"THE EFFECTS OF SIMPLIFICATION AND VOCABULARY GLOSSING ON UNSIMPLIFIED TEXTS"

SUBMITTED TO THE FACULTY OF THE ESL DEPARTMENT AT THE UNIVERSITY OF MINNESOTA

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

DECEMBER 1999

Accepted as a Plan B Paper - January 4 2000

ABSTRACT

This study explored the effects that simplification and glossing had on unsimplified texts. The literature on simplification and vocabulary glossing is reviewed, bringing to focus the flaws and benefits of each. A test was given to twelve learners to measure how the different kinds of texts (unsimplified, simplified, unsimplified with vocabulary glosses) affected comprehension, but the effects were not statistically significant. A questionnaire and oral interview were also given to reveal learners' preferences toward each kind of text. Learners felt that simplification helped them understand vocabulary though the reading comprehension test did not support that claim. Learners' reports regarding the ability of simplification or glossing to aid comprehension did not differ significantly, and did they did not express a general preference towards text type. Profiles of a higher level and a lower level learner suggest that certain text types may benefit learners of different reading levels. The paper concludes with a critique of each text type and recommendations for future use.

INTRODUCTION

The high level of difficulty of some reading texts seems to pose problems for some ESL students. In response, instructors and publishers of ESL materials have often acted in three ways. One way has been to use (or write) simplified texts--texts that have been modified to improve their "readability." Another technique that has been used to make texts more accessible to the reader has been the use of marginal vocabulary glosses. Others have insisted that no assistance be given to the reader, but that the text remain unsimplified, or "authentic." This paper explores advantages and shortcomings of each of these kinds of texts, focusing on two issues: the effect simplification and vocabulary glosses have on an unsimplified text, and ESL learners' preferences for each type of text.

Simplification

Simplification is often found in graded readers whose publishers have taken approaches to simplification that have varied widely (Lotherington-Wolosyzn 1989). Likewise, the term itself takes on several different meanings; indeed, *simplification* seems a bit of a misnomer for all its complexity. Ways to simplify include lexical factors such as frequency, degree of abstractness, lexical density, paraphrasing; syntactic factors, such as sentence splitting and deletion of irrelevant information; and text and discourse factors such as temporal organization of segments and text organization with reference to the main topic and subtopics (Tommola 1980). When one considers simplification, then, it is worth noting the kind of simplification being discussed.

Methods of simplifications and their effects on comprehension

It has been claimed that simplification improves comprehension (Yano, Long, and Ross 1994; Johnson 1981; Urquhart 1984, in Ellis 1993). Various kinds of simplification have been used in the studies that make this claim, such as shortening sentence length and keeping the number of multisyllabic words and embedded clauses to a minimum (Yano, Long, and Ross 1994) and simplifying syntax and paraphrasing, reducing the number of T-units by one-half (Johnson 1981). However, the results of studies on the effects of simplification are not one-sided. One study examined the effect of shortening sentence length, finding that it did not affect comprehension and suggested it may in fact hinder comprehension (Blau 1982). Another study found that simplification that eliminated redundancy, difficult and inessential words, that shortened sentences and paragraphs, that paraphrased and added in-text glossing did not affect comprehension (Lotherington-Wolosyzn 93).

Effects of simplification on learner attitudes

In one study (Lotherington-Wolosyzn 93) students were able to distinguish simplified texts from unsimplified ones. They then were asked to rank the texts as to level of difficulty. The students ranked the unsimplified texts as being more difficult than the simplified ones, though there was no significant difference as to their actual ability to comprehend each kind of text. Thus the students underrated their comprehension of unsimplified texts and overrated their comprehension of the simplified versions, indicating that simplified texts may be a sort of "optical illusion", only *seeming* easier to comprehend.

Theoretical objections to simplification

Objections to simplified language have been numerous. It has been argued that the process of simplification "makes learning harder" and "creates misconceptions about language" (Goodman and Freeman 1993). It has also been noted that "one must know a great deal about language to make it simpler without making it artificial, inauthentic, and harder to make sense of" (Goodman and Freeman 1993). Other observations of simplification have been that it results in the reduction of semantic information (Lautamatti 1978), decreased cohesion (Honeyfield 1977; Lautamatti 1978) and decreased authenticity

(Tommola 1980). It has also been argued that simplification limits valuable reading experiences--that difficult words and passages should not be simplified "if for no other reason than that students need experience in recognizing that a single complex term or paragraph will not mean that the text is unintelligible in its entirety" (Swaffar 1985).

Measures used to assess the effects of simplification on comprehension

Studies concerning the effects of simplification have used various measures to assess comprehension. The results in the literature are mixed, even when similar measures have been used. In studies where comprehension was found to affect comprehension, multiple choice (Yano, Long and Ross 1994) and multiple choice combined with recall protocols (Johnson 1981) have been used. In studies where it has been found that simplification has not affected comprehension, multiple choice (Blau 1982) and recall protocols have been used (Lotherington-Wolosyzn 1993).

The effects of vocabulary glossing on comprehension

Marginal glossing is sometimes used to make texts more accessible to learners. However, there are few studies related to the effects of vocabulary glossing on comprehension; at least three of these provide evidence that challenges their effectiveness (Johnson 1982; Pak 1986 in Lee 1989; Snavely in Lee 1989). Two of these studies suggested that glosses may actually hinder reading comprehension (Johnson 1982; Pak 1986 in Lee 1989). In contrast, at least two studies (Jacobs 1991, cited in Jacobs, Dufon and Fong 1994; Lee 1989) report that marginal glosses do indeed improve comprehension. Another study reports a trend favoring students who had glosses (Jacobs, Dufon and Fong 1994). In addition, a study on computerized reading reported that glossing may promote comprehension (Lomicka, 1998).

The possible shortcomings of the studies that have challenged the effectiveness of glosses have been noted by Lee (1989). He points out that Johnson's and Pak's studies both used short, nonauthentic passages: Johnson's experimenter-generated passage was 363 words long, and Pak's passage, which was taken from a reader especially prepared for ESL students, was 477 words long. Lee also points out Pak used a cloze test, which has encountered debate in the literature when used as a measure of macro-level comprehension (Cohen 1994). In contrast, the study by Lee--which found that glosses promote comprehension--used an authentic literary text of 936 words. In Lee's study, comprehension was measured by recall protocols written in the native language, whereas in Johnson's study recall in the L2 was used as a dependent measure, in addition to a cloze test and a recognition task.

Benefits and Shortcomings of Vocabulary Glossing

A possible shortcoming of vocabulary glossing is that it may be distracting, causing the reader to focus too much on word meaning rather than text meaning (Lotherington-Wolosyzn 1993; Swaffar 1985). It has been suggested that highlighting vocabulary may interfere with ESL learners' acquisition of good reading strategies (Lotherington-Wolosyzn 1993). In addition, it has also been suggested that vocabulary glosses may inhibit guessing at the meaning of words by using their context (Swaffar 1985).

One benefit of vocabulary glosses is that they may increase comprehension and reduce reading difficulty. The central challenge in second language reading appears to be vocabulary (Grabe & Stoller 1997). A connection between knowledge of vocabulary and reading comprehension has been made in several studies (Bossers 1992 and Coady 1993 cited in Koren 1999; Grabe & Stoller 1997). One study estimates that readers need to be capable of understanding 95 per cent of the words of a text in order to comprehend it (Hirsch & Nation 1992 cited in Koren 1999). In addition, it has been shown that interpretation of a foreign language text may be more influenced by vocabulary than by knowledge of the subject matter or syntactic structure (Laufer and Sim 1985).

Learners appear to feel that vocabulary knowledge is critical to second language reading. In one study, subjects overwhelmingly attributed their comprehension problems to difficult vocabulary items, though the actual influence of lack of vocabulary knowledge was in question (Lotherington-Wolosyzn 1993). When asked to rank the cause of reading difficulty on a scale of 0 (no difficulty) to 5 (maximum degree of difficulty), learners responded that vocabulary was what caused the most difficulty in reading (3.23 mean) (Yorio 1971). Grammar, by comparison, was reported by students to cause relatively less difficulty (2.19 mean). Though the key question remains the actual effect of vocabulary on reading difficulty as measured by quantitative research methods, learners' intuitions may also provide clues regarding the influence of vocabulary on comprehension.

The literature also discusses other possible benefits of vocabulary glosses. One study suggests that glossing increases vocabulary learning (Watanabe 1992 cited in Jacobs, Dufon, and Fong 1994). Also, students have expressed a preference for glossing (Holley 1970; Jacobs, Dufon and Fong 1994). In addition, glossing allows for greater use of authentic texts (Rivers in Jacobs, Dufon and Fong 1994). In the Rivers study, "authentic" apparently means that although glosses have been added, the text itself has not been changed or altered in any way.

Authentic texts

Though it seems there is no consensus in the literature on what is meant by "authentic", for the purposes of this paper we can refer to Scarcella and Oxford who note that "generally, authentic language is considered unedited, unabridged text that is written for native...speakers" (in Day and Bamford 1998). One benefit of authentic texts is that it avoids many of the possible pitfalls of simplification and vocabulary glossing mentioned earlier. An additional benefit of authentic texts, according to Swaffar (1985), is that they may increase motivation.

Though there are some advantages to authentic texts, reading them may be an unrealistic goal for beginning learners, even if they have a dictionary to assist them. It has been suggested that weaker students will not benefit from dictionary use since selecting words in a dictionary may be too difficult (Bensoussan 1983). In fact, it may be that this realization has been the primary impetus for the creation of simplified and glossed texts.

The present study

Though several studies exist in the ESL literature comparing simplified texts to unsimplified ones, relatively few studies compare texts with vocabulary glosses to unsimplified texts. In addition, it seems a sufficient comparison of all three kinds of texts--simplified, glossed and unsimplified--has not been made in the literature. This, then, is the focus of the present study.

Research Question

What are the effects of simplification of text and glossing of vocabulary on:

a. reading comprehension?

b. learner preferences towards the text?

RESEARCH DESIGN

Sample

Twelve learners from eight different language groups participated in the study: Korean (4), Czech (1), Indonesian (1), Japanese (1), Arabic (1), Spanish (1) and Thai (1). Students from several ESL classes in the Minnesota English Center were invited to participate in the study; the twelve learners who participated were those willing to take part. There were seven males and five females, their ages averaging twenty-three years old. On average, the learners had studied nine years of English, had spent one and a half months in a full-time English program in the US., and had spent four months in the US. Of the seven students who had taken the TOEFL, the average score was 513. Two of the learners were enrolled in intermediate ESL classes and ten were enrolled in high-intermediate ESL classes.

Instrumentation and Materials

Three texts were given to the students, in no particular order. Each text was of approximately equal length and was a different section of the same magazine article. Each section was about a certain technology that was used to aid the environment, so that although each text was different in content, they were all about the same topic--technology and the environment. This choice of texts, then, served to minimize differences of content. The length of each text was comparable as well. Of the three texts, one of them was unsimplified (or authentic), one simplified and one unsimplified with glosses.

As previously mentioned, several different methodologies have been used in regards to the kinds of simplifications that have been made and the measures of comprehension that have been used. For the purposes of this study, the simplifications focused on vocabulary, not syntax. The words that were simplified were chosen by six ESL learners of approximately the same language level as those who participated in the study. These learners read each unsimplified text and marked the words they didn't know. If a word was unknown by two or more learners, it was later simplified. The words were simplified as concisely as possible; in other words, if a one word synonym was found that could accurately capture the meaning of the original word, the one word synonym was used. This was not always possible, so at times a short phrase was used. The same words that were chosen by these learners were also glossed for the glossed versions of the texts. The simplifications and glosses were kept consistent wherever possible; that is to say that the same definition or synonym substituted in the simplified text was used in the glossed text. However, at times, the definition in the simplified text had to be reduced to make the text read more smoothly. For example, in one case the word "erosion" was translated in the simplified text as "breaking down":

> Todd has even grander plans for his brand of organic technology: a network of Living Machines designed not only to clean the canals in Venice but to protect the city's buildings from breaking down by the wash of motorboats..."

In this case the full definition that was used in the gloss ("natural processes that result in earthy or rocky material being removed from the earth's surface") would not have fit smoothly in the sentence, so the definition was reduced out of necessity to "breaking down."

Each text had a series of open-ended questions to assess reading comprehension. These questions focused on main ideas, not on details. The justification for using open-ended questions as a measure of comprehension instead of cloze passages, multiple choice questions or recall protocols as were used in the previously mentioned studies was twofold. First, there was a lack of studies using open-ended questions when exploring the effects of simplification and glossing. Second, open-ended questions not only elicit answers that are more qualitative or 'rich' in comparison to cloze and multiple choice questions, they may also require the reader to think critically about text meaning in ways that recall protocols do not.

The scoring of these open-ended questions proceeded as follows. First, a key that included complete answers to each question was constructed. Then scoring was done blindly by this researcher. When the answers were scored, students were sometimes given partial credit according to the completeness of their answer so that their level of text understanding was accurately measured. They were only given half credit when it seemed clear that they were merely copying the text instead of paraphrasing; in other words, paraphrasing their answers would show that they had a greater understanding of the text.

A questionnaire was given to guage learner preferences and opinions toward the different kinds of texts (unsimplified, simplified and unsimplified with glosses). The questionnaire asked students to rate the texts according to their preference, their ability to understand the meaning of the text, and their ability to understand vocabulary. In addition to asking the learners to indicate their preferences by numerically rating the texts (to elicit comparative results), they were encouraged to explain the reasons for their scoring (to gain responses that were "rich" in depth).

Background questionnaires were also given to gather information regarding the age, sex, home country, native language, number of years studying English, amount of time spent in the US., length of time studying English full time in the US. and most recent TOEFL test score.

An oral interview was given to two students concerning their text preference and use of vocabulary glosses. These students were not chosen for any particular reason other than that they were available for interviews wheras others were not. The interview was given to them immediately following their completion of the comprehension question and questionnaires. First, they were asked to indicate the kind of text that they preferred (simplified, unsimplified, glossed). It was hoped that this oral interview would elicit responses that would add to their written responses to the same question given them on the questionnaire. In other words, some students find it easier to elaborate orally rather than in writing. The learners were then asked to reread a paragraph of the glossed text, recalling what they did with individual glossed words (e.g. looked at the glossing, did not look at the glossing, etc.) and why. The purpose of the second part of this interview was to determine more fully the effects of vocabulary glossing on reading comprehension.

