

# Do EFL Learners Make Instrumental Inferences when Reading? Some Evidence from Implicit Memory Tests

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Initial studies with second language learners, employing elaborative inferencing tasks, appear to contradict some ideas about the usefulness of schema theory for teaching reading to students of English as a foreign language. Learning instructions designed to activate instrumental inferencing in single sentence contexts may have a negative effect on recall, suggesting that they may disrupt processing during initial contact with the text.

精緻化推論のタスクを使った、第二言語学習者の研究を行ったところ、外国語として英語を学ぶ学生に読解を教える際のスキーマ理論の有用性の主張とは矛盾した結果が出た。一文だけの文脈では道具的推論を活性化させるための指示は、記憶に否定的な影響を与えるかもしれない。これは、こうした指示が、テキストとの接触の初期段階における処理の妨害になるかもしれないということを示している。

**T**hough there is some disagreement on the various versions of schema theory on offer, the theory itself has been influential in the methodology of teaching reading both to native and non-native speakers. Schema are produced by drawing inferences from the text and relating text-based information to information the reader already has, based on knowledge or experience.

In studies of elaborative inferences, i.e. those which relate information in the text to information in memory, researchers have used a variety of techniques to find support for schema theory (Graesser and Clark, 1985). Whitney and Williams-Whitney (1990) focused on research techniques which accommodated evidence that elaborative inferences are affected by contextual variables, and also demonstrated how subjects use elaborative inferences. Whitney and Williams-Whitney (1990)

and Fincher-Kiefer (1994) examined whether readers infer instruments implied by actions in short texts and single sentence contexts, while Whitney and Williams-Whitney also used implicit memory tests as an activation measure to examine the occurrence of instrumental inferences. Implicit memory tests are those in which performance is measured in the absence of conscious recollection (Graf and Schacter, 1985), such as a constrained word stem completion test. For example, Whitney and Williams-Whitney told subjects to read a series of sentences such as *The woman stirred her coffee* and then to take a constrained word stem completion test generated from the target instruments (e.g. sp—). When indirect priming effects appear in the constrained word stem completion test, as is indicated when subjects generate target instruments more frequently than the baseline level, one would expect that they draw instrumental inferences while reading. Indirect priming effects can be obtained as a result of lexical access to target instruments.

### Levels of Mental Representation

According to Fincher-Kiefer (1994), indirect tests may better reflect text processes occurring at multiple levels of representation, following the models developed by Johnson-Laird (1983); Just and Carpenter (1987); Kintsch (1988), and Perfetti (1989). In brief, these models suggest that readers construct several levels of mental representation as they read. At the first level of representation, thought to be the result of automatic lexical and syntactic processes, the explicit words of the text are represented. This level is called "surface memory." The second level, or propositional representation ("text-based"), is the result of semantic analysis. This level is obligatory during the reading process as it provides meaning to the reader. Finally, the third level, or situation model, is the level at which inferences are made, and is thought to be the site of the integration of individual sentences with an individual's prior knowledge. This level thus makes use of extra-textual information. The situation model provides the reader with an interpretation of the text. The absence or disruption of this model results in shallow comprehension.

Fincher-Kiefer cites the important point made by Lucas, Tanenhaus, and Carlson (1990) that certain test tasks may direct the reader to one level of representation, but other tasks may require a different level of representation. "Responses to indirect tests should reflect information encoded at all levels of representation, including the abstract representation of the situation model" (Fincher-Kiefer, 1994, p. 3).

A study by Tajika and Taniguchi (1995), which sought to confirm the occurrence of instrumental inferences using implicit memory tests, drew on both the research techniques proposed by Whitney and Williams-Whitney (1990) and the model of multiple levels of representation. Tajika and Taniguchi (1995) used a three-way research paradigm on three groups of matched subjects. They examined the effect of learning instruction (either *memorizing sentences*, *imaging situations*, or *generating instruments*); administered a word stem completion test consisting of related and unrelated words; and, finally, gave each group either a cued recall or a free recall test. Results showed a) a significant amount of priming in each group; b) an interaction between learning instruction and relatedness of words; and c) superior performance in the cued recall test. From these data, it is suggested that subjects draw instrumental inferences during reading.

