

READING AND "INCIDENTAL" L2 VOCABULARY ACQUISITION

An Introspective Study of Lexical Inferencing

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The present study is a follow-up to a classroom experiment with university ESL students that demonstrated incidental acquisition of new lexical knowledge through the reading of thematically related texts. Introspective data from similar students using the same materials are analyzed in this study to explore how vocabulary knowledge may be acquired as a by-product of reading for comprehension. The researchers sought to identify the strategies and the kinds of knowledge and information learners used when dealing with new L2 words they encountered while reading. Learners tended to ignore a large proportion of the words. For those words they attended to, inferencing was the main strategy employed. A taxonomy of the knowledge sources they used in inferring word meanings from various textual and other cues was developed, which provided a framework for describing learners' inferencing behavior. Findings are interpreted in terms of existing research and theory on incidental vocabulary acquisition within an input-processing framework. Pedagogical implications are drawn.

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Research on both first and second language development supports the conclusion that most vocabulary learning occurs naturally when learners attempt to understand new words they hear or read in context. Such learning has been called “incidental” because it occurs as learners are focused on something other than word learning itself. Much L1 vocabulary expansion beyond the first few thousand words in common oral use appears to take place in the context of reading for comprehension and is closely linked to the individual’s ongoing development of reading ability in the target language. Only recently have L2 researchers begun to focus on the events that take learners incrementally from a first meaningful encounter with a previously unknown word to the eventual successful integration of key features of that word into their mental lexicon. The complexity and iterative nature of this process have become apparent, as have many interacting factors that affect such learning during the learner’s encounters with the word over time. Nevertheless, incidental vocabulary learning from context is difficult to capture and remains poorly understood. The goal of this study is to reach a better understanding of how this process occurs and why a word may—or may not—be learned in this way in a given context. Introspective data are used to track educated adult ESL readers’ responses to unfamiliar words in texts as they read for comprehension, with an emphasis on their use of lexical inferencing.

READING COMPREHENSION AND VOCABULARY DEVELOPMENT

The symbiotic relationship between vocabulary knowledge and reading ability, or reading as both a cause and a consequence of vocabulary acquisition, has been well documented (Nagy, Herman, & Anderson, 1985; Nation & Coady, 1988; Stoller & Grabe, 1993). A good reader can guess the meanings of some unfamiliar words in a text but must also know most words in the text to be able to understand it well enough to do this. On the causal side, reading is credited with much of the phenomenal growth in L1 vocabulary knowledge that occurs during schooling. On the consequence side, the strong relationship between vocabulary knowledge and reading comprehension ability holds at all levels of literacy and education for both L1 and L2 learners. The higher the academic level, the greater the vocabulary mastery needed. Coady (1997), emphasizing the need for automatic word recognition of core vocabulary, proposed that “good knowledge of at least 5,000 words” in the L2, in addition to significant reading skill, is required for understanding “advanced, authentic academic” texts (p. 287). Hazenberg and Hulstijn (1996) concluded that L2 speakers of Dutch need a minimum initial threshold level of some 10,000 words to cope with academic reading requirements in first-year university studies in the Netherlands. Although these figures are based on measures of the number of words for which learners can recognize and give a meaning, how well the words are known also plays a role in comprehension. Qian

(1998), for example, demonstrated that depth (Read, 1996) as well as size of learners' vocabulary knowledge contributed to reading proficiency.

Research Evidence for Vocabulary Gains from Reading

In the past, the proposition that most vocabulary is learned incidentally has appealed to the default argument that learning from context is the only way to account for most vocabulary acquisition and for the close relationship between the growth of vocabulary knowledge and reading comprehension ability discussed above (e.g., Nagy & Anderson, 1984; Sternberg, 1987). Research evidence is now available from various L2 contexts that demonstrates incidental vocabulary learning from reading (discussed below) as well as from oral or mixed language input (Brown, 1993; Brown, Sagers, & LaPorte, this volume; Ellis, 1994; Ellis & He, this volume; Fraser, this volume; Joe, 1995; Wode, this volume). The positive outcomes of school L2 reading flood programs, in which rural Fijian school children spent a significant proportion of instructional time reading self-selected texts in the target language and subsequently showed significant vocabulary (and other) gains (Elley & Mungubhai, 1983; Krashen, 1989), are a further example. Other supportive evidence comes from a longitudinal case study of a Japanese ESL speaker studying anthropology at an American university (Parry, 1993) that demonstrated her incremental vocabulary growth over time through repeated encounters with given words in the course textbook. Experimental evidence of incidental vocabulary growth has been reported in research on secondary school students learning pseudo-L1 words and rare L2 words (Hulstijn, 1992), in which significant—if quite low—incidental learning of target words occurred from a single encounter in a 900-word text. Similarly, an experiment that required adult ESL learners to read and subsequently recall stories demonstrated retention of some low-frequency L2 words first encountered in a 300-word expository text (Joe, 1995). Our own experimental studies of vocabulary learning over a 6-week period by university ESL students also provide evidence for the learning and retention of previously unfamiliar words through the reading of thematically related texts for comprehension. Participants gained significantly both in the number of words they could recognize and the “depth” of this knowledge (Paribakht & Wesche, 1993, 1997; Wesche & Paribakht, 1996).