Data Collection Procedures

The learners met with me for eighty minutes on the average, either in a quiet classroom or office at the University of Minnesota in October, 1999. First, the learners were informed of what they would be asked to do and how long each part of the reading project would take. Then they were asked to read the introduction to the three texts. This part of the project did not require the learners to answer questions; they only had to read the introduction--which was glossed. After they were given ten minutes to read the introduction, they began to read their three texts. The learners were instructed to answer the questions as completely as possible, and to paraphrase their answers, not just copy from the text.

The texts were organized as follows to insure that each text was read the same number of times:

Learner 1	unsimplified/glossed	Text A
	simplified	Text B

	unsimplified	Text C
Learner 2	unsimplified with glosses simplified unsimplified	Text A Text C Text B
Learner 3	unsimplified with glosses simplified unsimplified	Text B Text A Text C
Learner 4	unsimplified with glosses simplified unsimplified	Text B Text C Text A
Learner 5	unsimplified with glosses simplified unsimplified	Text C Text A Text B
Learner 6	unsimplified with glosses simplified unsimplified	Text C Text B Text A

**Note: When this pattern is doubled, it accounts for the texts the twelve learners read.*

The learners were given twenty minutes to read a text and answer the questions. The texts were not labelled as to which was simplified and which was not. They were stopped after twenty minutes to ensure that each text was given equal time. After the learners completed reading all of the texts and answering the questions, the learners were told which texts were simplified and which were not. The students then had as much time as they needed to fill out the questionnaire about the texts and the background questionnaire.

Two students were given an interview that explored how they processed the unsimplified text with vocabulary. The interview was given immediately after they had finished the reading project and lasted about fifteen minutes each. Initially it had been planned that three students would be given interviews immediately upon finishing their tests, but a scheduling conflict following the test did not allow for the third student to participate.

Data Analysis

Scores for the comprehension test were analyzed across passage type using means, standard deviation and t-test. Scores for the text preference questionnaire were also analyzed using standard deviation, means and t-test. Qualitative results from the questionnaire and the interview were analyzed and organized to explore student opinions and preferences toward each kind of text, and to relate this information in a meaningful way to their test performance.

RESULTS

Effect of text type on reading comprehension

The results of the reading comprehension test are shown in Table 1:

Participant	Unsimpl.	Simplified	Glossed
Y	12	44	40
T	38	33	27
Te	22	39	36
J	27	47	27
N	45	33	38
D	31	50	66
B	78	67	56
F	28	38	55
S	55	31	44
G	40	67	67
H	22	27	47
He	72	63	66
Mean	39.2	44.9	47.4
St Dev	20.3	14.2	14.5

Results show that the mean of the scores for the unsimplified text with vocabulary glosses was highest (47.4), followed by the simplified text (44.9) and the unsimplified text (39.2). Despite the small number of participants, *t*--tests comparing scores for the text with vocabulary glosses to those of the unsimplified text were nearly significant (t=1.51; p=.078) while differences between the simplified text and the unsimplified texts were far less pronounced (t=.44; p=.334).

A comparison of low-level (those whose comprehension test score averages were lowest) and high-level learners (those whose comprehension test score averages were highest) is found in Table 2.

Participant	Unsimpl.	Simplified	Glossed
Low level learners			
Y	12	44	40
T	38	33	27
Te	22	39	36
Mean	24.0	38.7	34.3
St Dev	13.1	5.5	6.7
High level learners			
B	78	67	56
G	40	67	67
He	72	63	66
Mean	63.3	65.7	63.0
St Dev	20.4	2.3	6.1

Results from Table 2 reveal an apparent difference between the effects of text type on lower and higher level learners. Lower level learners' score averages were much higher on the simplified text (38.7) and the glossed text (34.3) than they were for the unsimplified text (24.0). However, the three highest level learners' score averages for the simplified text (65.7), the glossed text (63.0) and the unsimplified text (63.3) on the simplified text reveal that text type had almost no effect on comprehension.

Results of the questionnaire

The questionnaire asked three questions:

Question 1: Rate your ability to understand the meaning of the text.

Question 2: Rate your text preference.

Question 3: Rate your ability to understand vocabulary.

**For each question, "1" reflects a low score and "5" a high score.*

Results from the questionnaire are shown on Table 3:

Question 1													Mean	St Dev
Unsimpl.	3	3	4	3	3	3	2	4	5	2	4	2	3.2	0.9
Simplified	4	5	4	4	4	4	3	5	4	4	4	1	3.8	1.0
Glossed	3	5	4	2	3	3	3	5	4	3	5	5	3.8	1.1

Question 2													Mean	St Dev
Unsimpl.	2	4		3	3	3	1	4	5	1	4	4	3.1	1.3
Simplified	5	5	4	4	4	3	3	5	4	4	3	1	3.8	1.1
Glossed	1	3		2	2	4	1	5	4	4	5	5	3.3	1.6

Question 3													Mean	St Dev
Unsimpl.	3	3	4	4	3	3	2	4	5	2	4	2	3.3	1.0
Simplified	5	4		5	5	4	3	5	4	4	4	2	4.1	0.9
Glossed	2	5		2	4	4	2	5	3	4	5	5	3.7	1.3

A *t*-test revealed no significant differences regarding questions one (rating the ability to understand the text) and two (rating text preference). However, in regards to question three (rating ability to understand vocabulary), learner responses were significant ($t = 3.3$, $p > .001$); they felt that simplification helped them understand vocabulary.

In sum, the effect of simplification on an unsimplified text is not stronger than that of glossing. Learners reported no clear text preference regarding glossed, simplified and unsimplified texts. Learners felt that simplification helped understand vocabulary.

Qualitative results of questionnaire

As we have just seen, the quantitative results of the questionnaire reveal that few general conclusions can be made concerning learners' attitudes toward text type. However, the learners' qualitative comments provide more detail concerning learners' opinions and observations about each kind of text.

<u>Learners' questionnaire responses about the simplified text</u>

Reflective of their questionnaire ratings, learners seemed to feel that simplification aided comprehension:

> M: *"The simplified text use easier words even though there are some difficult word but mostly I can understand the content."*
>
> Y: *"I think [the simplified text] used some short sentences and easy vocabulary, so I can understand it."*
>
> M: *"If simplified text is easier to understand the gist. Even though there are some words that I don't know but I can look up for them later."*

D: *"The other texts [unsimplified and glossed] were somewhat difficult to understand."*

One learner reports that the simplified text allowed her to read without as much hesitation:

N: *"[The simplified text] is good for me. It was also difficult but text with simple words is easier, because I didn't need to stop reading at the words which I couldn't understand."*

Learners' questionnaire responses about the text with vocabulary glossing

Also consistent with the learners' comprehension performance were their reports that glossing made it easier for them to understand the text.

H: *"In [texts with marginal glosses] vocabulary list is helpful to understand it."*

S: *"It's easy when there's a vocabulary words, but [I just needed more time] because you know I must think about the words."*

One learner liked it that the glosses gave them the "exact" meaning or a word:

J: *"[the text with marginal glossing] is the easiest one, because sometimes I confusing the meaning of easy word. But [the text with marginal glossing] can help me understand the exact meaning.*

Another learner felt that although the vocabulary glosses "[took] more time" the glosses were "good for learning new word[s]."

Learners' questionnaire responses about the unsimplified text

Some learners reported difficulty with the unsimplified text:

N: *"Generally all three texts were difficult to understand the meanings. Because I have less vocabulary than the other ESL students. But most difficult was original one. If I don't know the meaning, I couldn't concentrate to read through.*

One learner seemed frustrated by the unsimplified ("original") text because it caused him to hesitate when he didn't understand a word:

M: *"The original [text] use a technical terms that hard to understand. The simplified [text] use easier words even though there are some difficult word but mostly I can understand the content. The original text use too many difficult word* *even though there are the meanings of them. I have to stop every time I found difficult word."*

Another learner felt that explanations of some of the difficult words were needed to assist him in comprehending the text:

M: *"[The original text] use technical terms that needed the explanations in order to understand*

Miscellaneous comments from the questionnaires

At least one learner felt that content, not text type, was most import for him:

B: I liked better the content of [the simplified text] and [the text with marginal glosses], maybe that is the reason [she preferred those texts]. The content of the original text didn't like me so much because I did not like the way of writing but I still enjoyed it.

A couple of learners said that they could infer meaning with all three kinds of texts:

B: "I could understand throughout the meaning of all. I had difficult time with some words and verbs but I could infer information."

F: "I basically can catch the main idea [of each kind of text]."

The quantitative and qualitative results from this study suggest that learner attitudes towards text type can not be painted in broad strokes. In reality, it may be that learner preferences are more a reflection of cognitive style differences than general preferences. For example, a learner who tends to prefer precision and exactness may prefer vocabulary glosses while a learner who is more willing to risk guessing at the meaning of words may prefer unsimplified texts.

The following profiles of a higher and a lower level learners seem to suggest that text preference may be influenced by learning styles and learner proficiency.

Results from the interviews: Learner Profiles of higher and lower level learners

Profile of a higher level learner

"H" is in the highest level English class in the Minnesota English Center. She also scored well on the TOEFL test (computer-220). She received the highest marks on the comprehension test given in this study. Perhaps not coincidentally, her scores on the three text types are nearly identical, showing that glossing and simplification may have had little influence on text comprehension. It is interesting that though her scores on the comprehension test were the highest, she nonetheless preferred the simplified text over the glossed and unsimplified text. She claimed to prefer guessing at the meaning of words from its context. Her comments about (and rating of) the vocabulary glosses were also the most negative, stating that it distraced her from the text.

> *"If I don't understand the vocabulary, I try to understand from the context. But if I know [the vocabulary glosses] are next to it, I look at it and it distracts me, I lose what the whole sentence is about...I didn't like that..."*

> *"...I don't like the [text with vocabulary glosses]...of course, it is easier to understand for me. If it's a topic you know a little bit about, I don't mind the original text, because you can guess a little bit if you don't understand..."*

In her retrospective interview, "H" reported that she did indeed use the context to infer the meaning of the word. This made it unnecessary to look at the marginal glosses.

> *"The first [glossed] word ("soar") I kept reading because I could get the meaning from the context... it's clear that Las Vegas--it's hot, right? Everyone knows that. And if you say that it's "above forty degrees" you assume its going to be increase--it's over..."*

She also reported that she was able to discern which words were most helpful in helping her understand the main idea of the sentence. This also made looking to the vocabulary glosses unnecessary.

> *"I looked only at the words which helped me understand the meaning of the sentence. This one wasn't that important. I got the meaning that it was hot there."*

However, though she earlier displayed a high level of ability for guessing the meanings of words from context, there were also instances where she could not infer a word's meaning from the words surrounding it.

> *(regarding the next two glossed words--"parched" and "barren") Yeah, I looked [the vocabulary glosses] at those two because otherwise the sentence doesn't really give me...I didn't get the meaning. Because those two words were main words that would give you the meaning, so I looked at [the vocabulary glosses for] those two.*

"H" still relied on the vocabulary glosses in some cases, though perhaps because of her high proficiency (because she didn't need the glosses) and personal preference (she didn't like the glosses), she often avoided using the glosses. She generally showed good reading skills by making educated guesses at word meanings and discerning which words were most important for understanding a sentences' meaning. Her comprehension scores were comparable on each part of the test: unimplified text, 72; simplified text, 63; glossed text, 66. This leveling of comprehension scores was indicative of the higher learners as a whole, and may be a result of the texts having been to easy for them.

Profile of a lower level learner

"Te" was in a lower level class than "H", and had never taken the TOEFL. His reading comprehension test scores were among the lowest of the twelve learners. He felt that glossing and simplification helped him understand the text. However, his preference was for the unsimplified text, since he claimed he liked to guess at the meaning of words, seemingly enjoying the challenge:

> *"...so, when I read some vocabulary words [in the glosses], I can understand [the text] and also this one [the simplified text] I can understand easily...more than the original text. And my preference is I like it (the simplified text) because it is easy reading and basically I can read it. But in my case, I like original text, because actually when I am reading the original text I don't understand some kind of vocabulary, this is true. But I can try to find the meaning--I like it. It is wrong or correct--I don't care about that. I like to try"*

Although "Te" reported instances of guessing at the meanings of words and discerning which words are important to the meaning of the sentence and which ones aren't (and thus don't necessarily need to be looked up in the glosses), he did so with less frequency and skill than "H" did. At other times, he merely skipped over words, apparently without reason. In at least one case, he showed lack of reading skill, immediately looking at the vocabulary gloss without trying to guess at the meaning of the word.

> Interviewer: *"Do you remember if you made a guess at what "jugs" meant, or right away did you look here [at the glosses]."*

> Te: *"As soon as I saw it I am looking for the meaning."*

It may be that lower level students such as "Te" have not had enough time to develop good reading skills such as guessing from the context. In addition, his vocabulary may be limited, making reading more difficult. If so, vocabulary glosses (and simplification) might be especially helpful for lower level learners, even if the learner seemingly has a positive attitude (or style preference) towards inferring meaning from context. He is an example of a lower proficiency learner who prefers reading unsimplified texts. Since he is a lower proficiency learner, however, it may be more beneficial to him to consider using simplified or glossed texts.

DISCUSSION

Answers to research questions

Research question: What are the effects of simplification of text and glossing of vocabulary on reading comprehension? Results from the comprehension questions reveal a tendency for both simplification and vocabulary glossing to increase comprehension. The tendency of vocabulary glossing to improve comprehension was greater than that of simplification, but not significantly so.

Research question: What are the effects of simplification of text and glossing of vocabulary on learner preferences towards that text? Results from the questionnaire and oral interview indicate there was no clear effect of simplification of text and glossing of vocabulary on learners' ability to understand the meaning of the text or text preference. However, learners did feel that simplification aided their ability to understand vocabulary.

