumed in the sense that statements are in seminatural English syntax (the GIM II Query Language used in ASSIST is such a model).

3. Synonym capability exists only in that global terms can be used to stand for a cluster of more specific terms.

4. Query statements are input via a keyboard.

5. The query language deals with retrieval of relatively brief items of information rather than document retrieval (including messages).

Thus, this research represents an attempt to maximize the effectiveness of GIM II-like systems.

OBJECTIVE

The overall objective of this research is to assess the impact of using global terms in addition to specific terms for formulating and inputting query statements written in seminatural English. More specifically, the following effects of the use of global terms will be assessed:

1. Does the use of global retrieval terms affect the speed of formulating query statements?

2. Does the use of global retrieval terms increase the speed with which query statements can be input (i.e., typed)?

3. Does the use of global terms affect the accuracy of statements input into the system?

4. Will users express a preference for adding global terms to specific terms?

5. Does the use of global retrieval terms affect the recall and recognition of specific retrieval terms?

6. Does the use of global terms affect how the user employs aids, such as a dictionary containing the retrieval terms and a chart displaying these terms?

No attempt is made to assess the importance of loss of precision of output in information due to the use of global retrieval terms. Precision and its effects depend on the size of the data base and the way the output is organized.

METHOD

Participants

Beginning participants were 43 enlisted personnel (E4 and above) from Fort Belvoir, Va., with GT scores $\geq$ 110 who had some familiarity with typing (even if only "hunt and peck" typing). Approximately 39% were women.

Because an important measure of participant performance--the time required to write and type query statements--is meaningless if participants are very inaccurate typists, all participants had to reach a minimal level of performance to be included in the study. The performance criterion required 50% of the query statements to be formulated and typed without error.[3]

To insure the proper number of participants in each group, the experimenter scored the number correct at the end of each daily session (an average of two participants were run per day). Seven of the 43 participants did not reach the criteria for acceptable performance, and their data were not included in the analysis. Of the 36 subjects who met the criteria, 18 were assigned to the specific group (allowed to use only specific terms) and 18 were put in the global-specific group (allowed to use both global and specific terms).

Equipment

Electric typewriters simulated the keyboard of a terminal. The participants typed the query statements on paper. Each participant was also given a test booklet, a data dictionary, and a data name chart.

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[3] Only query statements without LIMIT OUTPUT restriction were used in the analysis (see footnote 5 for the underlying rationale). Thus, for inclusion in the study, subjects had to type a minimum of 16 query statements without error. The mean number correct for the global-specific group was 25.1 (range 18-31). The mean number correct for the specific group was 24.4 (range 16-31).

Test Booklet

Throughout the performance portion of the experiment, participants used a test booklet consisting of an instruction section, a performance assessment section, an ancillary learning test, and a rating evaluation sheet.

The instruction section was used to teach the players a simplified version of GIM II Query Language and how to use both the data dictionary and the data name chart (described below). This section also contained three practice problems for which the participant had to write and type query statements to retrieve the requested information.

Following each practice problem, participants were given feedback on their answers and explanations of underlying strategies for retrieving information. The advantages of using global terms, where applicable, were pointed out to the participants in the global-specific group. This group was told to use the global terms when they thought it would save time, provided that the global term replaced two or more of the specific terms required by the query statement. These participants were told not to use a global term if it only subsumed one specific term because it "wouldn't give you any advantage and would produce too much extraneous information." Each of the global terms was defined to comprise five or six specific terms.

The performance assessment section contained 48 problems (see Appendix A for sample problems). The participant had to write and type a query statement that would satisfy the information requirements for each problem. The problems were classified in five categories depending on whether global retrieval terms could be used. A description of these categories and the number of problems in each category follows. (Where applicable, the number of specific retrieval terms required to produce the same information is shown in brackets.)

- Category 1. Six problems with information requirements completely satisfied by a global term in the query statement (five to six specific terms).

- Category 2. Six problems with information requirements satisfied by one global term plus use of one or two specific terms in the query statement (six to eight specific terms).

- Category 3. Twelve problems with information requirements satisfied by one global term plus two to three specific terms or by an additional global term which subsumes the two to three specific terms in the query statement (seven to nine specific terms).

- Category 4. Twelve problems with information requirements satisfied only by three to four unrelated specific terms in the query statement.

- Category 5. Twelve problems with information requirements satisfied only by three to four specific terms in the query statement or by a single global term which subsumed these specific terms.

The specific retrieval terms were assigned to the different problem categories on a semirandom basis, so that it was advantageous to use each specific term with other terms or subsumed under a global term in at least three problems. For each global term there were at least four problems in which it could be used in place of multiple specific terms.

One-third of the problems contained in each category had LIMIT OUTPUT restrictions that required the query statement to be written so that extra categories of information would not be produced. Half of these LIMIT OUTPUT problems required use of a WITH CLAUSE (see page 1 and Appendix A for examples of a query using the WITH clause). These restrictions were used to force the global-specific group to use specific terms in some of their query statements and to prevent careless use of global terms.

Instances of the different types of problems were randomly assigned to positions 1 through 48 in the performance assessment section of the test booklet. Two different random orders were used, so that approximately 50% of the participants in each group (specific and global-specific) used one of the two orders (see Appendix A for examples of problems).

An ancillary learning test assessed how well participants in both groups had learned the specific terms. The recall and recognition tests contained the definition of the term and a space for the participant to write the appropriate specific retrieval term. For the recognition test (given after the recall test), the participant was allowed to use the data name chart.

The rating sheet consisted of a number of 9-point rating scales designed to assess how participants went about writing the query statements, how easy they thought the statements were to write and input, and how they perceived the value of using global terms (for subjects in the specific groups, global terms were defined and their use was described).

A data dictionary was given participants. The dictionary listed every retrieval term and followed each term with an underlined phrase that indicated what the term stood for (all retrieval terms were abbreviations or brevity codes). Each retrieval term also was described or "defined" in terms of the type of data that it would retrieve. The retrieval terms and their definitions were based on those listed in the Ground Order of Battle Files (GOBBA).[4]

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[4] Data Base Task Group and Systems Development Task Group FORSIC-IDHS. Data Base Specifications (DS), ASSIST CONUS TESTBED SYSTEM (ACTS), October 1974.

The dictionary used by the specific group contained 57 retrieval terms. The dictionary used by the global-specific group contained the identical 57 specific terms plus 14 global terms, each of which subsumed five to six specific terms (see Appendix B for an example).