In spite of the evident role of reading in much advanced vocabulary acquisition, it is also apparent from both research and experience that the process is slow, often misguided, and seemingly haphazard, with differential outcomes for different learners, word types, and contexts (Bensoussan & Laufer, 1984; Haynes, 1993, 1998; Parry, 1993). According to Sternberg (1987), even if most vocabulary is learned from context, one should not conclude that this “is the fastest or most efficient way of learning specific vocabulary” (p. 94). Nonetheless, a clear understanding of this seemingly universal process would allow

both learners and instructors to use it more effectively in developing both reading ability and lexical knowledge.

Input Processing

When learners attend to unfamiliar words or word features in context, the process may be understood in terms of “input processing” (Chaudron, 1985; Gass, 1988, 1997; Hatch & Brown, 1995; Krashen, 1985; see also the review in Wesche, 1994). In the framework proposed by Gass (1988), five major stages are distinguished between the learner’s initial encounter with novel L2 input data and the incorporation of new knowledge based on the input—be it accurate or misguided—into the learner’s target language system. These stages are: (a) apperceived input, or some level of noticing of novel language data by the learner and its association with prior knowledge; (b) comprehended input, or assignment of meaning to the incoming language data; (c) intake, or assimilation of new linguistic information, limited by the level of analysis during initial comprehension; (d) integration of part or all of the intake into the learner’s internalized second language (rule) system; and (e) output, or active use of the new knowledge by the learner, which may aid conversion of further comprehended input to intake.

Hatch and Brown (1995), in a similar view, see the word-learning process as a “series of sieves” through which a new word must pass as it gains entry into the learner’s lexicon (p. 373). Their description includes the learner’s initial encounter with a new word, taking in its form, understanding its meaning, consolidating the form and meaning in memory, and ultimately using the word in production. The above characterization of acquisition by stages, although not capturing the very small increments through which lexical knowledge may be built (Landauer & Dumais, 1997), is meaningful in terms of the experience of learners and instructors and is amenable to current cognitive processing theory in SLA.

Intake and subsequent integration of new lexical knowledge normally require repeated input processing during multiple experiences with the word (see Hulstijn, 1992; Parry, 1993, 1997). From these encounters the learner has the opportunity to develop a mental representation of the word form and features of its meaning(s), as well as other kinds of lexical knowledge such as the word form’s network links with other words and syntactic constraints (see De Bot, Paribakht, & Wesche, 1997; Henriksen, this volume; Nation, 1990; Richards, 1976; Schmitt, 1997).

Lexical Inferencing and Mediating Factors

The comprehension and successful intake of new lexical knowledge while reading for comprehension involves, among other things, a cognitive process known as *inferencing*. “In inferencing, attributes and contexts that are familiar are utilized in recognizing what is not familiar” (Carton, 1971, p. 45). *Lexical*

inferencing “involves making informed guesses as to the meaning of a word in light of all available linguistic cues in combinations with the learner’s general knowledge of the world, her awareness of context and her relevant linguistic knowledge” (Haastrup, 1991, p. 40). If successful, it can serve briefly for purposes of immediate comprehension in a listening, interaction, or reading context, and under favorable conditions it may lead to retention of the word form, as well as semantic and other lexical information. In spite of its evident role in vocabulary acquisition, relatively little is known about the underlying cognitive processes. (See, however, Carton, 1971; Haastrup, 1991; Sternberg, 1987.)

Research has identified textual, word, learner, and situational factors that interact to promote or discourage word learning from written texts. The nature of the written texts in which words are embedded, features of given words, learner knowledge and effort, and the mental tasks learners do with the words all appear to play a role. These factors may be understood in terms of input processing, and some bear directly on lexical inferencing. Repeated and varied occurrences of given words in a text presumably make them more salient for readers. This holds for low-frequency words in thematically related readings, which contribute to their retention (Paribakht & Wesche, 1997; Parry, 1993), but high-frequency words are even more likely to be learned from a given text, whatever their frequency of occurrence in that text (Brown, 1993), presumably because they have already been encountered elsewhere and are somewhat familiar. An even more important predictor of the probability that a word will be learned from a given text than its frequency is its usefulness for understanding that text (Brown, 1993). It is not surprising, then, that content words with clear referents (e.g., nouns, verbs, and adjectives) tend to be more easily learned than function words (e.g., articles and prepositions; Brown, 1993; Paribakht & Wesche, 1997). Beyond word features, a vital factor in successful vocabulary learning through reading is the presence in the surrounding text of sufficient and clear semantic and other linguistic cues that enable the reader to correctly infer the meaning or other characteristics of an unfamiliar word (De Glopper, 1996; Dubin & Olshtain, 1993; Haastrup, 1991; Haynes, 1993; Hulstijn, 1992; Li, 1988; Sternberg, 1987). Without such cues, inferencing may lead to misguesses (Bensoussan & Laufer, 1984).