Unsimplified texts

The results of this study seem to show that students had more difficulty understanding the unsimplified text than they did the simplified and glossed texts. Yet it seems that *more* difficulty is not necessarily a problem; indeed, a certain amount of difficulty may be associated with the reading of all kinds of texts. However, the degree of difficulty might be a concern if it results in the learner's not being able to comprehend the main ideas of the text, or by the motivation of the learner being lowered due to frustration. Thus, it is worthwhile to explore alternatives (e.g. simplification and vocabulary glossing) that may make reading texts more accessible, to beginning and intermediate level readers in particular.

Previous studies had indicated strong preferences for texts that had vocabulary glosses as opposed to texts that did not (Holly 1970; Jacobs, Dufon, and Fong 1994). The results from this study, however, did not support such a preference. It appears that before any confident assertations can be made concerning student preferences, more research needs to be done in this area.

Simplification

Though there seemed to be a tendency for simplification to increase comprehension, this may not completely justify its use. First, as results from the questionnaire and oral interviews suggest, learners showed no clear preference for this kind of text over unsimplified texts or texts with vocabulary glosses. As previously mentioned, the literature is quite articulate in its misgivings concerning simplification, suggesting that it "homogenizes" or "dilutes" a text and may "reduce cohesion and readability" (Honeyfield 1977). Other aforementioned criticisms point out that simplification reduces semantic information and doesn't help students learn how to deal with complex words. In view of these criticisms, it seems desirable to search for an alternative to simplification whenever possible.

It seems that for simplification, it is not a matter of either-or; it is a matter of *when* and *how*. For very beginning learners of English, some simplification may be needed in order to help learners avoid over-reliance on dictionaries and the general frustration that would come from reading material that is beyond one's ability. However, the opposite error of unnecessary 'spoon-feeding' must also be avoided; learners need to be weaned from simplification as soon as possible. To change metaphors, one might say simplification is a kind of linguistic 'half-way house'; no one is meant to stay there permanently.

The answer to "when" should one leave simplification seems to be *earlier*. It appears that students tend to overestimate the value of simplification (Lotherington-Wolosyzn 1993). In this study, students felt that simplification aided their ability to understand vocabulary. Whether or not it did in fact help them remains to be seen. At any rate, it did not appear to improve their reading comprehension scores, suggesting that simplifications effect on the learners' ability to understand vocabulary may have been overstated as well. A foreseeable consequence of overestimating the effects of simplification could be that students might not challenge themselves with unsimplified or glossed material even though they may be ready for it. Similarly, it might be true that teachers and publishers won't encouraging students to engage in reading unsimplified and glossed texts early enough.

The question of "how" one should simplify might be answered *well* . In other words, "it is worth remembering that--as with all books--there are good, bad and indifferent simplified texts" (Carter and Long cited in Day and Bramford 1998). Linguistic simplification is no easy chore, and to do it well is no small challenge. Therefore, some simplifications may be better than others at retaining semantic content, cohesiveness, and overall readability.

Beyond concerns of the quality of simplification, however, lies the issue of what *kinds* of simplification may be preferable? It has been suggested in a study by Long and Ross (1993) that elaboration may provide an alternative way to modify texts that avoids the pitfalls of simplification, such as removing new linguistic forms or diluting semantic content. An example of what is meant by elaboration is found below:

(1) NS baseline version

> Because he had to work at night to support his family, Paco often fell asleep in class.

(2) Simplified version

> Paco had to make money for his family. Paco worked at night. He often went to sleep in class.

(3) Elaborated version

> Paco had to work at night to earn money to support his family, so he often fell asleep in class. (Long and Ross 1993)

Though this study by Long and Ross showed that learners scored significantly higher on simplified texts in comparison with unsimplified texts, it also showed that there was no statistical difference between the reading scores of learners who read elaborated texts and those who read simplified texts. Therefore, elaboration may be a viable alternative to lexical and syntactic simplification.

Texts with vocabulary glossing

The literature mentions some legitimate concerns with vocabulary glossing, namely that it may "distract" the reader from the text or may inhibit guessing from the context. Although this study reveals instances of both of these shortcomings in using glossing, it also reports cases where it seemed the reader was able to skillfully use the glosses in ways that need not be distracting or inhibit guessing. It seems then that with proper training, a strategic use of vocabulary glosses could be achieved.

Though questions remain concerning vocabulary glossing, it appears that it is a viable way to make unsimplified texts more accessible to lower proficiency readers. Vocabulary glossing avoids the aforementioned shortcomings of simplifications, which in comparison to the perceived problems of glossing may be more substantial. Also, the results of this study provide evidence that simplification has no greater effect on comprehension than does vocabulary glossing; in fact, the comprehension scores for vocabulary glossing were higher than that for simplification, though not significantly so. Vocabulary glossing allows for a more complete and thorough definition than does simplification, which, in order to increase how smooth a text reads, must sometimes result in a reduction of semantic information (See Appendix J). In other words, glosses can say more about words--they can be more rich in content--than some of the synonyms that are used in simplification. In addition, vocabulary glossing retains the advantages of unsimplified texts while giving learners an important tool to help them with text comprehension; to put it another way, it is merely one way of adding to a text instead of subtracting from it.

Alternatives to simplification

Other ways of "adding to the text" may provide alternatives to simplification. Several studies show that the readers' background knowledge has a significant effect on reading comprehension (Chen and Donin 1997, Malik 1990, Pritchard 1990, Johnson 1981) and one study reported that background knowledge had more of an effect on comprehension than did text simplification (Johnson 1981). It seems, then, that one way to make a text more accessible to learners without changing the text itself would be to give the reader more background knowledge concerning a topic--in explanations at the beginning of the text or in its margins, or by the use of visuals or other forms of realia. Vocabulary glosses, of course, are also an example of providing readers with background knowledge.

Honeyfield (1977) considers yet other alternative approaches to simplification. He suggests that students need to be taught that they can get wanted information without knowing the meaning of every word, and that strategies can be developed for dealing with such words. He also underscores the need to develop the ability to use context clues to guess at the meaning of words (however, as previously suggested, context clues may not be enough by themselves). In addition, focusing the purpose of the reading, or giving them a clear reason for reading, says Honeyfield, may assist the reader: "focusing on realistic reading purposes...can show students that an unsimplified passage is not necessarily "difficult" for a reader who has a definite aim." He recommends teaching students communicative structure (e.g. recognizing sequence signaling words such as *moreover, however, thus, on the other hand,* etc.) as well. Finally, he suggests that since unsimplified material also exists in varying degrees of difficulty it should be graded and used accordingly (Honeyfield 1977).

All of these alternatives to simplification--including the use of vocabulary glosses--could be used in various combinations to increase comprehension while keeping the original text itself intact.

Effects of text type on learner preference

From the results of this study, preference for text type (simplified, unsimplified, glossed) may be a result of learning style and profiency . These results may temper claims of a generalized preference of vocabulary glosses over unsimplified texts (Holley 1970, Jacobs, Dufon and Fong 1994) and assumptions about unsimplified ("authentic") texts being inherently more motivating to students. In other words, it may be premature to conclude that, in general, learners prefer a certain kind of text (glossed, unsimplified, simplified); it appears learner proficiency and learning styles might need to be considered before such a conclusion can be drawn.

Limitations of study

The sample for this study was small; if there had been a larger number of participants, the results might have been more pronounced. It would have been ideal if the participants were randomly chosen; this sample included only participants who were willing to respond to the researcher's request to be in the study. Also, if the level of the participants had been lower it seems likely that the data would have shown greater effects of vocabulary glossing and simplification. In addition, the texts were given in this order:

vocabulary glossed, simplified and unsimplified. If the texts had been randomized, it seems reasonable that the data might also have shown even greater effects of vocabulary glossing and simplification since texts may have become progressively easier for the students. Furthermore, if more words from the texts had been simplified and glossed, it is possible that a greater effect would have been found between these texts and the unsimplified texts. However, such simplification was not done for the following reasons: it might result in a more severe watering-down of the simplified text or a text with marginal vocabulary glosses that is too distracting due to a greater density of glosses. Also, if TOEFL scores for each learner would have been available, it would have been beneficial to see if there was some relationship between proficiency, performance on the test, and the learners' text preference. Finally, since after the learners finished reading the texts they were informed about the type of each text (simplified, unsimplified, glossed), learners may have answered the questions about text preference by stating their predispositions about text type rather than responding to the texts that they had just read.

Recommendations for future research and pedagogical implications

Considering the dearth of studies in this area, it is recommended that future studies on such comparisons on text type be attempted, with larger sample sizes. Such studies could investigate the various kinds of simplification (e.g. syntactic and lexical), using various methods of measuring comprehension (e.g. recall protocols, open-ended questions, multiple-choice questions). Possible alternatives to text simplification need to continue to be examined by researchers, and the question concerning what kinds of text modification may be the most helpful for learners (e.g. elaborative) needs to be explored. Also, future studies might focus on comparing the different formats for glossing--in the text margin, in the back of the text, and on a computer.

Instructors and publishers need to carefully weigh the advantages and shortcomings of each type of text, and in light of this knowledge use the different kinds of texts appropriately. They especially may need to consider various alternatives to simplification, employing the use of vocabulary glossing as an example of one such alternative.

Conclusion

This study recognizes that some texts may be too difficult for second language learners. To compensate, the use of vocabulary glossing may be preferable to simplification as a means to making texts more accessible. Text preference may not be as clearly generalized as the literature would suggest. Learner profiles suggest that vocabulary glossing and simplification may be beneficial for lower level students, but for higher students the effect of different text types seems to level off since the texts may be too easy for them.