About 50% of the specific and global terms listed in the dictionary were actually used by the participants. The remaining terms were extraneous and were used to simulate the presence of terms commonly used by the analyst.

The data name chart listed all the retrieval terms contained in the data dictionary. For the global-specific group, all the specific retrieval terms subsumed under a global term were listed next to the global term and were enclosed in brackets. The data name chart (30.5 cm x 30.5 cm for the specific group; 30.5 cm x 61 cm for the global group) was attached to the wall in front of the participant.

Procedure

Participants were randomly assigned to either the specific or specific-global group and were seated at a desk containing the data dictionary, data name chart, and test booklets appropriate to their group. Prior to the experiments proper, participants were given a 5-minute typing test to measure typing speed. After completion of the typing test, participants received the test booklets and went through its instruction portion. The instruction portion of the booklet contained an exercise in which the participants had to use the data dictionary to find terms that would provide the requested items of information.

When the participants had completed the exercise, the experimenter went over the answers with the participants to insure that each understood how to use the data dictionary. At the end of the instruction section, the participants had to write and type appropriate query statements for a second exercise with three sample problems. Using a stopwatch, participants recorded the time required to write and the time required to type the query statements. The experimenter went over these problems with the participants and reviewed the instructions. After completion of the first four problems in the performance section, the experimenter reviewed those problems, correcting any mistakes and explaining the nature of any errors. After this review, participants were on their own for the remainder of the test.

During initial problems, the experimenter also recorded typing time, using a stopwatch to make sure participants were recording their times accurately. Incorrect recording of times by participants was not a problem.

After completion of the performance section of the test, participants were tested for ancillary learning of the retrieval terms. Participants were also asked to rate the ease of writing and typing query statements and the advantages of using global terms, and to indicate what strategies they used to write the query statements.

RESULTS

A 2 x 2 x 2 factorial design, unweighted means analysis, in which GT Score, Typing Speed, and Term Specificity were dichotomized into high-low categories, was used to analyze median time required for writing and typing query statements in each of the five categories of problems.[5] Table 1 summarizes the significant effects of GT Score, Typing Speed, Term Specificity, and their interactions on median writing and typing time for each of the five categories of problems. Appendix C contains tables for each analysis of variance yielding statistically significant effects.

None of the three variables had a consistent effect upon writing speed. However, two of the variables--Typing Speed and Term Specificity--had a significant effect on median times necessary for typing the query statements.

It is not surprising that both typing speed and term specificity should affect median time required to input or type the query statement; term specificity directly affects the length of the query statement. However, the magnitude of the effect of term specificity is not so easily predicted; it depends on whether the number of errors (and therefore time spent correcting errors) decreases, the proportion of times that global terms are used (where applicable), and the number of specific terms subsumed under a global term (fixed at five or six in this experiment).[6]

Table 2 shows the mean of the median typing times for each of the five problem categories as a function of typing speed and term specificity. Appreciably more time is required to use specific terms when information requirements can be satisfied either by use of a global term (category 1) or by a global term plus one to three specific terms or a second global term (categories 2 and 3). For problems in which only specific terms

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[5] For this and subsequent analyses, all statements with LIMIT OUTPUT restrictions were eliminated: (a) some participants became confused by the syntax requirements for some limit output statements, and (b) only a relatively small number of statements (16) had LIMIT OUTPUT restrictions providing too few counters to be meaningfully analyzed. The correlation between total number correct and number correct after LIMIT OUTPUT problems were eliminated was .97 for the global-specific group and .91 for the specific group.

[6] As indicated in a later analysis, there was no significant relationship between retrieval term specificity and number of errors corrected.

Table 1

Summary of Results of Analyses of Variance of Time Required for Writing and Typing Query Statements for Each Problem Category

	Writing problem category					Typing problem category				
	1	2	3	4	5	1	2	3	4	5
GT Score	-	-	-	-	-	-	-	-	-	-
Typing Score	-	-	**	-	-	-	*	**	**	**
Term Specificity	-	-	-	-	-	**	**	**	-	*
GT Score x Typing Speed	-	-	-	-	-	-	-	-	-	-
GT Score x Term Specificity	-	-	-	-	-	-	-	-	-	-
Typing Speed x Term Specificity	-	-	-	-	-	-	-	-	-	-
GT Score x Term Specificity x Typing Speed	-	-	-	-	-	-	-	-	-	-

* $p \leq .05$.
** $p \leq .01$.

Table 2

Mean of Median Typing Speeds for Five Categories of Problems as a Function of Typing Speed and Term Specificity

	Typing speed									
	Categories of problems									
	1		2		3		4		5	
Term Specificity	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo
Global-specific	21.0	21.6	29.7	62.7	28.7	58.9	27.7	41.0	26.7	37.3
Specific	49.2	61.4	41.6	85.4	43.8	96.6	33.4	43.7	30.8	47.9

can be used (category 4), or for which only three to four related specific terms will satisfy the information requirements (category 5), no significant differences were found between the global-specific and the specific groups.

Other analyses, using the 2 x 2 x 2 analysis of variance design previously described, indicate that GT Score, Typing Speed, and Term Specificity did not significantly affect the accuracy of query statements typed onto the answer sheets (i.e., the number of correct query statements), the number of statements with data names listed correctly, or the number of times the correction procedure was used. Recall of the specific terms was significantly related to GT Score; individuals with high GT scores remembered more of the specific terms ($F = 4.33$, $p < .05$). Significant interactions also occurred between GT Score and Typing Speed ($F = 4.52$, $p < .05$) and between GT Score and Term Specificity ($F = 7.58$, $p < .05$) with regard to the number of specific terms recalled. For individuals with high typing speeds, high GT scores were associated with better recall of specific terms. For individuals with low typing speeds, the number of terms recalled was essentially the same for both high and low scorers. For the group using specific terms, individuals with high GT scores tended to remember more of the specific terms, whereas this effect was not exhibited for individuals in the global-specific group.

A 2 x 2 x 2 ANOVA of the same design previously discussed, was used to analyze the effect of Number of Correct Statements, Number of Specific Terms Recalled, and Retrieval Term Specificity on median speed of writing query statements and number of corrections made. There were no significant main effects of these variables on median speed of writing query statements. Of the four interactions, only one reached significance, Number of Specific Terms Recalled by Number of Corrections for category 1 of the five categories of query statement ($F = 7.68$, $p < .05$). Number of Correct Statements was significant with regard to the number of times the correction procedure was used ($F = 9.17$, $p < .01$). Individuals with the highest number of correct query statements used the correction procedure half as often as individuals with low accuracy (with a $\bar{X}$ number of times used equal to 5.0, as contrasted to 9.6 for the low-accuracy group).