### Implications for Second Language Learning

The above research findings indicate that native-speaker subjects instructed to generate an image associated with a sentence will have greater access to related target lexis and to accurate recall of the sentence. If this is so, then the effect of a particular learning instruction (in this case "generate an instrument associated with the sentence") should be to enhance encoding processes, resulting in visual, situational and propositional representations of the material during reading.

This multiple representation should in turn give rise to greater accuracy and superior performance in sentence recall. However, this is not always the case. Paris and Lindauer (1976) suggested that weaker readers, such as children in lower elementary grades, were poor at making elaborative inferences of this kind. Is this also true of second language learners? At what point in second language acquisition do learners begin to make such instrumental inferences? Will learning instructions make a difference in recall? Researching these areas with EFL learners may yield insights about:

- i) knowledge representation in L1 and L2 (reader's knowledge);
- ii) some effects of particular learning instructions and questioning techniques in the EFL classroom (reader's strategy);
- iii) the comprehension of texts and the recall of lexis and sentence structures;
- iv) the place of prior knowledge in interpreting the text; and
- v) the interaction between the points given above.

Also studies of concept mediation in bilingual subjects (Dufour and Kroll, 1995, p.168) showed that more fluent individuals can effectively access lexical and conceptual connections between their two languages, and are able to conceptually mediate the second language, but less fluent individuals are not. If less fluent learners cannot access conceptual information directly from the second language, as an inferencing task demands, then their responses to such tasks may be slow and prone to error, as they attempt to resort to their first language for concept mediation.

### Constraints

There are several constraints:

- a) Studies to date on elaborative inferencing such as Tajika and Taniguchi (1995) were conducted with native speaker readers. As yet, to our knowledge no data have been gathered from non-native speakers in a similar experimental paradigm.
- b) The reading materials used are single sentences. Though there are data describing the effect of instrumental inferencing in longer discourse, the findings are not always clear (see McKoon and Ratcliff, 1992, for a useful review).
- c) The above experiments are confined to examining simple propositional sentences which give rise to instrumental inferences. In more detailed or complex propositional sentences, particularly in longer discourse, other kinds of inferences may be drawn, for example global and predictive inferences.
- d) In any research conducted on second language learners, there will be difficulties in controlling for variables such as general and cultural knowledge, and the availability of lexical items ( for example, whether or not they have been previously taught to the subjects).

With the above constraints in mind, it was decided to extend the research paradigm devised by Tajika and Taniguchi (1995) for native-speaker subjects to a similar group of non-native speaker subjects (college students): English majors studying English as a foreign language.

### *Aims*

The goals of this research were:

1. To acquire data on the effects of learning instruction on mental representation;

2. To examine the processing of information, inferencing and recall as evidenced in the reading skills of second language learners; and
3. To enable a comparison to be made between native speakers and second language learners in the above areas.

## Method

### *Design*

The method used was a simplified version of  $3 \times 2 \times 2$  mixed factorial design used by Tajika and Taniguchi (1995). The first factor was learning instruction, consisting of three levels: control, image and generation. The second factor was the recall test, consisting of two levels, cued recall and free recall. The third factor was relatedness of words used in a word stem completion test, which consisted of two levels, related and unrelated. While the first and second conditions were manipulated between subjects, the third condition was varied within subjects.

The two major points of difference between Tajika and Taniguchi (1995) and the present experiment were in the omission of the "image" level from the design, so that there remained only the "generation" and control groups; and in the words used for the word-stem completion test, which were *all* instruments from the sentences, and which themselves contained no unrelated words. Scoring of relatedness, then, was on whether subjects themselves used related or unrelated words to complete word-stems.

### *Subjects*

Thirty students at Aichi University of Education participated in the experiment on a voluntary basis. Ten were assigned to each of three groups, A, B and C. Those in Groups A and B were at the end of their freshman year, and had received regular weekly instruction in English for the whole year. Their level was approximately that of the Cambridge First Certificate, though proficiency varied across macro skills. Subjects in Group C, who provided baseline data, were in their sophomore year, but their English level may not have been significantly different from that of the freshmen students.

