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ABSTRACT

This paper reports on a project aimed at finding out what students do when working cloze passages on computer. To generate data, a computer-based cloze program, "Super Cloze," was configured so that all student keypresses would be recorded. This was worked by several classes of students at Sultan Qaboos University (Oman) during their scheduled computer lab sessions. The data reveal fresh insights into what students do when working with computer-based cloze. Following on these insights, suggestions are made for developers of computer-assisted language learning cloze programs, particularly in optimal design of help and hint features. (JL)

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Strategies in solving computer-based cloze: Is it reading?

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A paper presented at the 25th Annual TESOL Convention
New York, March 24-28, 1991

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ABSTRACT

Cloze tests and exercises are commonly used in language learning settings, and with recent interest in text manipulation, their implementation on computer has proliferated, as computer-generated cloze creation is purely mechanical. Performance on cloze exercises has been related to reading ability; however, it has been suggested (Windeatt, 1986) that strategies used by students in solving clozes on computer are quite different from those used by students working from print medium.

This paper reports on a project aimed at finding out what students do when working cloze passages on computer. To generate data, a computer-based cloze program was configured so that all student keypresses would be recorded, and this was worked by several classes of students during their scheduled computer lab sessions.

Besides confirming many of Windeatt's findings regarding the differences in strategies employed when addressing computer- and print-based cloze passages (for example, that students working at computers solve problems in strictly linear order rather than working holistically), the data reveal fresh insights into what students do when working with computer-based cloze. Following on these insights, suggestions are made for developers of CALL-based cloze programs, particularly in optimal design of help and hint features.

INTRODUCTION

Cloze tests and exercises are commonly used in language learning settings. With recent interest in text manipulation, and as computer-generated cloze creation is purely mechanical, their implementation on computer has proliferated (e.g. Clozemas-ter, Jones, 1983; M-ss-ng L-nks, Chomsky and Schwartz, 1984; Super Cloze, Millmore and Stevens, 1990).

Performance on cloze exercises has been related to reading proficiency (Alderson, 1979 and 1980; Jonz, 1990); however, it has been suggested (Windeatt, 1986) that strategies used by students in solving cloze passages on computer are quite different from those used by students working from print medium. For example, students working at computers tend to deal with text one screen at a time rather than in its entirety, to work linearly and "get stuck on particular gaps" (p. 89), and to make more guesses at individual gaps than do students working cloze on paper. Windeatt also found that students using computer-based cloze were "reluctant" to use the help options available.

As Windeatt's experimental design employed split-screen video, with cameras trained simultaneously on the students and their monitors, the study points up salient differences between intrusive and non-intrusive studies. By "intrusive" is meant a study in which the researcher affects outcome by intruding on subjects with monitoring instruments not normally present during the process under study. Non-intrusive studies are those in which subjects are not aware that they are being studied.

Some devices (for example, video or audio recording equipment) may have only a temporary effect on subjects, and this is

often taken into account; for example, Fawcett (1980) was careful to collect samples of children's informal speech from the point that the children seemed to ignore the microphone. Thus the intrusion may not persist throughout an entire experiment. However, there is no accurate way of determining when intrusion ceases to be a factor, if it ever does, nor when it might unexpectedly come back into play during an experimental treatment.

Thus intrusion becomes a factor in a survey whenever a subject is aware that he or she is being studied, and it is difficult to say how this awareness peaks and ebbs during an experiment. It is accordingly difficult to assess the spontaneity of a subject's actions in vitro as opposed to those in vivo, as one could characterize conditions in non-intrusive studies. Aware that their moves are being recorded for replay, analysis, and judgment later, subjects may alter their behavior compared with what they would do if they didn't know they were being studied, thus reducing confidence in using research findings to predict behavior in circumstances beyond the experimental conditions.

There are perfectly good reasons for doing intrusive studies, as when the researcher requires more control over variables (e.g. control over task and time-on-task, recapitulation via interviews) than would be possible with non-intrusive studies. Conversely, researchers studying phenomena non-intrusively may lose these advantages, or lose the possibility for control treatment altogether. However, it may be that only non-intrusive studies can provide a true picture of naturally implemented CALL.

One circumstance pertinent to CALL is its function as a tool for self-access, and the study of CALL effectiveness in self-access does not lend itself to intrusive study. In other words,

if we want learners to act in a way natural to self-access, then the prime conditions of self-access (e.g. free choice of materials, work in private) must be maintained. Thus the study of CALL under self-access conditions cannot accurately be studied if subjects are aware that their behavior will come under scrutiny.

In a prior non-intrusive study, Stevens (1990) tracked student interaction with computer-based Hangman and classified student approaches to solving the problems as being either competency-based or non-competency based; that is, the subjects either used linguistic competence to solve the Hangman puzzles or they didn't. Common non-competency-based behaviors were abuse of hints, and resort to patterned or clustered keypresses. Stevens found that his subjects exhibited only 57% competency-based behaviors vs. 92% competency-based for "ideal" learners working either as native or non-native speakers of a target language; in other words, many subjects in the study employed Hangman as a self-access distraction. The study has not been replicated under intrusive conditions, but it is plausible that students who knew they were being studied would have paid more attention to what they were doing. Conversely, it is possible that Windeatt's finding that subjects made infrequent use of the help options would be overturned in a non-intrusive replication of his study. These are areas obviously ripe for future study.