Table 3 summarizes the results of the rating evaluation. All ratings were made on a 9-point scale. The first three statements were designed to ascertain the perceived ease with which the subjects carried out the different tasks related to inputting appropriate query statements into the system (i.e., ease of composing query statements, ease of typing query statements, and ease of using the data dictionary). The rating scale ranged from 0 (very difficult) to 8 (very easy). As Table 3 shows, there were no major discrepancies between the ratings of the global-specific and specific groups. Even though there were significant (large) differences between the specific and global groups in the actual typing time required for four of the five types of problems, the ratings indicate that the two groups did not differ in the perceived ease of inputting the query statements. Both groups perceived the typing part of the task as relatively easy.

Table 3

Summary of Rating Evaluation

	Ease of:						Frequency of using:									
	Composing query statements		Typing query statements		Using date dictionary		Data name chart before using dictionary		Data name chart without dictionary		Data name without referring to chart or dictionary		Global term without first looking up specific terms		Rating for value of using global terms	
Term specificity	X	Range	X	Range	X	Range	X	Range(%)	X	Range(%)	X	Range(%)	X	Range(%)	X	Range
Global-specific	6.1	4-8	7.2	4-8	7.0	5-8	39	10-80	34	≤10-90	53	≤10-90	34	≤10-70	6.7	2-8
Specific	6.7	5-8	6.9	5-8	7.4	6-8	27	40-70	32	≤10-90	54	≤10-90	-	-	7.0	3-8

It is possible that there would have been more disparity in the ratings had each participant used both the global-specific and the specific conditions.

The next four statements were designed to ascertain how participants went about writing the query statements. The rating scale varied from 10% or less of the time to 90% or more of the time; it was again a 9-point scale. (Since these categories are not mutually exclusive, the percentages can, and did, add up to more than 100%.) The only discrepancy between the two groups of participants was in the use of the data name chart before using the dictionary. The global-specific group tended to make more use of the data name chart before using the dictionary; perhaps it was easier first to scan the chart to spot a candidate global term and then go to the data dictionary to make certain the global term was applicable. After practice, many members in both groups supplied a large proportion of the terms from memory.

The last scale, used to rate the value of using global terms, ranged from 0 (of very little use) to 8 (very useful). Prior to making the rating, participants in the specific group, who had no experience in using global terms, were given a description of how global terms would be used. Both groups gave similar ratings for the value of using global terms which was, on the average, quite high. Note that the desirability of using global terms (or at least the rating given for their usefulness) is not strongly supported by the results of the performance evaluation and is at variance with the ratings given for ease of composing and typing query statements.

Participants in the global group were also asked to "list the most important disadvantages of using global terms (if any)." With regard to advantages, the overwhelming response was this: It saves time and/or requires less writing (and thereby saves time) and/or less typing (and thereby saves time). Three general disadvantages were pointed out:

1. The addition of global terms gives the user more terms to learn, which can prove confusing unless the global terms are frequently used.

2. It takes time (and causes confusion) to match global terms with the specific terms they represent (one respondent indicated that this is more true of global terms that contain information less obviously related).

3. The use of global terms often produces extraneous information.

DISCUSSION AND CONCLUSIONS

Generally speaking, the results lend only weak support to the use of global terms in addition to specific terms. The use of global terms in addition to specific terms had no effect either on the time necessary to write query statements or on the accuracy of typed query statements. The one area where the use of global terms did make a difference was in the time required to type the query statements. Where use of global terms was applicable, substantially less time was required to input query statements. Whether the demonstrated differences in typing time would be "operationally significant" depends on a number of factors, including--

1. The number of query statements the person using the system must input per unit time.

2. The number of specific terms subsumed by the global term (and the average number of letters per term).

3. The ease of selecting appropriate global terms, i.e., whether the relationship of the specific terms to the global terms is relatively obvious.

4. The usability of available global terms, i.e., the proportion of times that the majority of specific items of information subsumed under the global term would be requested together.

5. The proportion of time spent inputting as contrasted to writing query statements.

In designing the experiment, a number of arbitrary points along potential continua had to be chosen. For example, global terms subsumed five to six specific terms, although other numbers, such as 10 to 15 or more, could have been used. The assignment of 5 to 6 specific terms for each global term was made for several reasons: this was the range that the items in the particular data base seemed to fit into best; and unless elements of information are frequently requested together, subsuming a large number of specific terms under one global term produces a great deal of extraneous information that would represent "clutter" to the user. Another reason for using 5 to 6 specific terms is the average number of letters per term. The five-letter abbreviations used for the specific terms were taken from the ASSIST CONUS TESTBED SYSTEM data base. Six-letter abbreviations were used for the global terms, the extra letter being used to help discriminate between global and specific terms.

The fact that this experiment was carried out with a simulated rather than a "live" system also reduces the amount to be generalized from its results. The simulation is most comparable to the operator's task prior to the system execution of the query statement (i.e., where before he or she pushes the execute tab or the system equivalent, he or she writes the query statement, types it, checks it, and corrects any errors. The give

and take that occurs when the system "kicks back" an "incorrect" message or provides the "wrong" information was not simulated in this experiment.

The discrepancy between the perceived value and the empirically assessed value of using global terms is not too surprising, because results of opinion sampling do not always correlate highly with empirically assessed performance.[7] Whether stated preference would translate into greater user acceptance of the system is unknown. It seems likely that user preference would be lessened if the use of global terms produced a great deal of extraneous information.

The lack of relationship between GT score and the more important performance measures (number correct, speed of writing and typing query statements, etc.) for the range of GT scores (110-158) of participants in this experiment suggests that when the system operator is used as an intermediary, GT score may not be an important consideration. However, where the operator has to perform additional functions--for example, those of an intelligence analyst who decides what data should be retrieved--GT score may be more important. GT score might also be related to the speed of learning to use the query language, which was not measured in this experiment.

Based upon the current results, use of global terms or macroelements is not recommended unless the specific items of information subsumed under the global term are (or should be) normally retrieved together frequently. When this condition is met, use of global terms could (a) help prevent omission of important information when information requirements are not completely delineated, and (b) significantly increase the rate at which statements could be typed into the system when a large number of query requests per unit time must be input. If global terms are used, care should be taken that too many specific terms are not subsumed under global terms and that the specific items of information comprised in the global term are often requested together (or logically should be requested together).