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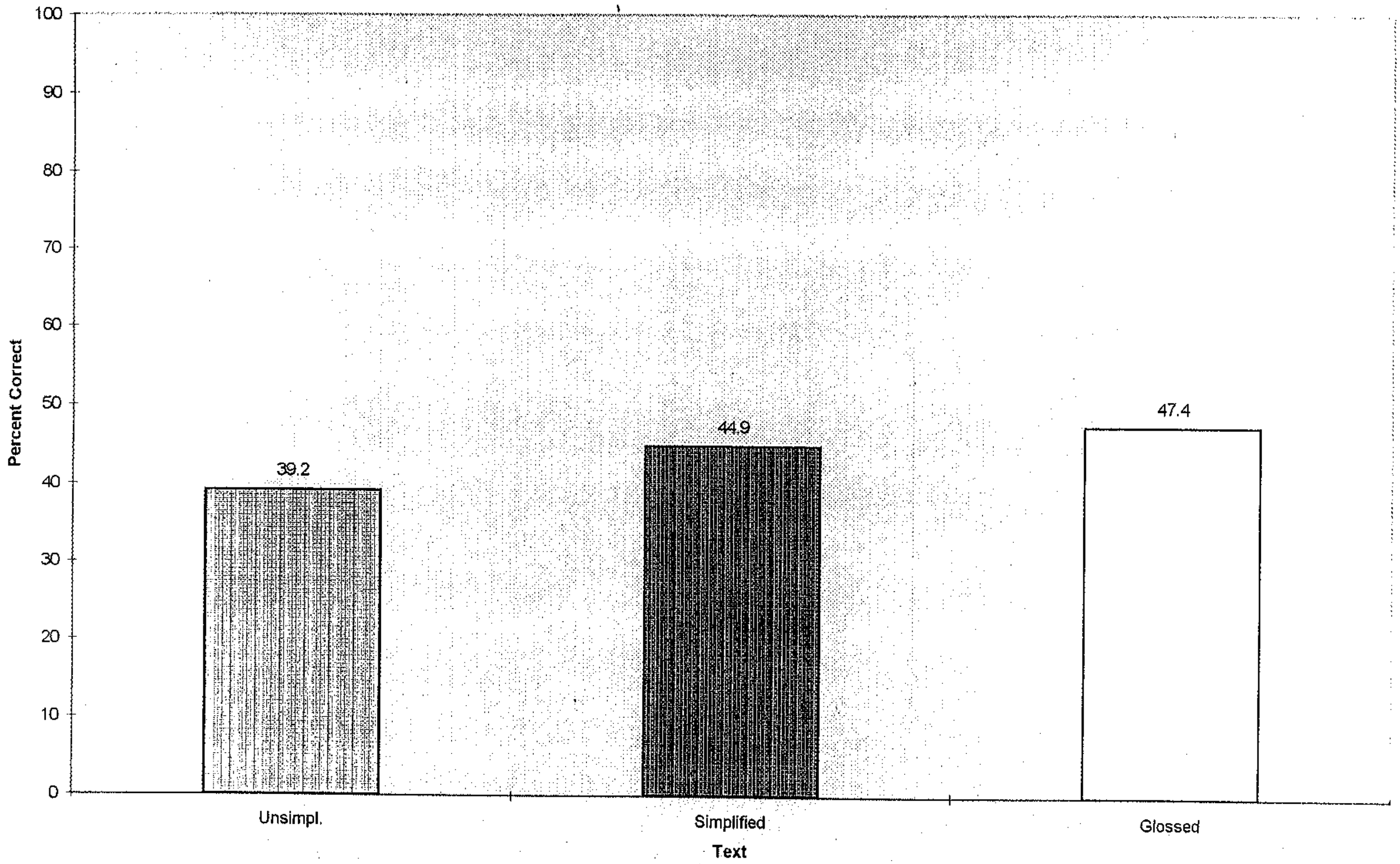
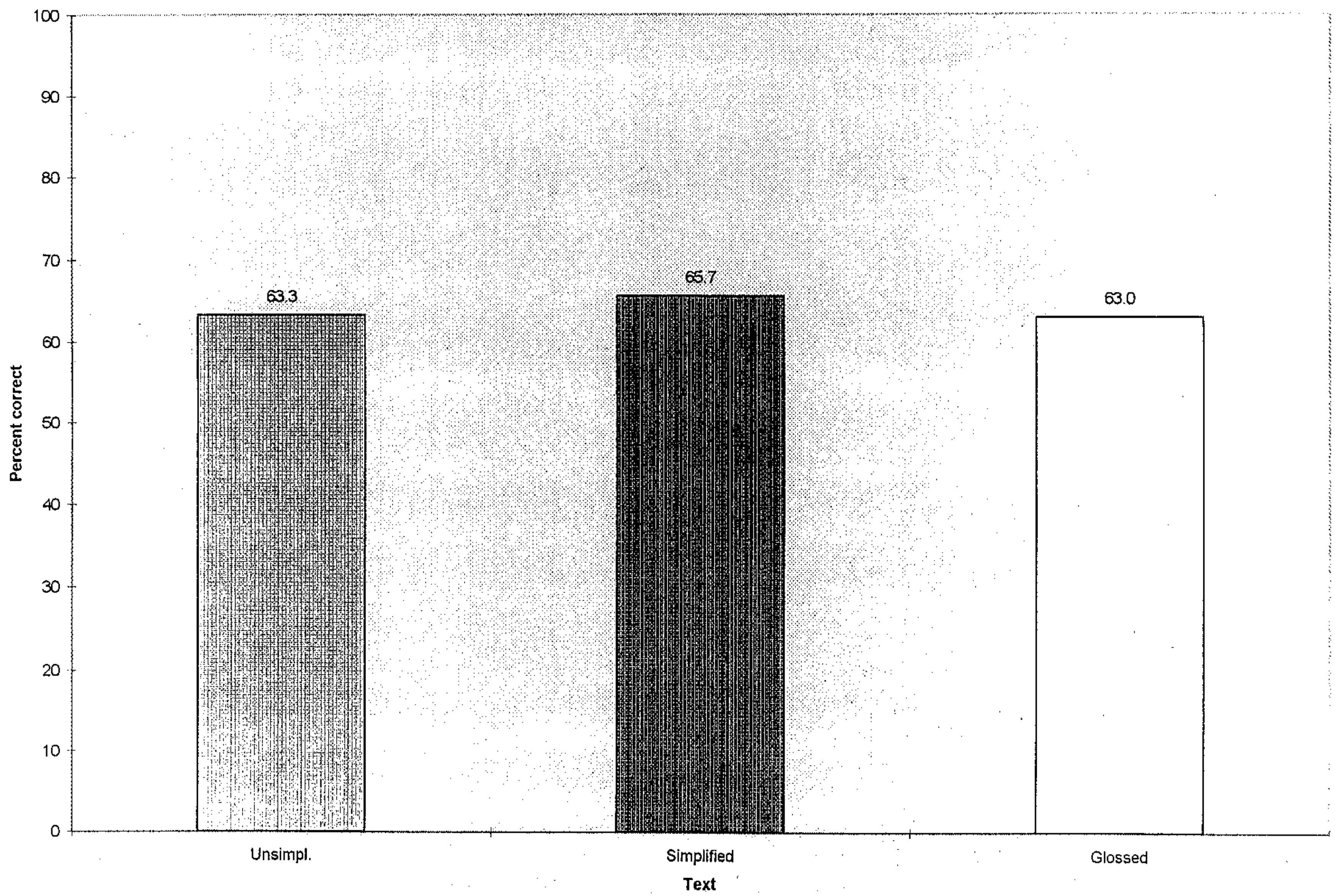
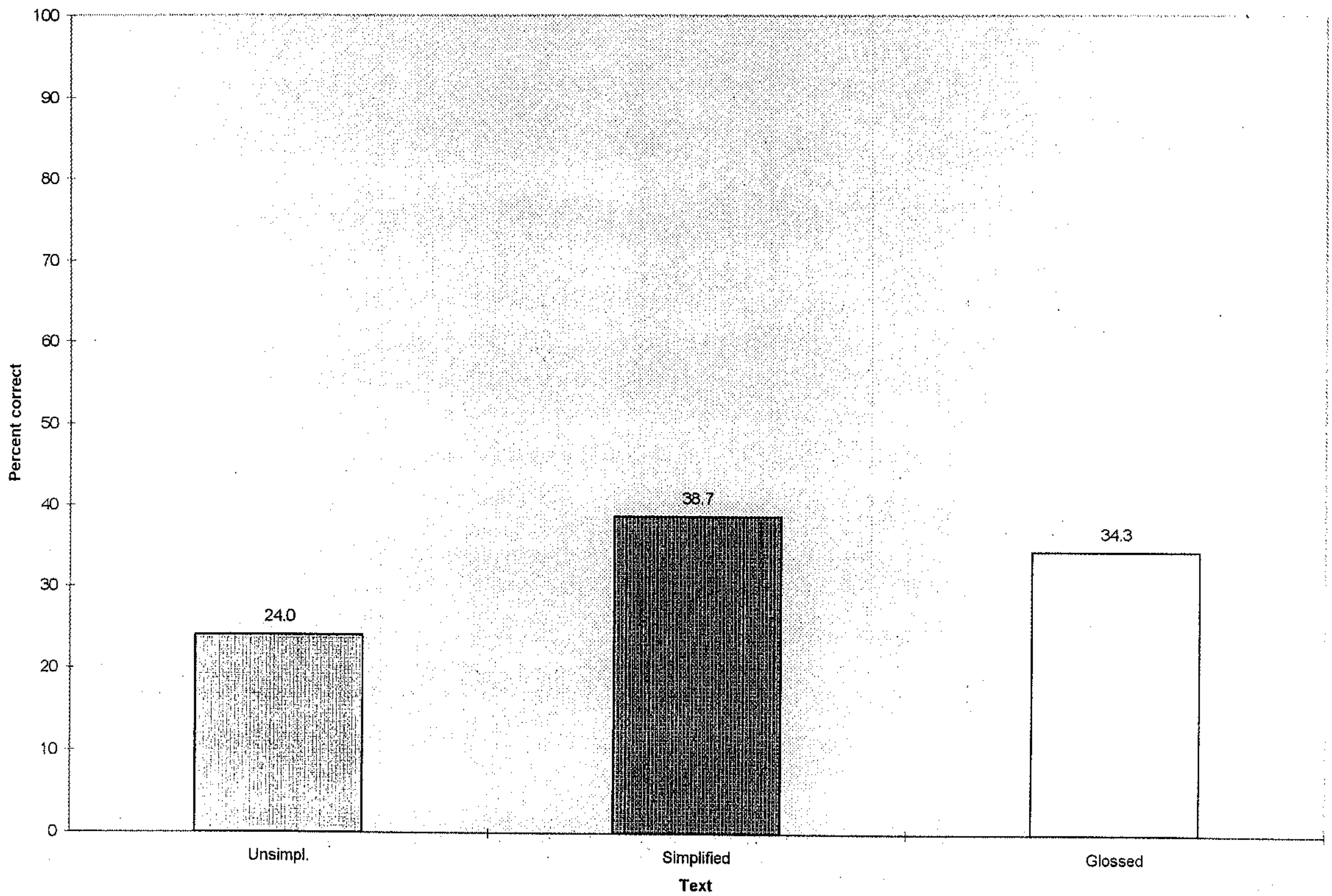
GRAPH A: COMPREHENSION OF TEXT