One question addressed in the present research is: do students "tune out" in a similar manner with computer-based cloze, which one would expect would be more cognitively engaging than Hangman, and in self-access might attract students of more serious caliber and inclination? This paper reports on a non-intru-

sive study aimed at finding out just what students do when working cloze passages on computer.

PROCEDURE

Super Cloze is a computer program which generates cloze exercises from ascii text files, one paragraph at a time, by default deleting every fifth word in the paragraph. However, students may over-ride the default setting as follows: they may change the deletion ratio to any value between 2 and 9; or they may choose to have only words in special word lists deleted. Super Cloze also offers a third option: deletion of words designated as targets in the ascii text itself, but this facility was not available to subjects in this study.

Super Cloze was placed on self-access in the Student Resource Centre (SRC) at Sultan Qaboos University in Oman and configured so that all keypresses of students using the program would be recorded. Occasionally, students were taken as a class to the SRC and encouraged to use the program with materials they were studying in that class.

Data in this study were collected from one such session. This particular session was chosen because the researcher was present and therefore had some idea of who the subjects were and what they were doing while working the cloze lessons; thus it was possible to attenuate some of the disadvantages to non-intrusive studies. It should be stressed however that the role of the researcher during the session was to help students locate their materials in the database; the researcher did not insist that any student use these materials or work only with Super Cloze. It was only after accumulation of a sizable body of information that

the need to work with a limited subset of the available data became obvious, at which point the researcher settled on this subset for the reasons just noted.

The data therefore represent interaction with the cloze program of 28 Omani second year university engineering students, both male and female, grouped at 14 computers in a CALL lab scheduled during their ESL class. Although free to do as they liked, the students had been encouraged to use Super Cloze to practice a passage on Young's split screen experiment, a reading whose paragraphs were lengthy and difficult, though all the students were supposed to have read the material beforehand, and the experiment had been discussed in class. The students in the experiment spent from 10 to 45 minutes on the recommended materials, 30 minutes being about average.

The data were analyzed in two stages. As often happens in exploratory studies, data analysis was more tedious than it might have been; in fact, the act of analysis itself led to many improvements to the data collection program. One of these improvements was to build in more frequent time markers, so that in future more accurate information regarding timing can be taken than that noted above. Other improvements will cause most of the first stage analysis to be done automatically in future studies using Super Cloze.

In the first stage analysis, the interaction was reproduced. The cloze passages were reconstructed, student cursor movements were tracked from gap to gap, student input at each gap was reconstructed, and a complete inventory of student behaviors and strategies was compiled.

In the second stage, the student behaviors and strategies were categorized as falling within one of four super-categories and tallied. The super-categories were: (1) achieving the correct answer the first time, (2) achieving the correct answer after feedback to error, (3) utilizing help, and (4) skipping a problem (once attempted) without achieving the correct answer.

Super Cloze was designed so that students should always be able to achieve a correct answer. Besides the program checking their answers for match with the deleted text, the students can see the number of letters required in any gap. Furthermore, they can at any time see the letter required at the current cursor position. Finally, they can see the solution; i.e. see the paragraph with all the gaps filled in and return to solving the problem. So options for achieving the correct answer range from trial-and-error through use of hints (to reveal any number of characters) to copying the answer from the solution screen, and these options are provided to prevent students' ever becoming "stuck" on any given problem.

In other words, the program provides users with multiple options regarding the strategies they wish to employ in resolving answers to cloze gaps, and these strategies come into play whenever subjects seek help, quit, or are not able to answer cloze gaps before first press of the Enter key.

(1) ACHIEVING THE CORRECT ANSWER THE FIRST TIME

Student input was considered correct-the-first-time when students either typed out the correct answer straight away or arrived at the correct answer after backspacing over errors or typos prior to first press of the Enter key for that problem. No

attempt was made to analyze errors or typos when the student arrived at the correct answer before first press of the Enter key.

(2) ACHIEVING A CORRECT ANSWER AFTER FEEDBACK TO ERROR

If the correct answer and student input did not match once the Enter key was pressed, then the input was categorized as follows:

- (a) NONSENSE - the student input bore no relation to any word or plausible answer in English;
- (b) WRONG WORD - the student typed a wrong word;
- (c) WRONG FORM - the student used an incorrect form of the correct word;
- (d) CAPITALIZATION ERROR - the student's input did not match the expected answer only because incorrect case was used;
- (e) DIACRITIC ERROR - the expected answer contained a number or diacritic not present in the student's input; or
- (e) PREMATURE ENTER - the student struck the Enter key prematurely, before completing the answer.

(3) UTILIZING HELP

In the course of getting an answer correct or incorrect, or prior to exiting without resolving a gap, students could get the program to provide help. There were three ways this could be accomplished:

- (a) HELP - Students could press F1 to see a help screen which explained how to use the program;
- (b) SEE SOLUTION - Students could press F5 to see the solution, which meant they were shown the paragraph in full - students could toggle between solution and problem

screens at will in this implementation of Super Cloze;

(c) HINT - Students could press F8 to reveal the letter expected at the present cursor position.