SUMMARY

This experiment assessed the impact of using two levels of retrieval terms for formulating and inputting query statements. Specific retrieval terms were used to retrieve one element of information; global retrieval terms were used to retrieve blocks of information that would otherwise require the use of five to six specific terms. The specific terms and their definitions were taken from the Ground Order of Battle File (GOBBA), "Data Base Specifications (DS), ASSIST CONUS TESTBED SYSTEM (ACTS)."

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[7] Potash, L. M., & Jeffrey, T. E. Factors in Design of Hardcopy Topographic Maps. ARI Technical Paper 284, January 1978. AD A049621

Thirty-six enlisted personnel from Fort Belvoir with GT scores $\geq$ 110 participated in the research. Participants were assigned either to a specific group, allowed to use only specific retrieval terms, or to a global-specific group, allowed to use both global and specific retrieval terms.

The results only weakly support the use of global terms in addition to specific terms. Opportunity to use global terms had no effect either on the time necessary to write query statements or on the accuracy of typed query statements. Where the use of global terms was applicable, substantial savings in the time required to input query statements was demonstrated. Except that the global-specific group reported more use of the data name chart before using the data dictionary, the two groups indicated that they went about writing query statements in approximately the same way. Both groups gave high ratings to the value of using global terms.

Based upon these results, use of global terms is not recommended unless the specific items of information subsumed under the global term are normally retrieved together frequently.

APPENDIX A

EXAMPLES OF PROBLEMS GIVEN TO SUBJECTS

Examples of the problems given to subjects are shown in this appendix. The problem given to the subject is shown beneath the section labelled "PROBLEM." The information requirements that must be met by the query statement are labelled "DESCRIPTION OF INFORMATION REQUIREMENTS." In cases where extraneous output is to be limited, a "LIMIT OUTPUT" section is also contained as part of the problem. Note that half of the limit output requirements necessitated use of the with clause. Where use of a global term would produce output for extraneous categories of information, the LIMIT OUTPUT clause made their use illegal. Since the purpose of the experiment was not to test the subjects use of syntax, a skeleton query statement is provided at the top of each problem to aid the subject in writing the query statement. The answer(s) are provided below each query statement beneath the section labelled "ANSWER."

PROBLEM

FROM GOBA (WITH_____EQ_____) LIST_____

DESCRIPTION OF INFORMATION REQUIREMENTS

You are worried about possible offensive action by enemy units and want information related to their combat readiness as well as their defensive electronic capability. THEREFORE DESIGN YOUR QUERY STATEMENT TO OBTAIN THE FOLLOWING INFORMATION FOR ALL ENEMY UNITS:

a) The total number of enlisted personnel other than NCO's in the unit.

b) The code indicating combat readiness category of the unit.

c) The time span required for the unit to reach full combat readiness (combat ready units have time equal to 0).

d) The code indicating the primary reason that the unit is not combat ready (combat ready units have primary reason equal to 0).

e) The code indicating the secondary reason that the unit is not combat ready (combat ready units have secondary reason equal to 0).

f) The code indicating the tertiary reason that the unit is not combat ready (combat ready units have tertiary reason equal to 0).

g) The military code number of the unit.

ANSWER

ANSWER: Using global terms. From goba list crsta perem.

Using specific terms. From goba list crcat catol reasl reas2 reas3 perem munbr.

PROBLEM

FROM GOBA (WITH_____EQ_____) LIST_____

DESCRIPTION OF INFORMATION REQUIREMENTS

Your superior comes hurriedly in and says that you better determine the nuclear capability for enemy units. You decide that you only want the information output for all units where there is at least some offensive nuclear capability. THEREFORE DESIGN YOUR QUERY STATEMENT TO OBTAIN THE FOLLOWING INFORMATION FOR THE SPECIFIED ENEMY UNITS:

a) The code indicating combat readiness category of the unit.

b) The military code number of the unit.

c) The code indicating the unit's offensive nuclear weapon capability.

d) The number of personnel in each unit capable of handling offensive nuclear weapons broken out by skill category.

e) The number of operational weapons with nuclear delivery capability in the unit broken out by category of weapon.

LIMIT OUTPUT

Make sure that:

a) Data is output only for units with offensive nuclear capability equal to 01.

b) Data is output only for the above categories of information.

ANSWER

Using Global Terms. from goba with offcn eq 01 list nuthr.

Using Specific Terms. from goba with offcn eq 01 list crcat offcn sknuc nucop munbr.

PROBLEM

FROM GOBA (WITH_____EQ_____) LIST_____

DESCRIPTION OF INFORMATION REQUIREMENTS

You want to know some of the defensive capabilities of the enemy because of the upcoming offensive. You decide to get data on their defensive biological capabilities, their defensive nuclear capabilities, and their defensive electronic capabilities. You decide that you had better find out what nuclear weapons they have as well. You're in a hurry so limit the output to the information that you need. THEREFORE DESIGN YOUR QUERY STATEMENT TO OBTAIN THE FOLLOWING INFORMATION FOR ALL ENEMY UNITS:

a) The code indicating whether the different types of weapons in the units have a nuclear delivery capability.

b) The code indicating the unit's defensive electronic capability.

c) The code indicating the unit's defensive biological capability.

LIMIT OUTPUT

Make sure that data is output only for the above categories of information.

ANSWER

Using specific terms: From goba list wpnuc decae decan decab.

A global term cannot be used because of the LIMIT OUTPUT restriction.

APPENDIX B

DATA DICTIONARY (GLOBAL-SPECIFIC GROUP)

RECORD TYPE A: Unit Designators (names, level, role, etc.) the chain of operational control for that unit; the readiness status; and specific combat capabilities.

UNVAL Unit Validity Validity data for information contained in record A; indicates how likely it is that data is correct.

UNDAT Unit Date Contains the date of the latest information on unit designators.

UNCHR Unit Characteristics Contains information in data elements UNAME, MUNBR, MODES, MSSTA, MSROL.

UNAME Unit Name Contains the primary name of the unit.

MUNBR Military Unit Number Contains the Military Code Number of the unit.

MODES Military Organizational Designation Contains a code designating the organizational type for the unit by service, force, or department.

MSSTA Military Service Status Contains a code indicating availability of the unit in full time military activity.

MSROL Military Service Role Contains a code indicating functional role the unit may perform.

ATTUS Attitude Toward United States Contains a code indicating the overall attitude of the unit towards the United States.

DEPN6 Dependability Contains information in data elements DEPN1, DEPN2, DEPN3, DEPN4, DEPN5 in addition to MUNBR

DEPN1 Dependability type 1 The unit Morale Rating.