### *Materials*

The materials used were the same 16 sentences used by Tajika and Taniguchi (1995), some of which were taken from Doshier and Corbett (1982). For further details on the selection of these sentences, see Tajika

and Taniguchi (1995, p. 95). The vocabulary in both the sentences and the instruments was simple, within the grasp of a low-intermediate level learner, and was assumed to be within the lexicon of the subjects (see Appendix).

The instructions were delivered in simple English, and the term "instrument" was illustrated to the "generate" group, Group A, prior to the experiment.

### *Procedure*

Each group was given a period of study, during which the test group, Group A, was required to read the 16 sentences, one by one, and *generate an instrument* as they read. For example, two of the sentences were *Yasuko stirred the coffee* and *Haruko took a picture of the scene*. The instruments of these sentences are *spoon* and *camera* respectively. They were given about 25 seconds for each sentence. Group B, the control group, were instructed merely to *read and memorize* the sentences. Again, they were allowed 25 seconds for each sentence.

After this, both groups first took the word-stem completion test. They were told that this was separate from the previous phase. The subjects were instructed to complete each word from the initial letters, according to the number of blank spaces given. In longer words, the first two letters were used. The words were selected as the instruments of the sentences by procedures set out in Tajika and Taniguchi (1995). The subjects were allowed ten minutes.

Groups A and B were then further divided, with 5 subjects in A1, A2, B1 and B2. Groups A1 and B1 were given a free recall test and required to write out the sentences they remembered on a blank sheet of paper, while A2 and B2 were given the instruments printed on the paper they received as cues. The presentation order of each cue matched that of the sentences from the study phase. The subjects were told to use the cues to help them recall the sentences. Subjects in both cued and free recall groups were allowed 15 minutes.

Group C provided the baseline data for the word-stem completion test, using instruments from the sentences (see Appendix for sentences) in a free association test.

### **Results**

The results obtained supported some of the findings of Tajika and Taniguchi (1995), Whitney and Williams-Whitney (1990), and Fincher-Kiefer (1994) for native speakers, but indicated differences of processing for second language subjects.

*Priming effects: Word stem completion test*

In the word-stem completion test, requiring subjects to complete the words by recalling the instrumental inferences of the sentences they had read, the "generation" group scored 3.55% against the control subjects' 0.5% (baseline = 1.3%). It is worth noting that while only a minimal difference may be seen between the baseline and control groups, both the control and the experimental subjects performed significantly better than the baseline in similar studies, including Tajika and Taniguchi (1995), where significant priming effects were found in each of the three learning instruction groups, with the generation group scoring highest. In the present study, a small priming effect was seen only in the generation group.

*Free recall and cued recall tests*

In the sentence recall test each correctly reproduced word was scored as two. Where an incorrect word was grammatically of the same group as the target word, such as a definite article substituted for an indefinite article, or one preposition (e.g. "on") substituted for another ("at"), one point was allowed. The use of the present tense of a correct verb, rather than, say, the past tense, for example "stirs" rather than "stirred", caused the deduction of one point, as did phonetic interference in misspelling a word, for example "rocked" for "locked," where the sense was otherwise obvious. The scoring was done individually by two raters. Agreement was 94%. Disagreements were settled in conference between the raters. Table 1 shows the proportions of correct recall for each group.

A two-way ANOVA was conducted, the first level being learning condition (generation vs. control), the second being recall test (free vs. cued). Results indicated there were significant main effects for condition [ $F(1, 16) = 16.67, p < .01$ ] and recall test [ $F(1, 16) = 33.44, p < .01$ ].

Contrary to Tajika and Taniguchi (1995), the control group performed better than the generation group, although the standard deviation of the control group was quite large. However, the cued recall group performed better than the free recall group for both learning condition groups, suggesting that a significant amount of priming had been obtained. There was no interaction between condition and recall test ( $F < 1$ ).