(4) SKIPPING A PROBLEM WITHOUT ACHIEVING THE CORRECT ANSWER

Students could exit a problem in three ways; either they could achieve a correct solution to a gap, or they could:

(a) SKIP TO NEXT GAP - Students could press a cursor movement key to move on to another gap (students sometimes did this by mistake, pressing a cursor key in lieu of the Enter key). In this event, they had the option of returning to the gap later; or

(b) SKIP TO NEXT PASSAGE - Students could press F9 to abandon the passage altogether.

In addition to a tally of learner responses according to the above categories, data were also collected on characteristics of the cloze passage itself. These data included the number of words in each paragraph presented, the number of gaps per passage, the deletion ratio, and number of characters in each gapped word. Finally, where hints were used, the percent of the number of hints vs. word-length was calculated.

RESULTS

The data are arranged primarily by workstation, the 14 of which are numbered 1 through 9, then A through E, and can be considered paragraph by paragraph, as in Table 1 (1-1 in the left column means Group 1, paragraph 1, etc.), or gap by gap, as in Figures 1 - 6. The data are most revealing when presented in the

latter format; however, as there were 539 gaps attempted by the students at the 14 workstations over the 30 or 40 minutes most worked at Super Cloze, a table comprising these results is too large to present here. For convenience of presentation, the values for each paragraph can be totaled as shown in Table 1 (and explained more thoroughly in the Key to Tables and Figures) to give "bottom line" statistical information, from which certain conclusions can be drawn.

The right-most column shows the options for targets for deletion chosen by students in each paragraph. Given the choice of deletion ratios (n=) varying from 2 to 9 (with 5 the default value) students invariably selected values ranging from 2 to 5 (actual deletion ratios were slightly higher than these values because dates and numbers were not clozed). Students could also chose word lists causing deletion of all pronouns, prepositions, helping verbs, all words with three letters, and words with greater than three letters (other choices were words of exactly or greater than 4 or 5 letters). They also sometimes chose a list called "nothing," which deletes all the words in the passage (i.e. n=1). Frequency of choice of the various options for deletion are shown in Table 2.

TABLE 2

TARGET FOR DELETION:	TIMES CHOSEN:
every 5th word (n=5)	28
helping verbs	8
all words ("nothing"; n=1)	4
every other word (n=2)	4
pronouns	3
3-letter words	3
every 3rd word (n=3)	3
every 4th word (n=4)	3
more than 3-letter words	1
prepositions	1

It is encouraging to see that over half the time, the students experimented with something other than the default value. It is also possible to examine whether passage difficulty (as indicated by deletion ratio, average word length, number of letters in words attempted, passage length, and number of gaps per paragraph) had any bearing on student frustration or success (as indicated by number of gaps attempted, the percent of the entire passage attempted, and frequency of use of help features).

In general, correlations were not well established (Table 3), probably because there was not enough variety in the texts used in this study to yield appreciable differences in student success or frustration. However, at around the $p = .005$ level of significance, the percentage of gaps completed by students per number of gaps in the passage correlated positively with deletion ratio and negatively with the number of gaps in the passage. In other words, and not surprisingly, the higher the deletion ratio (that is, the fewer the gaps), the further along in the passage the students got. In addition, two tendencies ($p < .1$) were noted: the number of letters in gapped words encouraged use of See Solution and Hint; also longer word lengths suppressed the percent of passages attempted.

DISCUSSION

The data confirmed many of Windeatt's findings regarding the differences in strategies employed when addressing computer- and print-based cloze passages. For example, all but 3 of the 14 groups of students worked the problems in strictly linear order; of these 3, two groups worked only one problem out of order (out of 19 and 32 gaps respectively). The third group worked only 5

out of 40 problems out of order, all of these occurring in the 24 gaps in the first two of three paragraphs attempted (A-1 and A-2, Figure 1; the 16 problems in the last paragraph were all worked in linear order). Thus there was a strong tendency for students to move down the screen from gap to gap, working each problem until it was resolved, rather than to approach the passages holistically.

Indeed there is scant evidence that students did any holistic reading at all. In the 58 paragraphs analyzed, only 9 (15.5%) were solved completely. Close examination of these cases shows:

- in 4 of the 9 cases, the students saw the solution screen for 59%, 58%, 34%, and 31% of the gaps they had to solve;
- in one case (C-1, Figure 2), the students solved 17 of 26 problems using hints, 9 of those (35%) using hints for more than half the characters in the answers, and 3 of the 9 using hints for ALL the characters in the answers;
- in one case where the students solved 32 gaps with only 5 wrong-word errors (5-2, Table 1), copying from the book cannot be ruled out; later in their session (5-6, Table 1), this group solved 22 gaps correctly (no errors, only one See Solution) with the deletion rate set at every word, strongly suggesting that the book was used.
- of the other three paragraphs solved completely, one had only 1 gap and two had only 4 (because deletion from Wordlist had been selected, and only 1 or 4 of the words on the list appeared in those particular paragraphs), in which case the reading required would be only in the immediate context of the gaps.