DEPN2 Dependability type 2 The unit Discipline Rating.

DEPN3 Dependability type 3 The unit Political Reliability rating.

DEPN4 Dependability type 4 The unit Officer/NCO efficiency rating.

DEPN5 Dependability type 5 The unit Combat effectiveness rating.

CRSTA Combat Readiness Contains information in data elements CRCAT, CATO1, REAS1, REAS2, REAS3 in addition to MUNBR.

CRCAT Combat Readiness Category. The code indicating the combat readiness category of the unit.

CATO1 Category type 1. Contains the time span required for the subject unit to reach full combat readiness. (Units are in days - combat ready units have time equal to 0).

REAS1 Reason number 1. Code for the primary reason the unit is not combat ready (combat ready units have primary reason equal to 0).

REAS2 Reason number 2. Code for the secondary reason the unit is not combat ready (combat ready units have secondary reason equal to 0).

REAS3 Reason number 3. Code for tertiary reason unit is not combat ready (combat ready units have tertiary reason equal to 0).

OFFCT Offensive Capability Total. Contains information in data elements OFFCN, OFFCB, OFFCC, OFFCE in addition to MUNBR.

OFFCN Offensive capability nuclear. Contains a code indicating the unit's offensive nuclear weapon capability.

OFFCB Offensive capability biological. Contains a code indicating the unit's offensive biological weapon capability.

OFFCC Offensive capability chemical. Contains a code indicating the unit's offensive chemical weapon capability.

OFFCE Offensive capability electronic. Contains a code indicating the unit's offensive electronic weapon capability.

DECAT Defensive Capability Total. Contains information in data elements DECAN, DECAB, DECAC, DECAE in addition to MUNBR.

DECAN Defensive capability nuclear. Contains a code indicating the unit's defensive nuclear capability.

DECAB Defensive capability biological. Contains a code indicating the unit's defensive biological capability.

DECAC Defensive capability chemical. Contains a code indicating the unit's defensive chemical capability.

DECAE Defensive capability electronic. Contains a code indicating the unit's defensive electronic capability.

OSTRU Organizational Structure. Contains information in data elements COMDS, SUPTP, UNCON, OPCON in addition to MUNBR.

COMDS Command designator. Indicates the type of echelon (next higher echelon) exercising control over the subject unit.

SUPTP Support type. Indicates the command/control/support relationship between the and its next higher echelon.

UNCON Unit control. Contains the name of the unit exercising operational control over the subject unit.

OPCON Operational control. Indicates the type of operational control exercised by the unit named in UNCON.

RECORD TYPE B. Personnel Strength data both actual and authorized (from Table of Organization and Equipment) broken down into officer, NCO, enlisted and civilian.

PRVAL Personnel Validity. Validity for information contained in record B.

PERDT Personnel Date. Contains the date of latest information on the personnel strength.

PERDA Personnel Data. Contains information in data elements PEREM, PERCV, PEROF, PERNC, PERTL, in addition to MUNBR.

PEREM Personnel enlisted men. Contains the total number of enlisted personnel other than NCO's in the unit.

PERCV Personnel, civilian strength. Contains the total number civilian personnel in the unit.

PEROF Personnel, officer strength. Contains the total number of officers in the unit.

PERNC Personnel, noncommissioned officer strength. Contains the total number of NCO's in the unit.

PERTL Personnel, total number of. Contains the total number of military personnel in the unit.

SKNUC Skills nuclear. Lists number of personnel in each unit capable of handling offensive nuclear weapons broken out by skill category - a 2 digit code.

RECORD TYPE C. Current location information including actual location, nearest city, temporary relocation.

LOVAL Location validity. Indicates the reliability of the location intelligence.

LODAT Location date. Contains the date of latest information for the location information.

LOINF Location information. Contains information in data elements WACNO, LONAM, CNTRY, GEOCR, UTMCR in addition to MUNBR.

WACNO World area code number. Contains the World Area Code (WAC) of the area in which the unit is located.

LONAM Location name. Contains the name of the installation or nearest city at which enemy unit is stationed.

CNTRY Country. Contains the code for the country of location at which enemy unit is stationed.

GEOCR Geographic coordinates. GEO coordinates of the city or installation at which unit is stationed.

UTMCR UTM coordinates. UTM coordinates of the city or installation at which enemy unit is stationed.

CELEV City elevation. Contains the elevation above sea level of the city or installation at which the unit is located (in meters).

NDPOT Nuclear destructive potential. Gives a rating of nuclear destructive potential against target city or installation.

RECORD TYPE D. Weapons and Equipment Assigned to the Unit.

WPVAL Weapon Validity. Contains a code for the reliability or accuracy of the intelligence information.

WPDAT Weapon date. Contains the date of latest information for the weapons data.

WPDES Weapon description. Contains information in data elements WPNAM, WPRNO, COMAF, WPNUC in addition to MUNBR.

WPNAM Weapon name. Contains the names of the different types of weapons in the unit.

WPRNO Weapon reference number. Contains the weapon reference numbers for the different types of weapons in the unit.

COMAF Country of manufacture. Contains the code for the country of manufacture of the different types of weapons in the unit.

WPNUC Weapons nuclear. Contains a code which tells whether the different types of weapons in the unit have a nuclear delivery capability.

WPQUA Weapon quantity. Contains information in data elements WPAUT, WPACT, WPOPR, in addition to MUNBR.

WPAUT Weapon authorized. Contains the quantity of weapons the unit is authorized broken out by category of weapon.

WPACT Weapon actual. Contains the actual quantity of weapons available to the unit broken out by category of weapon.

WPOPR Weapon operational. Contains the actual number of operational weapons in the unit broken out by category of weapon.

NUCOP Nuclear Operational. Number of operational weapons with nuclear delivery capability in the unit broken out by category of weapon.

RECORD TYPE E. This record contains global terms that contain information from more than one of previous record types (A, B, C, D).

NUTHR Nuclear Threat. Contains information in data elements OFFCN, CRCAT, SKNUC, NUCOP, in addition to MUNBR. Yields information concerning specified enemy units nuclear offensive capabilities.

OFFCN Offensive capability nuclear. Contains a code indicating the unit's offensive nuclear weapon capability.

CRCAT Combat readiness category. Indicates the combat readiness category of the unit.

SKNUC Skills nuclear. Lists number of personnel in each unit capable of handling offensive nuclear weapons broken out by skill category - a 2 digit code.