## Discussion

It is not obvious why the control group performed so much worse on the word stem completion test. It may well be that a larger number of subjects would have yielded a different effect in some of the results obtained, exhibiting clearer patterns than in the present sample.

Table 1: Sentences Recalled as a Function of Learning Instruction Condition and Recall Test Type

Learning Instruction		
Recall test	Control	Generation
Cued recall	121.6	91.6
Free recall	101.8	62.4

(n = 144)

These results suggest that there is some support for the proposal that instrumental inferences are made during reading for second language learners as well as native speakers. However, these inferences were only in evidence when subjects in the experimental group performed a word stem completion task. The generation of instrumental inferences did not help subjects in the free recall of sentences, unless they were cued, in which case, there was a significant priming effect. Subjects in the control group showed superior recall for sentences in both cued and free recall tests.

There appears to be an effect of learning instruction on mental representation, with effects differing according to the learning goal. For example, the instruction to generate an instrument may have a positive result when the task is to recall vocabulary, but is a distraction when the task is to memorize sentences accurately, as here it seems to obstruct propositional representation, which is in any case subject to rapid decay (McNamara, 1994).

Usually, material may be encoded in three ways—verbally, pictorially, and propositionally. One might expect visual representation yielding inference of the instrument to be more easily accessed and readily recalled than propositions such as sentence structure. (Lucas, Tanenhaus, and Carlson, 1990; Johnson-Laird and Stevenson, 1970).

The control group's superior performance suggests that where the L2 is being used, simple memorization of each sentence produces greater accuracy of recall. Some reasons for this may be:

- a) For subjects at the lower end of the proficiency scale the instruction to generate an image may interfere with recall. Here it should be noted that the learning style of these subjects has been developed in an environment where rote learning is the norm. This may have affected processing.



- b) Mental representation is not visual, but remains on the propositional level. For some Ss it may be more difficult to imagine something in the L2 than in the L1 (see Stevick, 1986, p. 4 for a comment).

In the dual coding approach developed by Paivio (1986), two types of representation were suggested: verbal and pictorial. When study materials are processed by dual codes, they are stored more strongly and permanently. Representation by dual codes thus implies imagery representation. Imaging study materials is dependent on familiarity with the materials. Thus, when study materials are presented as English sentences, it is harder for Japanese students to image using dual codes. In this model, students with high verbal ability will process each sentence using dual codes, but those low in verbal ability use mainly a verbal code.

Other reasons for the control group's superior performance may be:

- c) It may in fact take longer than the time allocated for L2 subjects to generate an instrument, whereas for many L1 subjects, the generation is in most cases automatic. For this reason, as well as those cited in b) above, it may well be that the allotted 15 minutes was insufficient for Japanese learners with low L2 reading proficiency.
- d) A "second-language effect" was observed in the mental representation of the control group, who are not accessing semantic levels while they carry out the task of reading and memorizing the sentences.
- e) The processing of information takes a different form in the L2, so that the model of multiple levels of representation needs to be modified in some way. It is not known whether lexicons are organized and accessed differently in L2 readers. The similarity to, or remoteness from, the L1 to the language being processed may make a difference.
- f) Because of the grammatical, lexical, and phonetic inaccuracies resulting from the use of the L1, the scoring procedure biases results.

Note, too, that the levels of English language proficiency in these learners were fairly generalized. Any particular group of Japanese students in university classes displays a wide range of proficiency. Further, there may be little difference in levels of English skills between freshmen and sophomores, possibly explaining some of the results.

*Implications for EFL classroom methodology*

Methodological assumptions to be examined include:

1. Encouraging learners to engage in organizational tasks with the text as an aid to storage in long term memory.
2. Encouraging learners to generate images or situations associated with vocabulary, sentences or a text during reading.

Stevick (1986) and others have suggested that the processing afforded by multiple levels of representation during sentence encoding aids recall. According to this view, involving subjects in more intensive processing of information, longer periods of engagement with the text, and more complex organizational tasks will ensure processing in long-term memory.