Therefore, in every case where students completed the paragraphs they were working on, they relied extensively on help; and in only three of the nine cases, where help used was in the 30-40% range, could it be said that reading of the entire paragraph, with comprehension, was a possibility.

Each of the 58 paragraphs encountered was displayed in its entirety on the subjects' monitors, so that students in this study were confronted with 2435 gaps. Of these, the subjects attempted 539 gaps, or 22.1% (and solved 476, or 19.5% of all gaps encountered, correctly). Thus the "reading" rate in this study would be about 20% of the total.

In addition to the nine cases where students dealt in some way with all gaps in the entire passage, 8 paragraphs were completed substantially beyond the 20% rate calculated above.

Taking these on a case by case basis:

- Group B worked only briefly on 4 of their 6 paragraphs; of the other two, they got through 50% of one (B-3, Table 1), but peeked at the solution screen 4 times in 12 gaps. In the other paragraph (B-6), they solved 61% of the blanks, but in doing so used hints to discern ALL the characters in the last 15 of 17 words attempted, echoing the "tuned out" non-competent behavior discovered with the majority of the subjects in the Hangman study cited earlier.
- Similarly, Group 8 solved 72% of their fifth passage (8-5, Figure 3), but used hints in 11 of 22 gaps attempted. In 6 of these, they used hints for 50% of the letters or fewer, but with 7 gaps (32%), they requested to see all or all but one of the letters required (hints requested for the two gaps with just 2 letters are included in both tallies).

- As can be seen from Figure 4, the work in D-1 is scattered with errors eventually resolved, suggesting that some effort was put into the first 20 gaps. Although this group used the solution screen 7 times, they delayed use of this strategy to the last 10 of 30 problems attempted (at which point they were essentially copying answers). They probably resorted to this ploy in order to get through most of the material by the end of the period, but reading strategies appear to have been applied in the first two thirds of the paragraph.
- Similarly, Group 9 (9-1, Figure 5) concentrated on one paragraph throughout the entire class period and solved 78% of it with no use of help; however, a healthy scattering of errors suggests judicious use of feedback, implying application of valid reading strategies.
- Group 6 (6-2, Figure 6) appears to have done some reading as well, completing 34% of the second of 5 paragraphs on which they made any real attempt. They correctly addressed 6 of 11 gaps before using the solution screen and hints to solve three of the next 5 problems. Use of hints was reasonable: 2 out of 5 and 4 out of 7 characters for two gaps.
- Group E (Table 1) spent the entire time on two paragraphs, achieving 56% and 70% completion rates. In so doing, the students made only 11 errors in 55 gaps; here, the students were either especially competent, or (possibly) using an external text.

Overall, these results suggest that reading rarely occurred on a global level, although reading of up to 20% of the material was not uncommon. Since the students tended to work linearly

from gap to gap starting with the first one, the gaps attempted would be the ones toward the beginning of each passage. Thus except in the cases noted above where students completed the passages or came close to completion, there is no evidence that the last 80% of the paragraphs were read at all. Windeatt's students in contrast read entire passages, as evidenced by recordings of their reading aloud. Whether they would have done so if left to their own devices is called to question by the results here.

Also disputed in this study is Windeatt's finding that with CALL-based cloze, students "seem reluctant to use the 'help' or 'cheat' facility" (p. 89). However, the Help information screen was requested at some point in 36% of all paragraphs in the present study. Hints were requested to help solve 9% of the gaps presented, and the students used See Solution for 18% of all words attempted (on average, 1.67 times per paragraph). As it is possible when viewing the solution screen to check on several gaps at a time, this facility may have been used to solve an even higher number of gaps.

Requests for hints reveal a letter at a time and give students a boost in using their intelligence to work out a likely word fitting the context in question; thus some use of hints is to be encouraged. Despite the exceptions noted above, hints were rarely abused. If we define "hint abuse" as using hints to reveal over 50% of the letters in an unsolved word, then in 13 paragraphs (22%) hint abuse occurred with at least one word; but in only 5 cases (8.6%) were more than a third of the gaps in a single paragraph thus abused.

See Solution was meant to allow students to view the para-

graph in total and then return to the problem screen and concentrate on vocabulary and syntax with questions of meaning resolved, but the students in this study appear to have used this feature in many cases as a source of answers to be copied; thus this feature appears to have been abused. Indeed, in 14 of the 58 paragraphs attempted (24%), students invoked See Solution for a quarter or more of the blanks attempted in those paragraphs.

As far as Windeatt's findings are concerned, it may be that the reluctance of his subjects to "cheat" was due more to the presence of cameras than to the nature of the medium under study. Indeed, this study shows that students are more willing to use help features when they feel they are "on their own" than when the researcher is palpably present. (Of course, this is true only if the students themselves are considered equal; it is more likely that individual differences in students could cause one individual or group to eschew help while another individual or group might view the ethics of receiving help differently. The presence of recording equipment could exacerbate such differences).