NUCOP Nuclear operational. Number of operational weapons with nuclear delivery capability in the unit broken out by category of weapon.

BIVLN Biological vulnerability. Contains information in data elements DEPN1, DECAB, UTMCR, CRCAT, PERTL, in addition to MUNBR. Yields information concerning vulnerability of specified enemy units to biological attack.

DEPN1 Dependability Type 1. The unit Morale Rating.

DECAB Defensive Capability Biological. Contains a code indicating the unit's defensive biological capability.

UTMCR UTM coordinates. UTM coordinates of the city or installation at which enemy unit is stationed.

CRCAT Combat Readiness Category. Indicates the combat readiness category of the unit.

PERTL Personnel, Total Number of. Contains the total number of military personnel in the unit.

NUVLN Nuclear Vulnerability. Contains information in data elements DEPN5, DECAN, UTMCR, CRCAT, in addition to MUNBR. Yields information concerning vulnerability of specified enemy units to nuclear attack.

DEPN5 Dependability Type 5. The unit Combat Effectiveness Rating.

DECAN Defensive Capability Nuclear. Contains a code indicating the unit's defensive nuclear capability.

UTMCR UTM Coordinates. UTM Coordinates of the city or installation at which enemy unit is stationed.

CRCAT Combat Readiness Category. Indicates the combat readiness category of the unit.

BITHR Biological Threat. Contains information in data elements OFFCB, CRCAT, in addition to MUNBR. Yields information concerning units biological offensive capabilities.

OFFCN Offensive Capability Nuclear. Contains a code indicating the unit's offensive nuclear weapon capability.

CRCAT Combat Readiness Category. Indicates the combat readiness category of the unit.

APPENDIX C

ANALYSES OF VARIANCE

Table C-1

Analysis of Variance for Time Required To Write Query Statements in Problem Category 3

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	802.4953	0.95	NS
Typing Speed	1	7217.4630	8.58	.01
Term Specificity	1	2204.2434	2.62	NS
GT Score x Typing Speed	1	449.4543	0.53	NS
GT Score x Term Specificity	1	386.4039	0.45	NS
Typing Speed x Term Specificity	1	2964.2373	3.52	NS
GT Score x Typing Speed x Term Specificity	1	1299.1873	1.54	NS
Within Cell (experimental error)	28	841.1411		
Total	35			

Table C-2

Analysis of Variance for Time Required To Type Query Statements in Problem Category 1

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	0.1350	0.00	NS
Typing Speed	1	87.6463	1.24	NS
Term Specificity	1	2494.0233	35.36	.01
GT Score x Typing Speed	1	0.9124	0.01	NS
GT Score x Term Specificity	1	7.7976	0.11	NS
Typing Speed x Term Specificity	1	72.1621	1.02	NS
GT Score x Typing Speed x Term Specificity	1	60.6744	0.86	NS
Within Cell (experimental error)	28	70.5430		
Total	35			

Table C-3

Analysis of Variance for Time Required To Type Query Statements in Problem Category 2

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	35.7082	0.36	NS
Typing Speed	1	644.9725	6.57	.05
Term Specificity	1	3178.4175	32.37	.01
GT Score x Typing Speed	1	120.5302	1.22	NS
GT Score x Term Specificity	1	7.7160	0.07	NS
Typing Speed x Term Specificity	1	63.9222	0.65	NS
GT Score x Typing Speed x Term Specificity	1	82.7626	0.84	NS
Within Cell (experimental error)	28	98.1891		
Total	35			

Table C-4

Analysis of Variance for Time Required To Type Query Statements in Problem Category 3

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	17.6063	0.15	NS
Typing Speed	1	1501.4446	12.47	.01
Term Specificity	1	3726.3375	30.95	.01
GT Score x Typing Speed	1	79.1923	0.66	NS
GT Score x Term Specificity	1	29.8108	0.25	NS
Typing Speed x Term Specificity	1	275.5665	2.28	NS
GT Score x Typing Speed x Term Specificity	1	27.2985	0.23	NS
Within Cell (experimental error)	28	120.4114		
Total	35			

Table C-5

Analysis of Variance for Time Required To Type Query Statements in Problem Category 4

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	8.8574	0.28	NS
Typing Speed	1	299.4854	9.51	.01
Term Specificity	1	38.5574	1.22	NS
GT Score x Typing Speed	1	36.7539	1.17	NS
GT Score x Term Specificity	1	7.1943	0.23	NS
Typing Speed x Term Specificity	1	5.3583	0.17	NS
GT Score x Typing Speed x Term Specificity	1	78.4089	2.49	NS
Within Cell (experimental error)	28	31.4804		
Total	35			

Table C-6

Analysis of Variance for Time Required To Type Query Statements in Problem Category 5

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	0.0864	0.004	NS
Typing Speed	1	415.5341	18.68	.01
Term Specificity	1	116.0544	5.22	.05
GT Score x Typing Speed	1	2.8536	2.85	NS
GT Score x Term Specificity	1	5.8806	0.26	NS
Typing Speed x Term Specificity	1	21.8428	0.98	NS
GT Score x Typing Speed x Term Specificity	1	2.1600	0.10	NS
Within Cell (experimental error)	28			
Total	35			

Table C-7

Analysis of Variance for Number of Specific Terms Recalled

Source of variation	Degrees of freedom	Mean square	F-ratio	P
GT Score	1	95.5206	4.33	.05
Typing Speed	1	28.7960	1.31	NS
Term Specificity	1	8.2134	0.37	NS
GT Score x Typing Speed	1	99.8786	4.52	.05
GT Score x Term Specificity	1	167.2708	7.58	.05
Typing Speed x Term Specificity	1	1.0586	0.05	NS
GT Score x Typing Speed x Term Specificity	1	33.7010	1.53	NS
Within Cell (experimental error)	28	22.0571		
Total	35			

Table C-8

Analysis of Variance for Time Required To Write Query Statements in Problem Category 1

Source of variation	Degrees of freedom	Mean square	F-ratio	P
Number of correct query statements	1	162.8261	0.19	NS
Number of specific terms recalled	1	513.9161	0.60	NS
Retrieval term specificity	1	448.3946	0.53	NS
Number of correct query statements x number of specific terms recalled	1	1425.7178	1.67	NS
Number of correct query statements x retrieval term specificity	1	6541.2980	7.68	.05
Number of specific terms recalled x retrieval term specificity	1	2316.7222	2.72	NS
Number of correct query statements x number of specific terms recalled x retrieval term specificity	1	988.9415	1.16	NS
Within cell	28	851.8144		
Total	35			