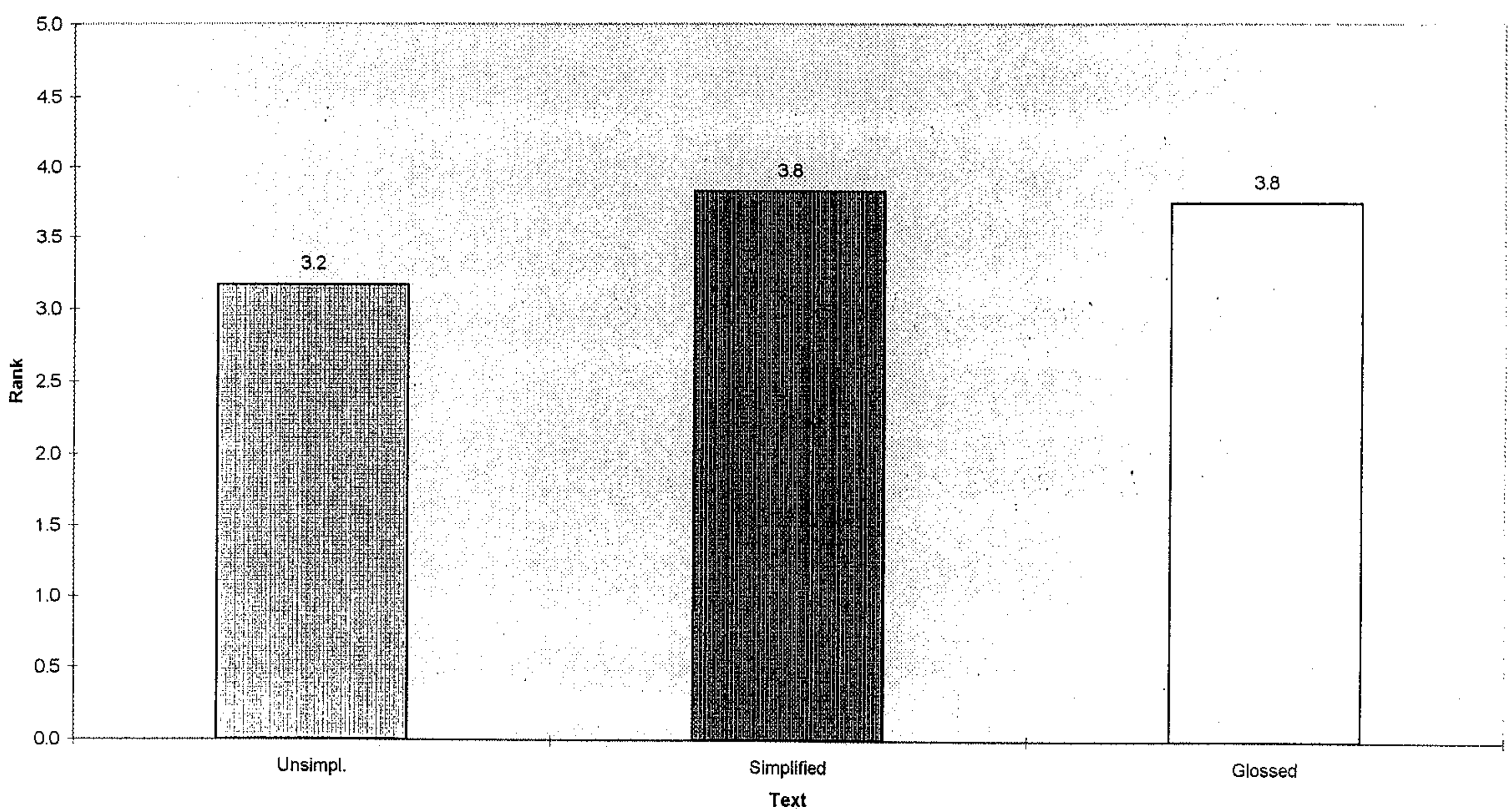
GRAPH B: HIGHER LEVEL LEARNERS' COMPREHENSION OF TEXT



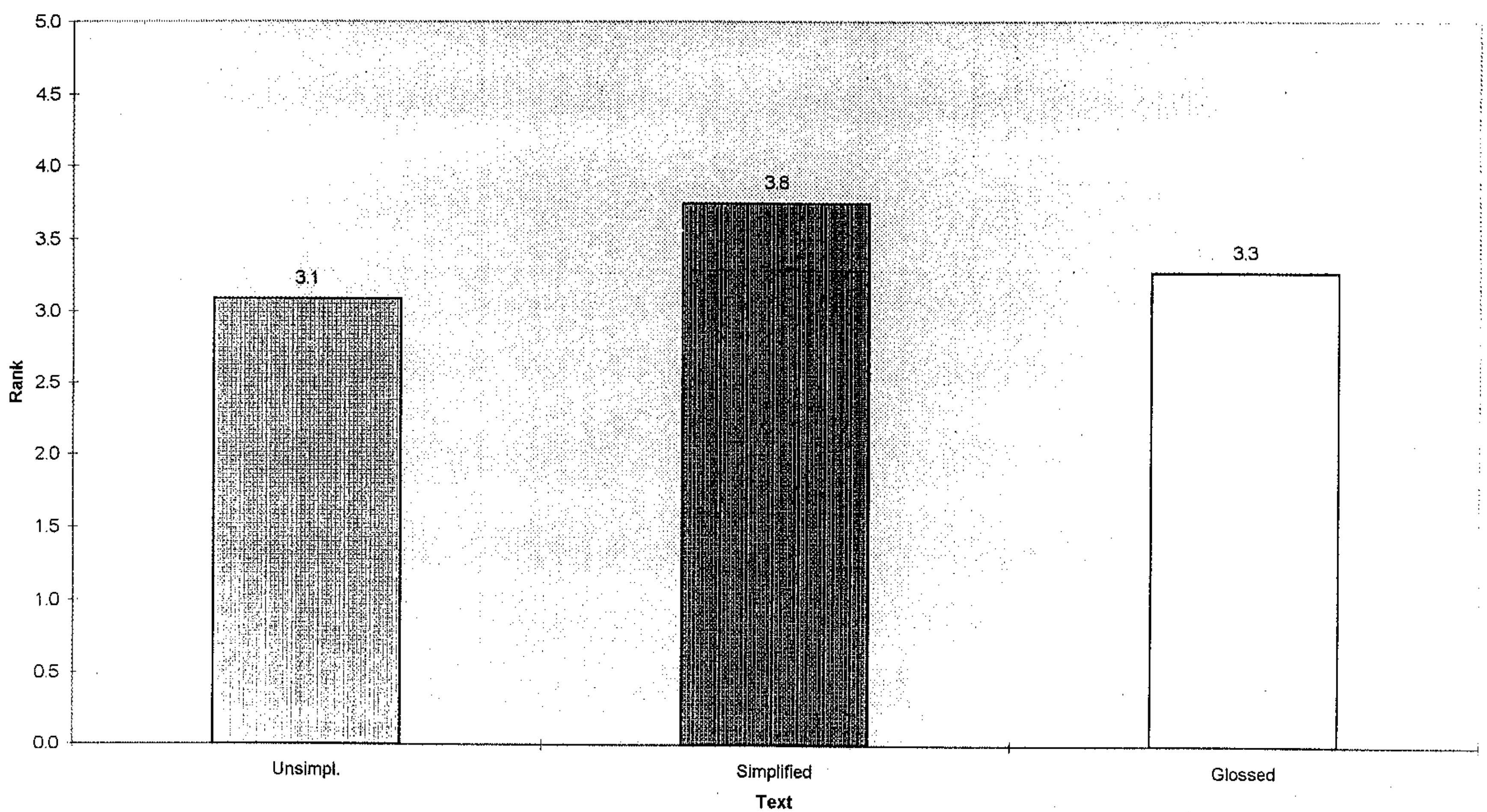
GRAPH C: LOWER LEVEL LEARNERS' COMPREHENSION OF TEXT



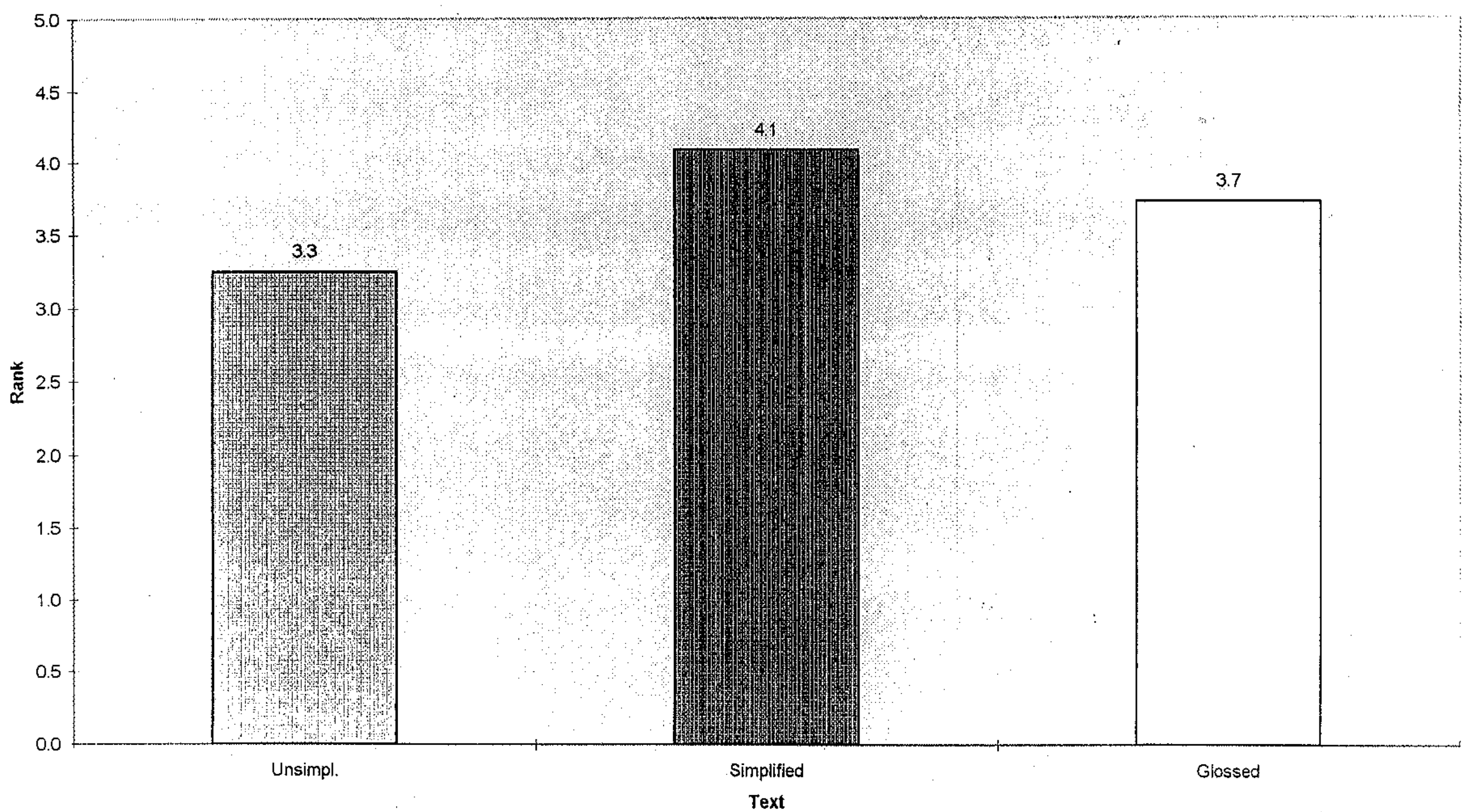
GRAPH D: ABILITY TO UNDERSTAND MEANING OF TEXT



GRAPH E: TEXT PREFERENCE



GRAPH F: ABILITY TO UNDERSTAND VOCABULARY



APPENDIX A: INTRODUCTIC...) TEXTS (GLOSSED)

Time International, March 2~, 1998 v 150 n30 p86(l)

Green Machines. (technology in environmentalism) *Dan Cray; Fiona Campbell.*

Technology, long seen as the enemy of the environment, is providing new solutions to some of the planet's most pressing problems

In the early days of environmentalism, "technology equals pollution" was a **rallying**[1] cry. Faced with the **relentless**[2] march of industry and commerce, the green movement became mostly reactive: **ecowarriors**[3] sailed into the paths of fishing boats or **blockaded**[4] logging roads. Activists often got their way only by persuading governments to **enact**[5] tough conservation and anti-pollution laws. But today a **profound**[6] shift is taking place. While protesters and regulators haven't gone away, environmentalism is becoming much more **proactive**[7], and a new **formula**[8] is gaining favor: technology equals solutions. No longer seen as the enemy, technology is being used to prevent environmental damage, manage **fragile**[9] ecosystems and devise ecofriendly products and manufacturing methods. Relying on everything from satellite systems and bioengineering to the **resilient**[10] processes of nature itself, scientists are learning how to clean up the air and water, produce nonpolluting fuels, and grow more food using fewer harmful chemicals. The once **derided**[11] "technology-fix" is making a comeback.

But none of these techniques is a magic **bullet**[12] that will forever **eradicate**[13] the threat of ecological **catastrophe**[14]. That will require a transformation in human behavior--leading to a new **willingness**[15] to assume responsibility for the environment and hold **consumption**[16] of resources to **sustainable**[17] levels. But the fruits of technology, combined with the needed change in attitudes, could very well enable us to have our earth and use it too. Here's a sampler of three technologies that are shifting the **equation**[18] for saving the planet.

1 **rallying:** joining together for a common purpose
2 **relentless:** unyeilding: not giving in
3 **ecowarriors:** fighters for nature
4 **blockaded:** blocked
5 **enact:** to make
6 **profound:** important; deep
7 **proactive:** working toward a solution before a problem occurs
8 **formula:** rule
9 **fragile:** weak; not strong
10 **resilient:** the ability to recover or become strong again
11 **derided:** laughed at; made fun of
12 **bullet:** solution
13 **eradicate:** end
14 **catastrophe:** disaster
15 **willingness:** to be ready to help
16 **consumption:** use
17 **sustainable:** to keep over a long period of time
18 **equation:** solution

Out in the middle of an alfalfa field in California's Imperial Valley, J.D. Rhoades is behind the wheel of what he considers the Ferrari of all farm vehicles. Resembling a cross between an Apollo lunar rover and a trundling haywagon, this particular machine is not built for speed, but built to seed. Rhoades' "moon buggy" is actually a sophisticated scientific instrument--complete with a real-time link to global positioning system (GPS) satellites--designed to measure soil salinity. The new piece of equipment, officially known as a "mobile salinity assessment vehicle" (MSAV), is the latest model in agriculture's increasingly high-tech armory of vehicles that enable farmers to map soil, plant crops and target pesticides more precisely and efficiently than ever before.

GPS networks--the same web of orbiting satellites that guided the precision bombing raids during the Gulf War--are being put to peaceful use on farms in the United States and Europe in "precision agriculture," the use of advanced technology to increase yields and reduce environmental impact. In traditional farming, a cultivated field is regarded as a single tract of land, and pesticides, herbicides and fertilizers are uniformly dispersed across the entire area. But each field can vary widely in terms of soil chemistry and weed concentration. One section might be infested with weeds, for example, and need heavy doses of herbicide, while another might be naturally weed-free. Precision agriculture enables farmers to tailor their use of chemicals to the requirements of small patches of soil, sometimes even on the scale of individual plants. As a result, the use of agrochemicals--and the ecological damage they cause--can be reduced.

Salinity, the accumulation in soil of harmful salts and other chemicals carried in fresh water, is one of the most serious downsides to modem irrigated agriculture. If the process of salinization goes unchecked, these chemicals gradually work their way to the surface, interfering with the flow of vital nutrients and killing crops. According to the United Nations Food and Agriculture Organization, salinity has already damaged 30 million hectares of the world's 240 million hectares of irrigated land. In China, for example, salinization has stunted yields in almost one-fourth of the country's farmland. This leaves farmers with a dilemma: "The world depends on irrigated agriculture," says Rhoades, director emeritus of the U.S. Department of Agriculture's Salinity Laboratory in Riverside, California. "But there's a side-effect: A serious degradation of our land, with one-quarter to one-third [of arable land] worldwide already degraded due to salinity."

To help farmers manage salinization, Rhoades and his team at the Department of Agriculture designed the MSAV to be an electronic bloodhound. It can detect salinity concentrations down to a depth of 1.8 m. It does this through electromagnets on its undercarriage that create a magnetic field in the soil directly beneath the vehicle. Any salts or other chemicals present conduct this electricity, and the resulting current is measured by onboard sensors. The amount of electricity generated indicates the degree of salinity in that location. When combined with maps created by the GPS satellites, this information can be used by farmers to diagnose salinity levels with degrees of accuracy to about 20 cm.

Charting salinity differences in this way can drastically improve crop yields. If farmers know where saline build-up is taking place, they can modify their irrigation systems to avoid saturating areas with already high concentrations, or vary tilling patterns to prevent the formation of ruts that channel water into certain places. Thanks to the GPS, says Rhoades, "You can see the leaching and drainage processes that cause salinity patterns. From there it's easy to solve the problem. Using spatial information to minimize the excesses that lead to contamination is the coming thing."

This "coming thing" has already arrived at Britain's Silsoe Research Institute in Bedfordshire. Here scientists are refining the techniques of precision agriculture down to the level of single plants. To practice what they call "plant-scale husbandry," the Silsoe team invented a small experimental vehicle outfitted with a video camera, a computer and an array of nozzles to spray chemicals. As this driverless, high-tech tractor makes its way across a field, the video camera feeds images of the terrain into a computer, which analyzes the data to separate the cultivated plants from the weeds. The computer then operates the nozzles to release precise doses of herbicide, pesticide and fertilizer as needed.

From experiments with marker dye on a cauliflower field, the Silsoe researchers reckon that, using this method, they could cut the amount of chemicals used by 90%. While these early results are promising, the scientists caution that autonomous vehicles like this won't be available on a commercial basis for another 10 years. Still, says Nick Tillett, a Silsoe research engineer, "This technology enables us to go back to more careful management of the land, to get back a better environmental balance."

GROWING GASOLINE

In downtown Hamburg, the scent of French fries fills the air. The odor is not, however, emanating from an unusually dense concentration of fast food outlets. it comes from the exhaLISt pipes of automobiles powered by rapeseed-methyl-ester, better known as "blodiesel." According to the Bonn-based Union for the Promotion of Oil and Protein Plants (UFOP), this alternative fuel made from the common rapeseed plant offers the same engine performance and mileage as conventional petroleum-based diesel but with a fraction of the harmful emissions that contribute to global warming. A 1997 study by the Society for Developmental Technology in Julich found that the production and combustion process of I kg of conventional diesel emits more than four times as much carbon dioxide and other greenhouse gases as that of I kg of rapeseed biodiesel.

German consumers, among Europe's keenest environmentalists, have developed a biodiesel habit. The alternative fuel is selling better than ever, with some 800 service stations dispensing 100,000 tons of the stuff last year, compared with 5,000 tons in 1993. Car manufacturers are responding. Volkswagen, Audi, Skoda and Seat already modify many of their diesel models to handle the alternative fuel, and Mercedes and BMW are in the process of doing so. Mercedes, in collaboration with Germany's Central Taxi Association, is promoting biodiesel as the fuel of choice for the country's fleet of cabs. And the organic gasoline has even received the German government's seal of approval: the new Reichstag in Berlin will be heated by it.

Apart from the obvious environmental benefits, biodiesel has the added advantage of being a renewable resource. Rapeseed, a crop traditionally used in the food industry, can be converted into fuel through a simple process of distillation. The rapeseed harvest is first pressed into an oil and mixed with methanol. Glycerol--a valuable byproduct used in everything from foodstuffs to pharmaceuticals--is recovered during initial processing. Then the biodiesel itself is extracted from the remaining mixture and refined.

Nothing comes without a price, however, and while biodiesel is an ecologically sound alternative to gasoline, it is not yet cost-efficient. Although the fuel is slightly cheaper than petroleum diesel at the service station, farmers who cultivate rapeseed for this purpose receive a subsidy from the European Union. "The state subsidizes biodiesel by about $1 per liter," says Gunter Alfke, head of the department for environmental affairs at the Hamburg-based Association of the Mineral Oil Industry. "That means, economically speaking, it's a flop." For biodiesel to become competitive, the price for a gallon of crude oil would have to increase by $1.33, according to Dieter Bockey of the UFOP. At 0.3%, biodiesel's market share in Germany is still minuscule. But some experts believe it could reach 5% by 2005. That would mean a 4% cut in Germany's carbon dioxide emissions from diesel automobile exhaust, not an achievement to tum up your nose at.

In Brignoles, France, engineer Guy Negre has gone beyond biodiesel. He has invented an engine that not only runs on thin air, but improves air quality to boot. Negre's Zero Pollution Urban Taxi covers about 200 km on 300 L of compressed air, which is stored in tanks similar to those used by scuba divers. In addition to a combustion chamber, the Z.P. taxi has an expansion chamber that compresses air at high temperatures. A small quantity of this compressed air is then injected into the combustion chamber at room temperature, producing a rise in pressure sufficient to drive the motor's cylinders. Designed specifically for inner cities where stop-and-go traffic accounts for a significant portion of polluting emissions, Z.P. vehicles inhale a fresh supply of air in about a minute at specially equipped service stations or recharge in four hours at home using a small electric compressor. The zero-pollution cars are also fitted with a carbon filtering system that sucks in dirty air during braking. The result: air emitted by the Z.P. engine is actually cleaner than that of the surrounding environment.