An ancillary discovery made in the course of the present project is that capitalization can be taught with computer-based cloze. Of 28 problems where answers were incorrect only because of capitalization, 26 were resolved successfully; and this does not take into consideration cases where capitalized words were, once learned, reconstructed correctly by the students and counted simply as correct-first-time. Despite this success, the question remains whether it is worth frustrating students during the time it takes to drive home the point (note for example how A-1,

Figure 1, reached an impasse over capitalization and then reverted to nonsense input and skipping problems before quitting). For diacritics, the answer is more assuredly no. Of the ten instances in the database where diacritics were encountered in gaps, only 5 such problems were resolved, whereas 5 were skipped in frustration.

Getting back to the question raised by the Hangman study, do students "tune out" with computer-based cloze as was the case with Hangman? The answer appears to be: sometimes, but much less frequently. As has been noted, there was some persistent help abuse, suggesting that the subjects in those cases were giving little thought to solution of the cloze problems. Furthermore, at least one set of students used the text book to copy answers, and such instances appear in the data as sessions where answers are mostly correct, with very little interaction with the program and, presumably, very little reading for comprehension.

On the other hand, the fact that the nonsense rate (the incidence of students entering gibberish) was a respectably low 7.4% suggests that students approached computer-based cloze more seriously than they did Hangman, where incidence of throw-away key-presses was higher. Also, subjects gained some awareness of capitalization in English. In sum, although there was some evidence of lack of engagement on the part of students in the learning task, there was further evidence that 20% of the passages - in some cases more - were being read.

CONCLUSION

Two lessons can be gained from the present research:

- (1) It is vital that CALL software be subjected to close scrutiny

in order to verify its use in a manner appropriate to language learning. Many untested assumptions have been made by theorists in our field regarding the use of CALL software; it is important to test not only the assumptions (e.g. does text manipulation cognitively engage students?) but that the software carries out the assumptions (e.g. how can a particular piece of text manipulation software be improved so that it cognitively engages students?).

- (2) It is important that research conducted to test CALL software for self-access be, at some stage, non-intrusive. Although carefully controlled and unavoidably intrusive studies have an important role in CALL research, it is important to be aware of their shortcomings, particularly in predicting the behavior of students who may not understand the rationale behind the software and may "tune out" as they use it on their own.

This study has implications for the design of CALL-based cloze programs, particularly in optimal design of help and hint features. Higgins's (1983, 1988) vision of the computer as pedagogue to a bright and inquiring student did not consider the possibility that the student might be snapping his fingers and ordering the pedagogue about: answer this, answer that, and don't bother me with details. The concept is basically sound; it's just that the forthcoming pedagogue must not abrogate its responsibility to guide students toward self-reliance. Both this study and Stevens (1990) suggest that unlimited hint and solution features may do some students a disservice by providing them a tool with potential for abuse. Although such features are an integral part of self-access CALL, further experimentation is

needed to refine exactly how and to what extent help can optimally be meted out to students.

This research has led to changes in the Super Cloze program. Besides refinement of the data collection noted earlier, the program has been changed so that it no longer clozes words containing capitals or diacritics, with plans to give the student the option of attending to case if desired. The study has also pointed up the need for work on scoring as an incentive to productive use of the program (i.e. as a disincentive to abuse). For example, one hint per gap could be free, with the price in points sliding upwards and increasing dramatically as 50% of the characters in an unsolved word were revealed. A single peek at the solution screen could also be lightly charged, with subsequent looks increasingly costly in point value.

Computer-based cloze undoubtedly has great potential, but this study questions whether that potential is realized with present implementations. Developers of such programs need to establish patterns of actual use in order to build into their programs inducements to pedagogically viable outcomes.

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KEY TO TABLES AND FIGURES

w/p = words per paragraph
#gap = number of gaps per paragraph
d/r = deletion ratio (w/p divided by #gap x 100)
#att = number of gaps attempted per paragraph
%att = % of gaps attempted (#att divided by #gap x 100)

For the following values, columns in Figures are TOTALED to give "bottom line" results unless otherwise noted.

len = length of each gapped word
bottom line is avlen, or average word length
ltr = total number of letters in a passage (sum of all len)
#ht = number of hints per word; bottom line is total
%ht = #ht divided by len in column
bottom line: total #ht divided by total ltr in paragraph x 100
help = Help screen seen # of times indicated
SS = Solution seen for items indicated
%SS = total solutions seen divided by #gap x 100
xns = student input was nonsense
xse = spelling error in student input
xww = student input wrong word
xwf = student input correct word in wrong form
xce = case error in student input
xde = diacritic error in student input
xpe = Enter key pressed prematurely
exok = exited problem; OK - learner input matched expected answer
skip = skipped problem by pressing cursor key
exQt = exited problem by pressing F9 or F7
Option = Option for deletion target selected, as follows:
n= ... where number is deletion rate chosen
noth NOTHING word list chosen
prep PREPOSITION word list chosen
hvrb HELPING VERB word list chosen
pron PRONOUN word list chosen
3ltr all 3-letter words deleted
3pls all words > 3 letters deleted