Table C-9

Analysis of Variance for Number of Times the Correction Procedure was Used

Source of variation	Degrees of freedom	Mean square	F-ratio	P
Number of correct query statements	1	173.9322	9.15	.01
Number of specific terms recalled	1	25.6391	1.35	NS
Retrieval term specificity	1	37.4867	1.97	NS
Number of correct query statements x number of specific terms recalled	1	3.6124	0.19	NS
Number of correct query statements x retrieval term specificity	1	3.2366	0.17	NS
Number of specific terms recalled x retrieval term specificity	1	16.9781	0.89	NS
Number of correct query statements x number of specific terms recalled x retrieval term specificity	1	0.0648	0.00	NS
Within cell	28	19.0029		

ARI Distribution List

4 OASD (M&RA)
2 HQDA (DAMI-CSZ)
1 HQDA (DAPE-PBR)
1 HQDA (DAMA-AR)
1 HQDA (DAPE-HRE-PO)
1 HQDA (SGRD-ID)
1 HQDA (DAMI-DOT-C)
1 HQDA (DAPC-PMZ-A)
1 HQDA (DACH-PPZ-A)
1 HQDA (DAPE-HRE)
1 HQDA (DAPE-MPO-C)
1 HQDA (DAPE-DW)
1 HQDA (DAPE-HRL)
1 HQDA (DAPE-CPS)
1 HQDA (DAFD-MFA)
1 HQDA (DARD-ARS-P)
1 HQDA (DAPC-PAS-A)
1 HQDA (DUSA-OR)
1 HQDA (DAMO-RQR)
1 HQDA (DASG)
1 HQDA (DA10-PI)
1 Chief, Consult Div (DA-OTSG), Adelphi, MD
1 Mil Asst. Hum Res, ODDR&E, OAD (E&LS)
1 HQ USARAL, APO Seattle, ATTN: ARAGP-R
1 HQ First Army, ATTN: AFKA-OI-TI
2 HQ Fifth Army, Ft Sam Houston
1 Dir, Army Stf Studies Ofc, ATTN: OAVCSA (DSP)
1 Ofc Chief of Stf, Studies Ofc
1 DCSPER, ATTN: CPS/OCP
1 The Army Lib, Pentagon, ATTN: RSB Chief
1 The Army Lib, Pentagon, ATTN: ANRAL
1 Ofc, Asst Sect of the Army (R&D)
1 Tech Support Ofc, OJCS
1 USASA, Arlington, ATTN: IARD-T
1 USA Rsch Ofc, Durham, ATTN: Life Sciences Dir
2 USARIEM, Natick, ATTN: SGRD-UE-CA
1 USATTC, Ft Clayton, ATTN: STETC-MO-A
1 USAIMA, Ft Bragg, ATTN: ATSU-CTD-OM
1 USAIMA, Ft Bragg, ATTN: Marquat Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Tng Dir
1 USA Quartermaster Sch, Ft Lee, ATTN: ATSM-TE
1 Intelligence Material Dev Ofc, EWL, Ft Holabird
1 USA SE Signal Sch, Ft Gordon, ATTN: ATSO-EA
1 USA Chaplain Ctr & Sch, Ft Hamilton, ATTN: ATSC-TE-RD
1 USATSCH, Ft Eustis, ATTN: Educ Advisor
1 USA War College, Carlisle Barracks, ATTN: Lib
2 WRAIR, Neuropsychiatry Div
1 DLI, SDA, Monterey
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-MR
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-JF
1 USA Arctic Test Ctr, APO Seattle, ATTN: STEAC-PL-MI
1 USA Arctic Test Ctr, APO Seattle, ATTN: AMSTE-PL-TS
1 USA Armament Cmd, Redstone Arsenal, ATTN: ATSK-TEM
1 USA Armament Cmd, Rock Island, ATTN: AMSAR-TDC
1 FAA-NAFEC, Atlantic City, ATTN: Library
1 FAA-NAFEC, Atlantic City, ATTN: Human Engr Br
1 FAA Aeronautical Ctr, Oklahoma City, ATTN: AAC-44D
2 USA Fld Arty Sch, Ft Sill, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DI-E
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DT-TP
1 USA Armor Sch, Ft Knox, ATTN: ATSB-CD-AD
2 HQUSACDEC, Ft Ord, ATTN: Library
1 HQUSACDEC, Ft Ord, ATTN: ATEC-EX-E-Hum Factors
2 USAEEC, Ft Benjamin Harrison, ATTN: Library
1 USAPACDC, Ft Benjamin Harrison, ATTN: ATCP-HR
1 USA Comm-Elect Sch, Ft Monmouth, ATTN: ATSN-EA
1 USAEC, Ft Monmouth, ATTN: AMSEL-CT-HDP
1 USAEC, Ft Monmouth, ATTN: AMSEL-PA-P
1 USAEC, Ft Monmouth, ATTN: AMSEL-SI-CB
1 USAEC, Ft Monmouth, ATTN: C, Facl Dev Br
1 USA Materials Sys Anal Agcy, Aberdeen, ATTN: AMXSY-P
1 Edgewood Arsenal, Aberdeen, ATTN: SAREA-BL-H
1 USA Ord Ctr & Sch, Aberdeen, ATTN: ATSL-TEM-C
2 USA Hum Engr Lab, Aberdeen, ATTN: Library/Dir
1 USA Combat Arms Tng Bd, Ft Benning, ATTN: Ad Supervisor
1 USA Infantry Hum Rsch Unit, Ft Benning, ATTN: Chief
1 USA Infantry Bd, Ft Benning, ATTN: STEBC-TE-T
1 USASMA, Ft Bliss, ATTN: ATSS-LRC
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA-CTD-ME
1 USA Air Def Sch, Ft Bliss, ATTN: Tech Lib
1 USA Air Def Bd, Ft Bliss, ATTN: FILES
1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: ATSW-SE-L
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: DepCdr
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: CCS
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCASA
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACO-E
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-CI
1 USAECOM, Night Vision Lab, Ft Belvoir, ATTN: AMSEL-NV-SD
3 USA Computer Sys Cmd, Ft Belvoir, ATTN: Tech Library
1 USAMERDC, Ft Belvoir, ATTN: STSFB-DQ
1 USA Eng Sch, Ft Belvoir, ATTN: Library
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-TD-S
1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATS-CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEX-GS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTS-OR
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-DT
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: DAS/SRD
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEM
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: Library
1 CDR, HQ Ft Huachuca, ATTN: Tech Ref Div
2 CDR, USA Electronic Prvg Grd, ATTN: STEEP-MT-S
1 HQ, TCATA, ATTN: Tech Library
1 HQ, TCATA, ATTN: AT CAT-OP-Q, Ft Hood
1 USA Recruiting Cmd, Ft Sheridan, ATTN: USARCPM-P
1 Senior Army Adv., USAFAGOD/TAC, Elgin AF Aux Fld No. 9
1 HQ, USARPAC, DCSPER, APO SF 96558, ATTN: GPPE-SE
1 Stimson Lib, Academy of Health Sciences, Ft Sam Houston
1 Marine Corps Inst., ATTN: Dean-MCI
1 HQ, USMC, Commandant, ATTN: Code MTMT
1 HQ, USMC, Commandant, ATTN: Code MPI-20-28
2 USCG Academy, New London, ATTN: Admission
2 USCG Academy, New London, ATTN: Library
1 USCG Training Ctr, NY, ATTN: CO
1 USCG Training Ctr, NY, ATTN: Educ Svc Ofc
1 USCG, Psychol Res Br, DC, ATTN: GP 1/62
1 HQ Mid-Range Br, MC Det, Quantico, ATTN: P&S Div