It took Negre and his team five years to design the Z.P. Taxi, which was taken on its first test spin in Brignoles two weeks ago. But it may take even longer to persuade automobile manufacturers to build it. Car companies "have a set mentality," he says. "They have already spent a great deal of money on electric cars, which turned out to be heavy and expensive. They don't want to listen to another new idea." The Mexican government, on the other hand, is all ears. It is backing an order for 40,000 Z.P. Taxis to replace the gasoline and diesel models in Mexico City, which suffers from probably the worst air pollution in the world due to its high altitude. Mexico City's first pollution-free taxis will hit the streets in two years. While they are not yet ready to displace fossil fuels, biodiesel and zero-pollution vehicles can still play an important role in reducing the level of greenhouse gases. "If we start with taxis, then move to buses and vans," Negre believes, "it will take very little time to improve the pollution problem in our cities."

During the summer, temperatures in Henderson, Nevada, a fast-growing suburb of Las Vegas, soar above 44[degrees]C. The desert landscape around the town is parched and barren. But despite the dry heat, Henderson boasts its very own lagoon, teeming with flora and fauna, including palm trees, pampas grass, cattails, irises, snails, freshwater shrimp, goldfish and koi. This little desert oasis is no mirage, but part of the wastewater treatment facility at the local Ethel M. Chocolates processing plant. It is what Living Technologies Inc., the Vermont firm that designed and built the lagoon, calls a Living Machine, a network of miniature environments that mimics natural biological processes to heat buildings, generate energy and clean up waste water. Says John Todd, visiting professor of ecological design at the University of Vermont's School of Natural Resources and co-founder of Living Technologies: "In Living Machines, the intelligence of the forest or lake is reapplied to human ends. They are both garden and machine."

A Living Machine operates according to the same natural processes of recycling at work in ecosystems such as rivers, prairies and estuaries. The difference is that a new breed of ecological engineers is using Living Machines to intensify and accelerate these processes for industrial purposes. The result: designer ecosystems, stocked with an exotic array of plants, animals and microorganisms--bacteria, protozoa and plankton--that have insatiable appetites for particular types of waste.

Michael Shaw, president of Living Technologies Inc., says the strategy is simple. First, gather the necessary bacteria, culture them, starve them and toss them into a contained environment--then just add wastewater. "The cultures are bugs in ajug," explains Shaw. "We stop feeding them and then throw them into the water. You've got a lot of very hungry bugs, so they just start chomping away on the waste."

During the production process, the plant at Ethel M. Chocolates, a subsidiary of M&M-Mars that manufactures individually wrapped candies, produces a form of concentrated dirty dishwater. It's not this waste itself that can kill aquatic life in rivers and lakes, but the fact that it consumes precious oxygen. Fish, for example, don't choke on passing nuggets of chocolate. Instead, they slowly suffocate as the sewage drains all oxygen from the water.

The voracious invertebrates in the Living Machine at Ethel M. Chocolates enjoy a particularly hearty feast. The initial tanks hold grease-eating bacteria and floating plants that gradually sift pollutants from the water. Toward the end of the line higher forms of life, usually scavengers like snails and clams, scour up the leftovers. Snails, for example, graze on dead bacteria, while clams filter out any remaining solids. By the time the water reaches the lagoon about seven days later, it's clean enough to be discharged back into the environment or recycled for subsequent use.

And where do all these ravenous bacteria come from? Often, the best place to find bugs with a taste for waste is at the source of the pollution itself. "We can take bacteria from the scum inside a factory's pipework," explains Shaw. "and grow a culture to use in the waste-treatment plant. These bacteria like that waste stream already." And Shaw is proud of what his industrial-strength organisms can accomplish, unaided by human hands. "People tend to think biology is weak ... but it's incredibly powerful," he says. "Plants and animals can do some incredible things."

The Living Machine in Henderson is the first of six such systems Living Technologies Inc. has created for M&M-Mars and its subsidiaries. Three are in the U.S., with three in Australia and two in Brazil. "It doesn't look like a waste-treatment plant," says Dick Baker, senior project engineer at Ethel M. "It looks like a park, and visitors aren't convinced it's really doing anything. But it's an evolving technology. We've had a very positive reaction in the community." And according to Shaw, Living Machines make economic as well as environmental sense. "The costs of a Living Machine are somewhat less than those of a conventional treatment system," he says. "And often our systems use two-thirds the energy of a conventional system."

Todd has even grander plans for his brand of organic technology: a network of Living Machines designed not only to clean the canals in Venice but to protect the city's buildings from erosion by the wash of motorboats; and living systems on rafts engineered to fish waste from the Delaware and Chesapeake Bays in the U.S. As the concept of living technology takes root, "the old division between nature 'out there' and ourselves 'in here' will be broken down," he predicts. Should Todd's natural remedies prove practical on a larger scale, green machines could some day be heating homes or cleaning streams near you.

FARMING BY SATELLITE

Out in the middle of an alfalfa field in California's Imperial Valley, J.D. Rhoades is behind the wheel of what he considers the Ferrari of all farm vehicles. **Resembling**[1] a cross between an Apollo **lunar rover**[2] and a **trundling**[3] haywagon, this particular machine is not built for speed, but built to seed. Rhoades' "moon buggy" is actually a sophisticated scientific instrument--complete with a real-time link to global positioning system (GPS) lites--designed to measure soil **salinity**[4]. The new piece of equipment, officially known as a "mobile **salinity assessment**[5] vehicle" (MSAV), is the latest model in agriculture's increasingly high-tech armory of vehicles that enable farmers to map soil, plant crops and target pesticides more precisely and efficiently than ever before.

GPS networks--the same web of **orbiting**[6] satellites that guided the **precision**[7] bombing **raids**[8] during the Gulf War--are being put to peaceful use on farms in the United States and Europe in "precision agriculture," the use of advanced technology to increase yields and reduce environmental impact. In traditional farming, a cultivated field is regarded as a single tract of land, and **pesticides**[9], **herbicides**[10] and fertilizers are uniformly **dispersed**[11] across the entire area. But each field can vary widely in terms of soil chemistry and weed concentration. One section might be **infested**[12] with **weeds**[13], for example, and need heavy doses of herbicide, while another might be naturally weed-free. Precision agriculture enables farmers to **tailor**[14] their use of chemicals to the requirements of small patches of soil, sometimes even on the scale of individual plants. As a result, the use of **agrochemicals**[15]--and the ecological damage they cause--can be reduced.

Salinity[16], the **accumulation**[17] in soil of harmful salts and other chemicals carried in fresh water, is one of the most serious downsides to modem irrigated agriculture. If the process of salinization goes unchecked, these chemicals gradually work their way to the surface, **interfering**[18] with the flow of vital **nutrients**[18] and killing **crops**[19]. According to the United Nations Food and Agriculture Organization, salinity has already damaged 30 million hectares of the world's 240 million hectares of irrigated land. In China, for example, **salinization**[20] has **stunted**[21] yields in almost one-fourth of the country's farmland. This leaves farmers with a **dilemma**[22]: "The world depends on irrigated agriculture," says Rhoades, director emeritus of the U.S. Department of Agriculture's Salinity Laboratory in Riverside, California. "But there's a side-effect: A serious **degradation**[23] of our land, with one-quarter to one-third [of arable land] worldwide already **degraded**[24] due to salinity."

T~ help farmers manage salinization, Rhoades and his team at the Department of Agriculture gned the MSAV to be an electronic **bloodhound**[25]. It can detect salinity concentrations down to a depth of 1.8 m. It does this through electromagnets on its undercarriage that create a magnetic field in the soil directly beneath the vehicle. Any salts or other chemicals present conduct this electricity, and the resulting current is measured by onboard sensors. The amount of electricity generated indicates the degree of salinity in that location. When combined with maps created by the GPS satellites, this information can be used by farmers to diagnose salinity levels with degrees of accuracy to about 20 cm.

Charting salinity differences in this way can drastically improve **crop yields**[26]. If farmers know where **saline**[27] build-up is taking place, they can **modify**[28] their **irrigation**[29] systems to avoid **saturating**[30] areas with already high concentrations, or vary **tilling**[31] patterns to prevent the formation of **ruts**[32] that channel water into certain places. Thanks to the GPS, says Rhoades, "You can see the **leaching**[33] and drainage processes that cause salinity patterns. From there it's easy to solve the problem. Using **spatial**[34] information to minimize the excesses that lead to contamination is the coming thing."

This "coming thing" has already arrived at Britain's Silsoe Research Institute in Bedfordshire. Here scientists are **refining**[35] the techniques of precision agriculture down to the level of single plants. To practice what they call "**plant-scale husbandry**[36]," the Silsoe team invented a small experimental vehicle outfitted with a video camera, a computer and an **array**[37] of **nozzles**[38] to spray chemicals. As this driverless, high-tech tractor makes its way across a field, the video camera feeds images of the **terrain**[39] into a computer, which analyzes the data to separate the cultivated plants from the weeds. The computer then operates the **nozzles**[40] to release precise **doses**[41] of herbicide, pesticide and fertilizer as needed.

From experiments with marker **dye**[42] on a **cauliflower**[43] field, the Silsoe researchers **reckon**[44] that, using this method, they could cut the amount of chemicals used by 90%. While these early results are promising, the scientists caution that **autonomous**[45] vehicles like this won't be available on a ~mmercial basis for another 10 years. Still, says Nick Tillett, a Silsoe research engineer, "This ~nology enables us to go back to more careful management of the land, to get back a better environmental balance."

APPENDIX C: UNSIMPLIFIED TEXTS WITH GLOSSING

During the summer, temperatures in Henderson, Nevada, a fast-growing suburb of Las Vegas, **soar**[1] above 44[degrees]C. The desert landscape around the town is **parched**[2] and **barren**[3]. But despite the dry heat, Henderson **boasts**[4] its very own lagoon, **teeming**[5] with flora and fauna, including palm trees, pampas grass, cattails, **irises**[5], snails, freshwater shrimp, goldfish and **koi**[6]. This little desert oasis is no ·**irage**[8], but part of the wastewater treatment facility at the local Ethel M. Chocolates processing ant. It is what Living Technologies Inc., the Vermont firm that designed and built the lagoon, calls a Living Machine, a network of miniature environments that **mimics**[9] natural biological processes to heat buildings, generate energy and clean up waste water. Says John Todd, visiting professor of ecological design at the University of Vermont's School of Natural Resources and co-founder of Living Technologies: "In Living Machines, the intelligence of the forest or lake is reapplied to human ends. They are both garden and machine."

A Living Machine operates according to the same natural processes of recycling at work in ecosystems such as rivers, **prairies**[10] and **estuaries**[11]. The difference is that a new breed of ecological engineers is using Living Machines to **intensify**[12] and accelerate these processes for industrial purposes. The result: designer ecosystems, stocked with an exotic array of plants, animals and microorganisms--bacteria, **protozoa**[13] and plankton--that have **insatiable**[14] appetites for particular types of waste.

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The **voracious**[19] **invertebrates**[20] in the Living Machine at Ethel M. Chocolates enjoy a particularly arty feast. The initial tanks hold grease-eating bacteria and floating plants that gradually sift ·llutants from the water. Toward the end of the line higher forms of life, usually **scavengers**[21] like **snails**[22] and **clams**[23], **scour up**[24] the **leftovers**[25]. Snails, for example, **graze**[26] on dead bacteria, while clams filter out any remaining solids. By the time the water reaches the lagoon about seven days later, it's clean enough to be discharged back into the environment or recycled for **subsequent**[27] use.

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Todd has even grander plans for his brand of organic technology: a network of Living Machines designed not only to clean the canals in Venice but to protect the city's buildings from **erosion**[31] by the wash of motorboats; and living systems on **rafts**[32] engineered to fish waste from the Delaware and Chesapeake Bays in the U.S. As the concept of living technology takes root, "the old division between nature 'out there' and ourselves 'in here' will be broken down," he predicts. Should Todd's natural remedies prove practical on a larger scale, green machines could some day be heating homes or ·aning streams near you.

In downtown Hamburg, the scent of French fries fills the air. The odor is not, however, **emanating**[1] from an unusually **dense**[2] concentration of fast food outlets. it comes from the **exhaust**[3] pipes of automobiles powered by **rapeseed-methyl-ester**[4], better known as "biodiesel." According to the ...n-based Union for the Promotion of Oil and Protein Plants (UFOP), this alternative fuel made ...n the common **rapeseed**[5] plant offers the same engine performance and mileage as conventional petroleum-based diesel but with a fraction of the harmful **emissions**[6] that contribute to global warming. A 1997 study by the Society for Developmental Technology in Julich found that the production and **combustion**[7] process of I kg of conventional diesel **emits**[8] more than four times as much carbon dioxide and other greenhouse gases as that of I kg of rapeseed biodiesel.

German consumers, among Europe's **keenest**[9] environmentalists, have developed a **biodiesel**[10] habit. The alternative fuel is selling better than ever, with some 800 service stations **dispensing**[11] 100,000 tons of the stuff last year, compared with 5,000 tons in 1993. Car manufacturers are responding. Volkswagen, Audi, Skoda and Seat already **modify**[12] many of their diesel models to handle the alternative fuel, and Mercedes and BMW are in the process of doing so. Mercedes, in collaboration with Germany's Central Taxi Association, is promoting biodiesel as the fuel of choice for the country's **fleet**[13] of cabs. And the organic gasoline has even received the German government's seal of approval: the new **Reichstag**[14] in Berlin will be heated by it.

Apart from the obvious environmental benefits, biodiesel has the added advantage of being a **renewable**[15] resource. Rapeseed, a crop traditionally used in the food industry, can be converted into fuel through a simple process of **distillation**[16]. The rapeseed harvest is first pressed into an oil and mixed with methanol. **Glycerol**[17]--a valuable byproduct used in everything from foodstuffs to **pharmaceuticals**[18]--is recovered during **initial**[19] processing. Then the biodiesel itself is extracted from the remaining mixture and refined.

Nothing comes without a price, however, and while biodiesel is an ecologically sound alternative to gasoline, it is not yet cost-efficient. Although the fuel is slightly cheaper than petroleum diesel at the service station, farmers who cultivate rapeseed for this purpose receive a **subsidy**[20] from the European Union. "The state **subsidizes**[21] biodiesel by about $1 per liter," says Gunter Alfke, head of the department for environmental **affairs**[22] at the Hamburg-based Association of the Mineral Oil ...ustry. "That means, economically speaking, it's a **flop**[23]." For biodiesel to become competitive, the price for a gallon of **crude**[24] oil would have to increase by $1.33, according to Dieter Bockey of the UFOP. At 0.3%, biodiesel's market share in Germany is still **minuscule**[25]. But some experts believe it could reach 5% by 2005. That would mean a 4% cut in Germany's carbon dioxide **emissions**[26] from diesel automobile exhaust, not an achievement to tum up your nose at.