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Table 1

Grp	#w/p	#gap	d/r	#att	%att	avlen	ltr	#ht	%ht	help	SS	%SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exQt	Option
1-1	163	32	5.1	1	3%	6	6	0	0%	1	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
1-2	149	35	4.3	4	11%	4.3	17	6	35%	1	0	0%	2	1	3	0	0	0	0	3	1	1	n=4
1-3	104	26	4.0	1	4%	4	4	1	25%	1	0	0%	5	0	1	0	0	0	0	0	0	0	1 n=4
1-4	163	32	5.1	8	25%	8.3	66	10	15%	1	6	75%	0	2	3	0	1	1	1	7	0	1	n=5
1-5	163	32	5.1	7	22%	3.9	27	1	4%	0	0	0%	0	0	1	0	1	0	0	6	0	1	n=5
2-1	163	32	5.1	32	100%	4.5	145	0	0%	1	11	34%	0	0	0	0	1	0	0	32	0	0	n=5
2-2	177	177	1.0	1	1%	2	2	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 noth
2-3	177	88	2.0	14	16%	3.6	50	0	0%	0	12	86%	0	0	0	0	1	2	0	12	1	1	n=2
2-4	163	32	5.1	2	6%	7	14	0	0%	0	1	50%	3	1	0	0	0	0	0	1	0	1	n=5
3-1	163	32	5.1	32	100%	5.6	179	0	0%	0	19	59%	0	0	5	1	2	3	0	32	1	0	n=5
3-2	177	24	7.4	24	100%	2.5	60	0	0%	0	14	58%	0	0	1	0	0	0	0	24	0	0	prep
4-1	163	32	5.1	1	3%	2	2	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
4-2	177	13	13.6	13	100%	2.8	36	0	0%	1	4	31%	0	0	2	0	0	0	0	13	0	0	hvrh
4-3	163	32	5.1	1	3%	3	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
4-4	163	32	5.1	2	6%	10	20	6	30%	0	1	50%	0	0	1	0	0	0	1	1	0	1	n=5
4-5	177	4	44.3	4	100%	3.5	14	2	14%	0	0	0%	0	0	1	0	0	0	0	3	0	1	pron
4-6	177	44	4.0	22	50%	3	66	17	44%	0	0	0%	0	0	2	0	1	0	0	21	0	1	3ltr
4-7	163	32	5.1	1	3%	10	10	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
4-8	163	32	5.1	1	3%	10	10	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
4-9	163	5	32.6	1	20%	3.0	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 hvrh
5-1	163	1	163	1	100%	2	2	0	0%	1	0	0%	0	0	1	0	0	0	0	0	0	0	1 pron
5-2	163	32	5.1	32	100%	4.4	140	0	0%	1	2	6%	0	0	5	0	2	1	0	32	0	0	n=5
5-3	177	35	5.1	5	14%	3.4	17	0	0%	0	1	0%	0	0	0	0	0	0	0	4	0	1	n=5
5-4	163	5	32.6	2	40%	4	8	0	0%	0	0	0%	0	0	0	0	0	0	0	1	0	1	hvrh
5-5	163	163	1	18	11%	5.2	94	0	0%	0	0	0%	0	3	2	0	0	0	0	17	0	1	noth
5-6	163	163	1	23	14%	5.2	120	0	0%	0	1	4%	0	0	0	0	0	0	0	22	0	1	noth
6-1	163	119	1.4	1	1%	3	3	0	0%	1	0	0%	0	0	0	0	0	0	0	0	0	0	1 3pls
6-2	163	32	5.1	11	34%	3.6	40	6	15%	2	3	27%	0	0	0	2	2	1	0	10	0	1	n=5
6-3	177	59	3.0	1	2%	3.0	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=3
6-4	177	4	44.3	4	100%	3.5	14	0	0%	0	0	0%	0	0	0	0	0	0	0	4	0	0	pron
6-5	163	163	1	7	4%	6.1	43	0	0%	0	0	0%	0	0	0	0	0	0	1	6	0	1	noth
6-6	163	5	32.6	1	20%	3	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 hvrh
6-7	163	5	32.6	1	20%	3	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 hvrh
6-8	123	11	11.2	1	9%	4	4	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 hvrh
6-9	123	11	11.2	1	9%	4	4	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 hvrh
7-1	149	28	5.3	7	25%	5.3	37	0	0%	0	1	14%	0	0	0	0	0	0	0	6	0	1	n=5
7-2	163	32	5.1	1	3%	2	2	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
8-1	163	32	5.1	1	3%	10	10	0	0%	2	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
8-2	163	5	32.6	3	60%	3.7	11	6	55%	1	1	33%	0	0	3	0	0	0	0	2	0	1	hvrh
8-3	163	32	5.1	1	3%	6	6	0	0%	0	0	0%	0	0	0	0	3	0	0	0	0	0	1 n=5
8-4	163	32	5.1	1	3%	3	3	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
8-5	163	32	5.1	23	72%	4.3	100	40	40%	1	0	0%	0	0	4	1	2	0	0	22	0	1	n=5
9-1	163	32	5.1	25	78%	6	149	0	0%	1	0	0%	16	1	10	4	14	15	0	24	0	1	n=5
A-1	149	31	4.8	8	26%	3	24	0	0%	1	0	0%	11	0	5	0	2	0	0	5	4	1	3ltr
A-2	163	32	5.1	16	50%	4.4	71	5	7%	0	4	25%	2	4	5	1	4	1	1	10	8	1	n=5
A-3	163	32	5.1	1	3%	10	10	1	10%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=5
A-4	163	32	5.1	16	50%	4.2	67	8	12%	0	0	0%	0	0	0	0	1	0	0	13	2	1	n=5
B-1	177	44	4	1	2%	2	2	0	0%	0	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=4
B-2	163	32	5.1	6	19%	4.5	27	0	0%	1	0	0%	0	0	2	0	2	0	0	5	0	1	n=5
B-3	123	24	5.1	12	50%	4.2	50	0	0%	0	4	33%	0	3	4	0	3	0	0	11	0	1	n=5
B-4	163	81	2	3	4%	5.7	17	0	0%	0	1	33%	0	0	0	0	0	0	0	2	0	1	n=2
B-5	163	81	2	4	5%	7	28	0	0%	0	2	50%	0	3	0	0	1	0	0	2	1	1	n=2
B-6	149	28	5.3	17	61%	4.4	75	68	91%	0	1	6%	0	0	1	0	1	0	0	16	0	1	n=5