1 US Marine Corps Liaison Ofc, AMC, Alexandria, ATTN: AMCGS-F
1 USATRADOC, Ft Monroe, ATTN: ATRO-ED
6 USATRADOC, Ft Monroe, ATTN: ATPR-AD
1 USATRADOC, Ft Monroe, ATTN: ATTS-EA
1 USA Forces Cmd, Ft McPherson, ATTN: Library
2 USA Aviation Test Bd, Ft Rucker, ATTN: STEBG-PO
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Library
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Educ Advisor
1 USA Aviation Sch, Ft Rucker, ATTN: PO Drawer O
1 HQUSA Aviation Sys Cmd, St Louis, ATTN: AMSAV-ZDR
2 USA Aviation Sys Test Act., Edwards AFB, ATTN: SAVTE-T
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA TEM
1 USA Air Mobility Rsch & Dev Lab, Moffett Fld, ATTN: SAVDL-AS
1 USA Aviation Sch, Res Tng Mgt, Ft Rucker, ATTN: ATST-T-RTM
1 USA Aviation Sch, CO, Ft Rucker, ATTN: ATST-D-A
1 HQ, DARCOM, Alexandria, ATTN: AMXCD-TL
1 HQ, DARCOM, Alexandria, ATTN: CDR
1 US Military Academy, West Point, ATTN: Serials Unit
1 US Military Academy, West Point, ATTN: Ofc of Milt Ldrshp
1 US Military Academy, West Point, ATTN: MAOR
1 USA Standardization Gp, UK, FPO NY, ATTN: MASE-GC
1 Ofc of Naval Rsch, Arlington, ATTN: Code 452
3 Ofc of Naval Rsch, Arlington, ATTN: Code 458
1 Ofc of Naval Rsch, Arlington, ATTN: Code 450
1 Ofc of Naval Rsch, Arlington, ATTN: Code 441
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Acous Sch Div
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L51
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L5
1 Chief of NavPers, ATTN: Pers-OR
1 NAVAIRSTA, Norfolk, ATTN: Safety Ctr
1 Nav Oceanographic, DC, ATTN: Code 6251, Charts & Tech
1 Center of Naval Anal, ATTN: Doc Ctr
1 NavAirSysCom, ATTN: AIR-5313C
1 Nav BuMed, ATTN: 713
1 NavHelicopterSubSqua 2, FPO SF 96601
1 AFHRL (FT) Williams AFB
1 AFHRL (TT) Lowry AFB
1 AFHRL (AS) WPAFB, OH
2 AFHRL (DOJZ) Brooks AFB
1 AFHRL (DOJN) Lackland AFB
1 HQUSAF (INYSD)
1 HQUSAF (DPXXA)
1 AFVTG (RD) Randolph AFB
3 AMRL (HE) WPAFB, OH
2 AF Inst of Tech, WPAFB, OH, ATTN: ENE/SL
1 ATC (XPTD) Randolph AFB
1 USAF AeroMed Lib, Brooks AFB (SUL-4), ATTN: DOC SEC
1 AFOSR (NL), Arlington
1 AF Log Cmd, McClellan AFB, ATTN: ALC/DPCRB
1 Air Force Academy, CO, ATTN: Dept of Bel Scn
5 NavPers & Dev Ctr, San Diego
2 Navy Med Neuropsychiatric Rsch Unit, San Diego
1 Nav Electronic Lab, San Diego, ATTN: Res Lab
1 Nav TrngCen, San Diego, ATTN: Code 9000-Lib
1 NavPostGraSch, Monterey, ATTN: Code 55Aa
1 NavPostGraSch, Monterey, ATTN: Code 2124
1 NavTrngEquipCtr, Orlando, ATTN: Tech Lib
1 US Dept of Labor, DC, ATTN: Manpower Admin
1 US Dept of Justice, DC, ATTN: Drug Enforce Admin
1 Nat Bur of Standards, DC, ATTN: Computer Info Section
1 Nat Clearing House for MH-Info, Rockville
1 Denver Federal Ctr, Lakewood, ATTN: BLM
12 Defense Documentation Center
4 Dir Psych, Army Hq, Russell Ofcs, Canberra
1 Scientific Advsr, Mil Bd, Army Hq, Russell Ofcs, Canberra
1 Mil and Air Attache, Austrian Embassy
1 Centre de Recherche Des Facteurs, Humaine de la Defense Nationale, Brussels
2 Canadian Joint Staff Washington
1 C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
3 Chief, Canadian Def Rsch Staff, ATTN: C/CRDS(W)
4 British Def Staff, British Embassy, Washington
1 Def & Civil Inst of Enviro Medicine, Canada
1 AIR CRESS, Kensington, ATTN: Info Sys Br
1 Militaerpsykologisk Tjeneste, Copenhagen
1 Military Attache, French Embassy, ATTN: Doc Sec
1 Medecin Chef, C.E.R.P.A.-Arsenal, Toulon/Naval France
1 Prin Scientific Off, Appl Hum Engr Rsch Div, Ministry of Defense, New Delhi
1 Pers Rsch Ofc Library, AKA, Israel Defense Forces
1 Ministeris van Defensie, DOOP/KL Afd Sociaal Psychologische Zaken, The Hague, Netherlands