In Brignoles, France, engineer Guy Negre has gone beyond biodiesel. He has invented an engine that not only runs on thin air, but improves air quality to **boot**[27]. Negre's Zero Pollution Urban Taxi covers about 200 km on 300 L of compressed air, which is stored in tanks similar to those used by scuba divers. In addition to a combustion chamber, the Z.P. taxi has an expansion chamber that compresses air at high temperatures. A small quantity of this compressed air is then injected into the combustion chamber at room temperature, producing a rise in pressure sufficient to drive the motor's cylinders. Designed specifically for inner cities where stop-and-go traffic accounts for a significant portion of polluting emissions, Z.P. vehicles **inhale**[28] a fresh supply of air in about a minute at specially equipped service stations or recharge in four hours at home using a small electric compressor. The zero-pollution cars are also fitted with a carbon filtering system that sucks in dirty air during braking. The result: air **emitted**[29] by the Z.P. engine is actually cleaner than that of the surrounding environment.

It took Negre and his team five years to design the Z.P. Taxi, which was taken on its first test **spin**[30] in Brignoles two weeks ago. But it may take even longer to persuade automobile manufacturers to build it. Car companies "have a set mentality," he says. "They have already spent a great deal of money on electric cars, which turned out to be heavy and expensive. They don't want to listen to another new idea." The Mexican government, on the other hand, is all ears. It is backing an order for 40,000 Z.P. Taxis to replace the gasoline and diesel models in Mexico City, which suffers from probably the worst air pollution in the world due to its high **altitude**. Mexico City's first pollution-free taxis will hit the streets in two years. While they are not yet ready to displace **fossil fuels**[31], biodiesel and zero-pollution vehicles can still play an important role in reducing the level of greenhouse **gases**[32]. "If we start with taxis, then move to buses and vans," Negre believes, "it will take very little time to improve the pollution problem in our cities."

FARMING BY SATELLITE

Out in the middle of an alfalfa field in California's Imperial Valley, J.D. Rhoades is behind the wheel of what he considers the Ferrari of all farm vehicles. Looking like a cross between a moon vehicle and a haywagon, this particular machine is not built for speed, but built to seed. Rhoades' "moon buggy" is actually a sophisticated scientific instrument--complete with a real-time link to global positioning system (GPS) satellites--designed to measure the amount of salt and chemicals in the soil . The new piece of equipment, officially known as a "mobile salt level vehicle" (MSLV), is the latest model in agriculture's increasingly high-tech armory of vehicles that enable farmers to map soil, plant crops and target chemicals used to kill insects more precisely and efficiently than ever before.

GPS networks--the same web of satellites moving around the earth that guided the precision bombing attacks during the Gulf War--are being put to peaceful use on farms in the United States and Europe in "exact agriculture," the use of advanced technology to increase yields and reduce environmental impact. In traditional farming, a cultivated field is regarded as a single tract of land, and chemicals used to kill insects and unwanted wild plants and fertilizers are uniformly dispersed across the entire area. But each field can vary widely in terms of soil chemistry and weed concentration. One section might be filled with unwanted wild plants, for example, and need heavy doses of chemicals that kill unwanted wild plants, while another might be naturally weed-free. Precision agriculture enables farmers to change their use of chemicals to fit the requirements of small patches of soil, sometimes even on the scale of individual plants. As a result, the use of chemicals used in farming--and the ecological damage they cause--can be reduced.

The presence and accumulation in soil of harmful salts and other chemicals carried in fresh water, is one of the most serious downsides to modem irrigated agriculture. If the process of adding salt and chemicals to the soil goes unchecked, these chemicals gradually work their way to the surface, getting in the way of the flow of vital nourishing parts of the soil and killing the plants that farmers grow for food. According to the United Nations Food and Agriculture Organization, salinity has already damaged 30 million hectares of the world's 240 million hectares of irrigated land. In China, for example, salt and chemicals in the soil has decreased yields in almost one-fourth of the country's farmland. This leaves farmers with a difficult decision: "The world depends on irrigated agriculture," says Rhoades, director emeritus of the U.S. Department of Agriculture's Salinity Laboratory in Riverside, California. "But there's a side-effect: A serious damaging of our land, with one-quarter to one-third [of arable land] worldwide already damaged due to salinity."

To help farmers manage the amount of salt and chemicals in the soil, Rhoades and his team at the Department of Agriculture designed the MSLV to be an electronic tool to measure salt and chemicals. It can detect salt and chemical concentrations down to a depth of 1.8 m. It does this through electromagnets on its undercarriage that create a magnetic field in the soil directly beneath the vehicle. Any salts or other chemicals present conduct this electricity, and the resulting current is measured by onboard sensors. The amount of electricity generated indicates the degree of salinity in that location. When combined with maps created by the GPS satellites, this information can be used by farmers to diagnose salinity levels with degrees of accuracy to about 20 cm.

Charting salt and chemical differences in this way can drastically improve the amount of food that farmers produce. If farmers know where salt and chemical build-up is taking place, they can change their watering systems to avoid filling areas with already high concentrations, or vary tilling patterns to prevent the formation of ruts that channel water into certain places. Thanks to the GPS, says Rhoades, "You can see the examples of water washing out and the drainage processes that cause salt and chemical patterns. From there it's easy to solve the problem. Using spatial information to minimize the excesses that lead to contamination is the coming thing."

This "coming thing" has already arrived at Britain's Silsoe Research Institute in Bedfordshire. Here scientists are improving the techniques of exact agriculture down to the level of single plants. To practice what they call "plant-scale growing," the Silsoe team invented a small experimental vehicle outfitted with a video camera, a computer and an array of short tubes fitted to the end of a hose to spray chemicals. As this driverless, high-tech tractor makes its way across a field, the video camera feeds images of the land into a computer, which analyzes the data to separate the cultivated plants from the unwanted wild plants. The computer then operates the hose to release precise amounts of herbicide, pesticide and fertilizer as needed.

From experiments with marker coloring on a vegetable field, the Silsoe researchers believe that, using this method, they could cut the amount of chemicals used by 90%. While these early results are promising, the scientists caution that individual vehicles like this won't be available on a commercial basis for another 10 years. Still, says Nick Tillett, a Silsoe research engineer, "This technology enables us to go back to more careful management of the land, to get back a better environmental balance."

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Apart from the obvious environmental benefits, biodiesel has the added advantage of being a resource that can be used again and again. Rapeseed, a crop traditionally used in the food industry, can be converted into fuel through a simple process which turns it into a liquid. The rapeseed harvest is first pressed into an oil and mixed with methanol. Glycerol--a valuable liquid used in everything from foodstuffs to medicine--is recovered during initial processing. Then the biodiesel itself is extracted from the remaining mixture and refined.

Nothing comes without a price, however, and while biodiesel is an ecologically sound alternative to gasoline, it is not yet cost-efficient. Although the fuel is slightly cheaper than petroleum diesel at the service station, farmers who cultivate rapeseed for this purpose receive money from the European Union to make prices lower. "The state helps by paying about 1$ for every liter of biodiesel," says Gunter Alfke, head of the department for environmental actions at the Hamburg-based Association of the Mineral Oil Industry. "That means, economically speaking, it's a failure." For biodiesel to become competitive, the price for a gallon of oil that has not yet been purified or cleaned would have to increase by $1.33, according to Dieter Bockey of the UFOP. At 0.3%, biodiesel's market share in Germany is still very small. But some experts believe it could reach 5% by 2005. That would mean a 4% cut in Germany's carbon dioxide emissions from diesel automobile exhaust, not an achievement to turn up your nose at.

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BUGS IN A JUG

During the summer, temperatures in Henderson, Nevada, a fast-growing suburb of Las Vegas, rise above 44[degrees]C. The desert landscape around the town is dry and empty. But despite the dry heat, Henderson is proud of its very own lagoon, filled with flora and fauna, including palm trees, pampas grass, cattails, flowers, snails, freshwater shrimp and goldfish. This little desert oasis is no fake—it is real--a part of the wastewater treatment facility at the local Ethel M. Chocolates processing plant. It is what Living Technologies Inc., the Vermont firm that designed and built the lagoon, calls a Living Machine, a network of miniature environments that copy the actions of natural biological processes to heat buildings, generate energy and clean up waste water. Says John Todd, visiting professor of ecological design at the University of Vermont's School of Natural Resources and co-founder of Living Technologies: "In Living Machines, the intelligence of the forest or lake is reapplied to human ends. They are both garden and machine."

A Living Machine operates according to the same natural processes of recycling at work in ecosystems such as rivers, grassy flat lands and the openings of rivers. The difference is that a new breed of ecological engineers is using Living Machines to strengthen and accelerate these processes for industrial purposes. The result: designer ecosystems, stocked with an exotic array of plants, animals and microorganisms--bacteria, and plankton and other microscopic (extremely small) animals--that have insatiable appetites for particular types of waste.

Michael Shaw, president of Living Technologies Inc., says the strategy is simple. First, gather the necessary bacteria, culture them, starve them and toss them into a contained environment--then just add wastewater. "The cultures are bugs in a bottle" explains Shaw. "We stop feeding them and then throw them into the water. You've got a lot of very hungry bugs, so they just start eating away on the waste."

During the production process, the plant at Ethel M. Chocolates, a subsidiary of M&M-Mars that manufactures individually wrapped candies, produces a form of concentrated dirty dishwater. It's not this waste itself that can kill aquatic life in rivers and lakes, but the fact that it consumes precious oxygen. Fish, for example, don't choke on passing nuggets of chocolate. Instead, they slowly stop breathing and die as the waste material from sewers drains all oxygen from the water.

The hungry animals in the Living Machine at Ethel M. Chocolates enjoy a particularly hearty feast. The initial tanks hold grease-eating bacteria and floating plants that gradually sift pollutants from the water. Toward the end of the line higher forms of life, usually creatures that feed on waste like snails and clams, eat up the uneaten food. Snails, for example, feed on dead bacteria, while clams filter out any remaining solids. By the time the water reaches the lagoon about seven days later, it's clean enough to be discharged back into the environment or recycled for future use.

And where do all these hungry bacteria come from? Often, the best place to find bugs with a taste for waste is at the source of the pollution itself. "We can take bacteria from the scum inside a factory's pipework," explains Shaw. "and grow a culture to use in the waste-treatment plant. These bacteria like that waste stream already." And Shaw is proud of what his industrial-strength organisms can accomplish, not helped by human hands. "People tend to think biology is weak ... but it's incredibly powerful," he says. "Plants and animals can do some incredible things."

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Questions for Farming by Satellite. Directions: answer each question as **completely** as possible, **using you own words** (e.g. don't just copy down whole sentences) as much as possible.

1. Try to describe (what it looks like) the vehicle JD Rhodes has built.

2. What IS JD Rhodes' vehicle? What does it do?

3. How is farming with Rhodes' vehicle different than farming with traditional methods?

4. What causes salinity (the problems with salt and chemicals)? How does salinity affect plants and land?

5. How can knowing salinity (the problems with salt and chemicals) differences improve the amount of food a farmer can get?

Questions for Growing Gasoline. Directions: answer each question as **completely** as possible, **using you own words** (e.g. don't just copy down whole sentences) as much as possible.

1. What is the cause of the odor (smell) in Hamburg? Whay do you think it smells like french fries?

2. Does it seem Germans are good environmentalists? Why or why not (give reasons)?

3. What are some of the benefits of biodiesel?

4. How does the European Union support biodiesel? Is biodiesel an economic success? Why or why not?

5. What are the benefits of Guy Negre's engine?

Bugs in a Jug Questions. Directions: answer each question as **completely** as possible, **using you own words** (e.g. don't just copy down whole sentences) as much as possible.

1. Describe what kind of place Henderson, Nevada is. Do you think it rains a lot there? Why or why not? Is there a lot of water?

2. What kinds of actions do Living Machines copy? What kinds of natural places do they copy? What do the living machines do with waste?

3. How can waste be harmful to fish and other life in lakes?

4. What exactly are the Living Machines made of?

5. What are some of the future hopes and plans for the Living Machines?

Questionnaire

Text "O" is an **original text** (the language was not simplified or modified to make it easier to read).

Text "S" is a **simplified text** (the language was simplified and modified to make it easier to read).

Text "O/V" is an **original text with vocabulary words** (the language was not simplified to make it easier to read).

*****The kind of text ("O", "S" or "O/V") is marked at the top of each text.***

Rate the following by circling the appropriate number. Then explain why you rated the texts as you did.

1. Rate your ability to understand the meaning of the text ("1" is high; "5" is low)

	high low
Text O (the original text)	1 2 3 4 5
Text S (the simplified text)	1 2 3 4 5
Text O/V (the original text with vocabulary words)	1 2 3 4 5

Why?

/ Simplify

2. Rate your text preference:

	high low
Text O (the original text)	1 2 3 4 5
Text S (the simplified text)	1 2 3 4 5
Text O/V (the original text with vocabulary words)	1 2 3 4 5

Why?

3. Rate your ability to understand vocabulary:

	high				low
Text O (the original text)	1	2	3	4	5
Text S (the simplified text)	1	2	3	4	5
Text O/V (the original text with vocabulary words)	1	2	3	4	5

Why?

APPENDIX G: TEXT PREFERENCE
QUESTIONNAIRE RESPONSES

Question 1

G: "In [the text with marginal glosses], the vocabulary words make me easy to understand, but in case of [the simplified text] it is somewhat confusing because it's wordy and not-familiar field to me. [The original text] is complicated but it's familiar field.

S: "In the [text with marginal glosses] I like when there's an essay and there's a vocabulary words but I think just the time isn't enough.

F: "I basically can catch the main idea [of each kind of text]."

B: "I could understand throughout the meaning of all. I had difficult time with some words and verbs but I could infer information."