This strategy has been successful for L1 readers, and to date it has been assumed to be available to all L2 speakers. The present findings suggest that this may not hold true for some learners of a second language. In particular, it might not always result in greater accuracy of recall of the propositional text-base. The learning instruction and task type may have significant positive or negative effects on storage and retrieval of information.

Results in the word stem completion task seem to corroborate the usefulness of the learning instruction to generate an instrument when the goal is acquisition of vocabulary. In light of the above results, recent trends to use mnemonic techniques for the memorization of vocabulary may be viable for at least some L2 learners. Actively generating an instrumental inference seems to involve encoding on multiple levels of representation for lexical targets (c.f. Ellis, 1995)

If either of the above assumptions is questionable, the types of comprehension questions and text-based activities frequently required of students in popular ELT publications, and inspired by learning techniques and memorizing strategies found to be successful for native speakers, may not always achieve their stated aim for use with lower to middle proficiency learners of a second language.

### Conclusion

Subjects who are not yet bilingual may need to process sentences automatically in the first phase of contact with a text. At this stage, learning instructions designed to encourage elaborative inferences may

block some levels of processing, as is suggested by poor results in sentence recall tasks.

Generally, native speaker subjects will encode sentences in various ways; McNamara (1994) suggests that some material will elicit visual, some situational and some propositional representation. However, it remains unclear whether this is dependent on the task, the learner's cognitive style, content, sentence structure, or discourse (see Fincher-Kiefer, 1994). The predisposition of Japanese learners of an L2 towards rote learning may result in automatically encoding sentences at the propositional level.

Clearly the application of this research to classroom methodology may be quite limited. It may be confined to students of lower proficiency, and to comprehension and instrumental inferences in single sentence contexts. Further studies with second language learners are needed. As Grabe (1995) points out, in his discussion of the dilemmas posed by second language reading development, "... we need to examine [which] research and instrumental studies from L1 reading contexts are *not* useful to L2 reading contexts and why" (p. 5).

In particular, this research may serve as a useful reminder that native-speaker data which are seen to support a particular model, theory, or strategy for the teaching of reading, cannot always be depended upon to support the use of the same strategies in teaching reading to second language learners.

On this point, the above findings support Grabe's (1995) statement that:

many L2 reading researchers have assumed that reading in different languages is nearly the same, calling on the same processing requirements. They have also assumed that reading skills in the L1 should transfer readily from the L1 to the L2. However, it is now evident that L1 reading skills do not automatically transfer to the L2 context, nor do reading processes in different languages appear to be all the same, particularly in terms of their effects upon beginning L2 reading students. (p. 3)

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(Received May 15, 1995; revised November 24, 1995)

#### Appendix: Sentences Used in Study

Yasuko stirred the coffee.

Haruko took a picture of the scene

Akira wrote the answer on the  
blackboard.

The president sat at the desk.

A baseball player hit a home run.

The car driver checked the street  
location.

Hanako cut an apple.

Sayuri hit a tennis ball.

Hideo cut the articles out of the  
newspaper.

Yuki locked the door.

Yoshiko painted a picture.

Kumiko wrote a letter.

Aki lit a cigarette.

The policeman shot the thief.

Keiko ate her rice.

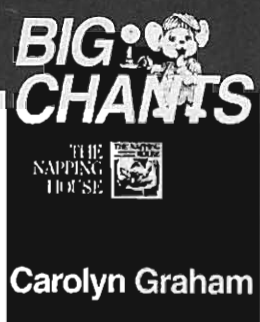
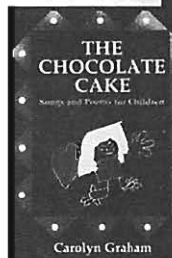
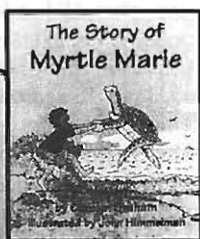
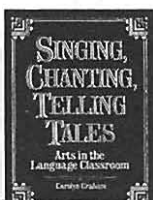
Tomoko turned on the light.

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