C-1	149	26	5.7	26	100%	3	78	29	37%	1	1	4%	0	0	1	0	1	0	0	26	0	0	3ltr
C-2	149	74	2	1	1%	9	3	3	33%	1	0	0%	0	0	0	0	0	0	0	0	0	0	1 n=2
D-1	163	32	5.1	30	94%	4.5	135	0	0%	1	7	23%	1	6	3	1	3	0	0	29	0	1	n=5
E-1	163	32	5.1	18	56%	4.2	75	0	0%	0	0	0%	0	0	5	0	0	0	0	17	0	1	n=5
E-2	163	53	3.1	37	70%	4.9	181	0	0%	0	0	0%	0	1	1	0	2	2	0	35	1	1	n=3

	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SSol	%SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exot	Option
Sums:		2435		539			2393	209		21	97		40	25	72	10	50	26	4	476	19	51	
/wrd:			11.25			4.44				4%		18%	7%	5%	13%	2%	9%	5%	1%	88%	4%	9%	
/par	160.8	41.9		9.29	22%					9%	36%	167%											

NOTE: /wrd and /par figures are averages where not indicated %



TABLE 3

	Percent attempted	Number attempted	Number of hints	Help screen	Percent See Soln.
Paragraph length	.1690 (.2089)	.1058 (.4337)	-.0939 (.4871)	-.1269 (.3468)	.1347 (.3179)
Average word length	-.2823 (.0334)*	-.1059 (.4332)	-.0353 (.7946)	.0896 (.5076)	.1795 (.1816)
Number of gaps per passage	-.3649 (.0053)**	.0792 (.5583)	-.0932 (.4903)	-.1291 (.3385)	.0047 (.9723)
Number of letters in gaps per paragraph	n/a	n/a	.2300 (.0853)*	.1631 (.2254)	.2959 (.0254)*
Deletion ratio	.3607 (.0058)**	-.2012 (.1333)	-.0748 (.5804)	.0743 (.5827)	-.1300 (.3350)

Coefficient (significance level); sample size = 57

FIGURE 1

GrpA	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exQt	Option
#1						3		0	0%											1		
#2						3		0	0%	1		7		1							1	
#3						3		0	0%											1		
#4						3		0	0%					2						1		
#5						3		0	0%											1		
#6						3		0	0%											1		
#7a						3		0	0%							2					1	
#8a						3		0	0%			3		1							1	
#7b												1									1	
#8b														1								1
P1=	149	31	4.8	8	25.81%	3	24	0	0%	1	0	11	0	5	0	2	0	0	5	4	1	3ltr
#1a														2		2					1	
#2						3		0	0%											1		
#3a																					1	
#4a																					1	
#1b						2		1	50%	1						2				1		
#5						9		0	0%											1		
#6						3		0	0%	1										1		
#3b						7		1	14%	1			1						1	1		
#4b						5		1	20%			2								1		
#7						7		1	14%								1				1	
#8						4		0	0%											1		
#9						4		0	0%						1						1	
#10						1		0	0%											1		
#11						6		1	17%					2							1	
#12						2		0	0%											1		
#13						9		0	0%	1			3								1	
#14						3		0	0%					1							1	
#15						1		0	0%											1		
#16						5		0	0%													1
P2=	163	32	5.1	16	50.00%	4.4	71	5	7%	0	4	25%	2	4	5	1	4	1	1	10	8	1 n=5