D: "The ideas of each text are different so some texts are easier to understand and even if I don't know the meanings of all the words."

N: "Generally all three texts were difficult to understand the meanings. Because I have less vocabulary than the other ESL students. But most difficult was original one. If I don't know the meaning, I couldn't concentrate to read through.

J: "As you know, [the simplified text] I don't have to think about what meaning of strange word or...."

M: "The original [text] use a technical terms that hard to understand. The simplified [text] use easier words even though there are some difficult word but mostly I can understand the content. The original text use too many difficult word even though there are the meanings of them. I have to stop every time I found difficult word."

Question 2

G:"If vocabulary words for new and familiar [words] were in the passage, it would be easy to understand"

S: "Sometimes when we know the background knowledge we can understand the text preference."

B: I liked better the content of [the simplified text] and [the text with marginal glosses], maybe that is the reason [she preferred those texts]. The content of the original text didn't like me so much because I did not like the way of writing but I still enjoyed it.

D: "The topic of [the simplified text] was interesting to me even though I didn't understand all the vocabulary I got the main idea
N: "The simplified text is good for me. It was also difficult but text with simple words is easier, because I didn't need to stop reading at the words which I couldn't understand.

J: "Even though it is not easy I must practice and know some new vocabulary."

M: "If simplified text is easier to understand to catch the gist. Even though there are some words that I don't know but I can look up for them later."

I: "Because [the simplified text] can be inferred but if I don't have knowledge about text, sometimes it is hard to understand for me."

Y: "I think [the simplified text] used some short sentences and easy vocabulary, so I can understand it."

Question 3

H: 3"In [texts with marginal glosses] vocabulary list is helpful to understand it."

G: "All of the three articles are not difficult to me, except some words, so it's easy."

S: "It's easy when there's a vocabulary words, but [I just needed more time] because you know I must think about the words."

F: "There are few unknown vocabulary in [the original text]. [In the simplified text] there are some vocabulary which I can't understand. But I can guess the meaning from the sentence." [In the text with marginal glossing] there are some new high-tech vocabulary which I never see before…it's difficult to guess the meaning from the sentence."

B: "I couldn't understand some words like trundling, patches, downsides. But I could understand all the other words maybe inferring but I did. I think I could understand because many words used it become from Latin so it is easy to know their meaning.

D: There are some words that I understood perfectly because they were not new to me and other words were new but I understood the meaning from the text and the sentences. Sometimes it's hard to guess the meaning of the word because it's a scientific word.

N: I don't have enough skill to understand the reading even in my first language. So it is harder to understand in 2nd language than in first language. I'm sorry, I'm afraid if mine is helpful to you or not.

J: "[the text with marginal glossing] is the easiest one, because sometimes I confusing the meaning of easy word. But [the text with marginal glossing] can help me understand the exact meaning.

M: "[The original text] use technical terms that needed the explanations in order to understand. [The simplified text] use ordinary word mostly, but some words I can find the meaning from the context. [The text with marginal glosses] use a lot of difficult words even though there are the meanings given. Hard to understand and take more times but good for learning new word.

I: The vocabulary [in the text with marginal glosses] is unusual to me and it is special field vocabulary. So if it does not have explain about vocabulary it is hard for me to understand. And the others vocabulary is usual for me so those are easier than the [text with marginal glosses].

Y: [regarding the original text] "I can master the text main idea, so I can guess new words."

First interview

H: ...If I don't understand the vocabulary, I try to understand from the context. But if I know [the vocabulary glosses] are next to it, I look at it and it distracts me, I lose what the whole sentence is about...I didn't like that.

Interviewer: Do you like to have the language simplified or do you like to have the original text, or do you like to have the vocabulary in the margins?

H: I don't like the [text with vocabulary glosses]...of course, it is easier to understand for me. If it's a topic you know a little bit about, I don't mind the original text, because you can guess a little bit if you don't understand...

The first [glossed] word ("soar") I kept reading because I could get the meaning from the context... it's clear that Las Vegas--it's hot, right? Everyone knows that. And if you say that it's "above forty degrees" you assume its going to be increase--it's over...I looked only at the words which helped me understand the meaning of the sentence. This one wasn't that important. I got the meaning that it was hot there.

(regarding the next two glossed words--"parched" and "barren") Yeah, I looked [the vocabulary glosses] at those two because otherwise the sentence doesn't really give me...I didn't get the meaning. Because those two words were main words that would give you the meaning, so I looked at [the vocabulary glosses for] those two.

(regarding "boasts") I looked at it, but I didn't get the meaning. I mean I know what "to take pride" is, but then I lost my thought what the sentence might be about, so I cannot jump over and continue my sentence. I also try to to get the whole meaining of the paragraph and not every single word.

(regarding "teeming") It's clear it's it is growing or surrounding...I don't think I looked at [the vocabulary gloss for] that one..I always try...you told me its [the length of time to read the text and answer the questions] is only twenty minutes, and I thought it's really long and so I tried to read really quickly to get the main point and then went back, and when I went back and looked at your questions I looked at some of the [vocabulary] because I thought it would help me to understand better to answer your questions. But the first when I read time I don't really look at each word...I get the main idea and then go back if I am unable to answer your questions.

(regarding 'irises') He gives you so many other examples, so if you don't understand one of them, it doesn't matter.

(regarding 'koi') [I didn't look at the vocabulary glosses for that one] because 'goldfish' and some other fish probably.

Second interview

T: so, when I read some vocabulary words, I can understand [the text] and also this one [the simeplified text] I can understand easily...more than the original text. And my preference is I like it (the simplified text) because it is easy reading and basically I can read it. But in my case, I like original text, because actually when I am reading the original text I don't understand some kind of vocabulary, this is true. But I can try to find the meaning--I like it. It is wrong or correct--I don't care about that. I like to try.

(soar) Yeah...first time I look for the meaing from the vocabulary.

(regarding "parched") In this case, I ignore that because...I just ignore it. Maybe it is not important; it just explain about the landscape, so I skip it.

(regarding boasts) "In this case I didn't [look at the vocabulary glosses]

(regarding "teeming) In this case, "teeming" I want to know the meaning because of "life" and...

(regarding "irises") "all of them is creature, so maybe it could be something...some kind of things

("mirage") "I know that meaning"

("mimics") "I know that meaning"

("prairies") "I skip it"

("estuaries") "I skip it"

("intensify") [he know the meaning]

Jug "I [looked at the vocabulary gloss]"

Interviewer: Do you remember if you made a guess at what "jugs" meant, or right away did you look here [at the glosses].

T: "As soon as I saw it I am looking for the meaning."

("chomping") "I [looked at the glosses] because...there's a relation between some kind of bacteria and waste, so I need to know the meaning.

Background Questionnaire

Name________________________________ Age ________Sex (M or F)

Home country________________________ Native Language ________________

Number of years studied English _______ Number of years lived in the U.S. ______________

How long have you studied English full-time in the U.S.?________________________

If you are in the MEC, what level are you in (e.g. "6")?________________________

If you have taken the TOEFL before, when was the last time you took it? ________________

What was your score? ____________

APPENDIX J: GLOSSES AND SIMPLIFICATIONS

Farming by Satellite (glosses)

1 **Resembling:** to look like
2 **lunar rover:** moon vehicle (or transportation)
3 **trundling:** the motion or noise of rolling
4 **salinity:** amount of salt in the soil
5 **salinity assessment:** measures amount of salt
6 **orbiting:** moving around a planet in space
7 **precision:** careful and exact
8 **raids:** a surprise attack
9 **pesticides:** chemicals used to kill insects
10 **herbicides:** chemicals used to kill weeds (unwanted wild plants)
11 **dispersed:** scattered
12 **infested:** containing a large number of
13 **weeds:** unwanted wild plants
14 **tailor:** to alter or adapt for a particular use
15 **agrochemicals:** chemicals used in farming
16 **salinity:** prescence of salt
17 **accumulation:** the act of gathering
18 **interfering:** getting in the way of something
18 **nutrients:** a kind of food for crops; something that nourishes
19 **crops:** cultivated plants such as grain, vegetables or fruit
20 **salinization:** land becoming filled with salt and chemicals
20 **irrigated:** to supply water with streams made by people
21 **stunted:** decreased; lessened
22 **dilemma:** a difficult decision
23 **degredation:** damaging; ruining
24 **degraded:** damaged; ruined
25 **bloodhound:** a dog with a keen sense of smell [illegible] se, means a tool to measure salt)
26 **crop yields:** the amount of food that farmers produce
27 **saline:** salt
28 **modify:** change
29 **irrigation:** watering
30 **saturating:** making full
31 **tilling:** cultivating (plants or crops)
32 **ruts:** holes
33 **leaching:** to be washed out by a liquid
34 **spatial:** space
35 **refining:** improving by making more precise
36 **"plant-scale husbandry":** helping individual plants to grow
37 **array:** many
38 **nozzle:** short tube fitted to the end of a hose
39 **terrain:** ground; field
40 **weeds:** an unwanted wild plant
41 **doses:** amounts
42 **dye:** ink; coloring
43 **cauliflower:** a kind of vegetable
44 **reckon:** believe
45 **autonomous:** independent

Farming by Satellite (simplifications)

1. *looking like*
2. *moon vehicle*
3. *--*
4. *amount of salt and chemicals in the soil*
5. *salt level*
6. *moving around the earth*
7. *precision*
8. *attacks*
9. *chemicals used to kill insects*
10. *chemicals used to kill unwanted wild plants*
11. *dispersed*
12. *filled*
13. *unwanted wild plants*
14. *change*
15. *chemicals used in farming*
16. *the presence...of harmful salts*
17. *accumulation*
18. *getting in the way of*
19. *salt and chemicals in the soil*
20. *the plants that farmers grow for food*
21. *decreased*
22. *difficult decision*
23. *damaging*
24. *damaged*
25. *tool*
26. *the amount of food that farmers produce*
27. *salt and chemical*
28. *change*
29. *watering*
30. *filling*
31. *tilling*
32. *ruts*
33. *examples of water washing out*
34. *spatial*
35. *improving*
36. *"plant scale growing"*
37. *array*
38. *short tubes fitted at the ends of hoses*
39. *land*
40. *hose*
41. *amounts*
42. *coloring*
43. *vegetable*
44. *independent*

Growing Gasoline (glosses)

1 **emanating:** coming from
2 **dense:** a great number of something in a small area
3 **exhaust:** gases released from an engine
4 **rapeseed-methyl-ester:** a kind of gasoline called "biodiesel"
5 **rapeseed:** a kind of plant
6 **emissions:** pollution
7 **combustion:** a chemical change which is followed by heat and light (and can occur in a car engine)
8 **emits:** puts out
9 **keenest:** smartest

Growing Gasoline (simplifications)

1. *coming from*
2. *great number*
3. *exhaust*
4. *a kind of gasoline made from plants*
5. *rapeseed*
6. *engine gases*
7. *using*
8. *emits*
9. *smartest*

10 **biodiesel:** a kind of gasoline made from living material
11 **dispensing:** selling
12 **modify:** change
13 **fleet:** a group of buses, aircraft, etc. under one control
14 **Reichstag:** Germany's new government buildings
15 **renewable:** able to use again
16 **distillation:** to turn something into a liquid
17 **Glycerol:** a syrupy, sweet liquid obtained from oils
18 **pharmaceuticals:** medicine
19 **initial:** beginning
20 **subsidy:** money paid by the government to make prices lower
21 **subsidizes:** using government funds to make prices lower
22 **affairs:** something needing action or attention
23 **flop:** failure
24 **crude oil:** oil that had not been cleaned or purified
25 **minuscule:** a very small amount
26 **emmisions:** gases that come from the automobiles; exhaust
27 **'to boot':** in addition
28 **inhale:** breath in
29 **emitted:** released
30 **'test spin':** a practice try
31 **fossil fuels:** oil, gas, coal
32 **gases:** vapors

10. biodiesel
11. selling
12. changed
13. group
14. governmental buildings
15. can be used again and again
16. which turns it into liquid
17. glycerol
18. medicine
19. initial
20. money
21. helps by paying
22. actions
23. failure
24. oil that has not yet been purified or cleaned
25. very small
26. emissions
27. as well
28. breathe
29. released
30. how high it is located
31. oil, gas, and coal
32. gases

Bugs in a Jug (glosses)

1 **soar:** to rise above
2 **parched:** dry
3 **barren:** empty
4 **boasts:** to take pride in
5 **teeming:** to be present in large numbers
6 **iris:** a kind of flower
7 **koi:** carp—a kind of fish
8 **mirage:** a strange effect of hot air conditions in a desert, in which objects appear which are not really there
9 **mimics:** to copy the action of
10 **prairies:** a wide, treeless grassy plain
11 **estuary:** the wide lower part or mouth of a river
12 **intensify:** to become more intense or strong
13 **protazoa:** microscopic (extremely small) animals
14 **insatiable:** unable to satisfy
15 **jug:** a container or kind of bottle
16 **chomping:** eating or biting
17 **suffocate:** unable to breathe
18 **sewage:** waste material carried in sewers
19 **voracious:** very hungry
20 **invertebrates:** a living creature which has no spine (backbone)
21 **scavengers:** a creature that feeds on waste
22 **snail:** a small animal with a soft body and a hard shell on its back
23 **clam:** a small soft-bodied sea animal with a double shell
24 **scour up:** eat up
25 **leftovers:** an unused portion of something, usually food
26 **graze:** to feed on; to eat
27 **subsequent:** coming after something else
28 **ravenous:** very hungry
29 **unaided:** not helped
30 **subsidiaries:** connected, but of second importance to the main company
31 **erosion:** natural processes that result in earthy or rocky material being removed from the earth's surface
32 **rafts:** a flat boat

Bugs in a Jug (simplifications

1. rise above
2. dry
3. empty
4. is proud of
5. filled with
6. flowers
7. --
8. no fake--it is real--
9. copy the actions of
10. grassy flat lands
11. the openings of rivers
12. strengthen
13. microscopic (extremely small) animals
14. insatiable
15. bottle
16. eating
17. stop breathing
18. waste material
19. hungry
20. animals
21. creatures that feed on waste
22. snails
23. clams
24. eat up
25. uneaten foods
26. feed
27. future
28. hungry
29. not helped
30. companies
31. breaking down
32. flat boats