FIGURE 2

GrpC	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exQt	Option		
#1						3		0	0%		1													
#2						3		3	100%		1													
#3						3		0	0%															
#4						3		3	100%															
#5						3		2	67%															
#6						3		0	0%															
#7						3		2	67%															
#8						3		0	0%															
#9						3		3	100%															
#10						3		0	0%															
#11						3		2	67%															
#12						3		1	33%															
#13						3		1	33%															
#14						3		2	67%															
#15						3		1	33%															1 hint: e in 'the'
#16						3		1	33%															
#17						3		0	0%															
#18						3		1	33%															
#19						3		1	33%							1								
#20						3		0	0%															
#21						3		1	33%															
#22						3		0	0%															
#23						3		2	67%															
#24						3		1	33%															1 hint: e in 'the'
#25						3		2	67%						1									
#26						3		0	0%															
P1=	149	26	5.7	26	100.00%	3	78	29	37%	1	1	4%	0	0	1	0	1	0	0	26	0	0	3ltr	

FIGURE 3

Grp8	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exqt	Option	
#1						3		0	0%											1			
#2						8		3	38%											1			
#3						4		0	0%											1			
#4						3		0	0%											1			
#5						3		0	0%											1			
#6						1		0	0%											1			
#7						6		3	50%											1			
#8						1		0	0%											1			
#9						3		0	0%											1			
#10						6		3	50%											1			
#11						5		5	100%											1			
#12						5		0	0%											1			
#13						2		1	50%					2						1			
#14						3		2	67%					1						1			
#15						6		0	0%											1			
#16						2		1	50%											1			
#17						8		7	88%					1	1					1			
#18						6		2	33%											1			
#19						5		0	0%							2				1			
#20						4		0	0%											1			
#21						10		9	90%											1			
#22						5		4	80%											1			
#23						1		0	0%	1												1	
P5=	163	32	5.1	23	71.88%	4.3	100	40	40%	1	0	0	0	4	1	2	0	0	22	0	1	n=5	

FIGURE 4

LogD	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	%SS	xns	xse	xw	xwf	xce	xde	xpe	exok	skip	exQt	Option
#1						3	0	0	0%								2				1		
#2						8	0	0	0%												1		
#3						4	0	0	0%					1							1		
#4						3	0	0	0%												1		
#5						3	0	0	0%					1							1		
#6						1	0	0	0%				1		1						1		
#7						6	0	0	0%					1							1		
#8						1	0	0	0%												1		
#9						3	0	0	0%												1		
#10						6	0	0	0%												1		
#11						5	0	0	0%												1		
#12						5	0	0	0%												1		
#13						2	0	0	0%						1						1		
#14						3	0	0	0%						2						1		
#15						6	0	0	0%												1		
#16						2	0	0	0%							1					1		
#17						8	0	0	0%						1						1		
#18						6	0	0	0%												1		
#19						5	0	0	0%									1			1		
#20						4	0	0	0%												1		
#21						10	0	0	0%		1						1				1		
#22						5	0	0	0%		1										1		
#23						1	0	0	0%												1		
#24						7	0	0	0%	1	1										1		
#25						2	0	0	0%		1										1		
#26						2	0	0	0%		1										1		
#27						3	0	0	0%		1										1		
#28						3	0	0	0%												1		
#29						10	0	0	0%		1										1		
#30						8	0	0	0%														1
P1=	163	32	5.1	30	93.75%	4.5	135	0	0%	1	7	23%	1	6	3	1	3	0	0	29	0	1	n=5

FIGURE 5

Grp9	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	xns	xse	xww	xwf	xce	xde	xpe	exok	kip	exQt	
Option																						
#1						10	0	0%	1						2				1			
#2						10	0	0%											1			
#3						6	0	0%											1			
#4						4	0	0%											1			
#5						10	0	0%											1			
#6						9	0	0%				1							1			
#7						11	0	0%							4				1			
#8						6	0	0%											1			
#9						3	0	0%											1			
#10						10	0	0%											1			
#11						2	0	0%				2			11	11			1			
#12						8	0	0%						1					1			
#13						5	0	0%											1			
#14						6	0	0%						1					1			
#15						6	0	0%											1			
#16						2	0	0%						1					1			
#17						7	0	0%						1					1			
#18						5	0	0%											1			
#19						3	0	0%											1			
#20						6	0	0%						4					1			
#21						2	0	0%						1	1				1			
#22						5	0	0%				12		3					1			
#23						6	0	0%											1			
#24						2	0	0%											1			
#25						5	0	0%				2			2							1
P1=	163	32	5.1	25	78.13%	6.0	149	0	0%	1	0	16	1	10	4	14	15	0	24	0	1	n=5

FIGURE 6

Grp	#w/p	#gap	d/r	#att	%att	len	ltr	#ht	%ht	help	SS	xns	xse	xww	xwf	xce	xde	xpe	exok	skip	exQt	Option		
#1						5		0	0%													1		
#2						3		0	0%														1	
#3						5		0	0%														1	
#4						2		0	0%														1	
#5						1		0	0%														1	
#6						2		0	0%														1	
#7						5		2	40%	1	1						2						1	
#8						5		0	0%														1	
#9						3		0	0%														1	
#10						7		4	57%	1	1				2								1	
#11						2		0	0%		1							1						1
P2=	163	32	5.1	11	34.38%	3.6	40	6	15%	2	3	27%	0	0	0	2	2	1	0	10	0	1	n=5	