Individual learner differences that have been shown to play a role in word learning through reading include a reader’s strength of effort to understand the text, generally leading to greater depth of processing (Hulstijn, 1992, in press; Joe, 1995). This goes beyond the tendency to infer (guess) new word meanings to the use of multiple cues in inferencing and subsequent monitoring of the inferences for accuracy. Important factors in successful inferencing include appropriate use of background linguistic knowledge in both the L1 and L2 (De Bot et al., 1997; Haastrup, 1991; Haynes & Baker, 1993) and world knowledge (De Bot et al., 1997; Sternberg, 1987). Several researchers have succeeded in improving learners’ success at word learning through strategy training (De Glopper, 1996; Fraser, this volume; Sternberg, 1987). The mental activities that learners engage in when they encounter a new word, their focus

of attention, and the nature and depth of their responses to new lexical information, influence what is (or is not) understood and what may be learned (Fraser, this volume; Haastrup, 1991; Hulstijn, 1992, in press; Joe, 1995; Wesche & Paribakht, 1998a).

The present study was undertaken to examine the process of incidental vocabulary acquisition through reading with an emphasis on its initial stages, taking into account the above findings. It followed directly from an earlier experimental study that demonstrated successful learning and retention of new words from reading thematically related texts (Paribakht & Wesche, 1997); thus lexical acquisition and retention are not the focus here, although some evidence is cited (see below).

Earlier Experimental Study

The experimental study (Paribakht & Wesche, 1997) on which the introspective research was based tracked vocabulary learning by 38 intermediate-level university ESL learners in a thematic reading program under *Reading Only* and *Reading Plus* instructional conditions, each program requiring equivalent class time. All learners experienced two thematic units for each treatment, thus acting as their own controls. In *Reading Only*, learners read selected texts on two themes (a total of four texts) and answered comprehension questions. The texts provided multiple exposures to a number of nouns, verbs, and discourse connectors that had been identified as generally unfamiliar to students at this level of ESL proficiency. In the *Reading Plus* treatment, students read four texts on two themes and then carried out text-based vocabulary activities targeting the same set of words. Gains in both treatments were measured by pre- and post-administration of the target word list using the Vocabulary Knowledge Scale (VKS; Paribakht & Wesche, 1993; Wesche & Paribakht, 1996), an instrument that was developed not only to gauge the number of given words learners know to some extent but also to identify different levels of knowledge ranging from recognition of the word form to recognition of its meaning and to the ability to use the word with grammatical and semantic accuracy in a sentence.

Comparisons of known versus unknown words before and after instruction on the VKS indicated significant gains in both treatments, although *Reading Plus* led to greater gains. After the *Reading Only* treatment, learners' knowledge of target words tended to remain at the recognition level, whereas after the *Reading Plus* treatment many learners were able to write sentences using the new words. These findings were interpreted to mean that, although multiple encounters with given words during reading leads to increased knowledge of the words, a combination of reading and text-based exercises demanding different kinds of analysis and practice of the words is more effective for vocabulary learning.

Despite the more favorable results of *Reading Plus*, the significant gains in *Reading Only* are arguably of greater practical significance for language learn-

ers, given the unlimited access most have to written texts in the L2 as opposed to the rarity of highly targeted L2 vocabulary instruction, particularly at higher proficiency levels. If the process by which lexical knowledge is gained through reading were better understood, learners as well as instructional programs might be able to harness it to counter the pessimistic results often claimed for reading as a means of vocabulary acquisition. For example, Hulstijn questions advocating a pedagogy of extensive reading for vocabulary expansion, given its generally meager results, unless one can specify “why and how L2 learners do this” (personal communication, July 1998).

The Introspective Study

In the present study, introspective and retrospective think-aloud data collection techniques were used¹ to explore the process leading to gains in vocabulary knowledge through reading.² L2 learners following similar procedures to those in the experimental study were guided in introspecting about the unfamiliar words they encountered while reading a text developed for the experimental study, about the kinds of lexical processing strategies they used in trying to understand parts of a text, and about the knowledge sources and contextual cues they appealed to when inferring the meanings of new words. Like the participants who took part in the experimental studies, these participants were intermediate-level ESL learners in a university setting.

The main research questions were: What strategies do learners use and what knowledge sources and contextual cues do they appeal to when attempting to understand the unknown words they encounter while reading?

Operationally, then, from those words that learners had previously identified as unknown, which ones did they ignore and which did they try to understand during the reading process? How did learners go about attempting to understand what these words meant? Which shared patterns were noted, and how much individual variation was observed with respect to what these learners reported doing and thinking? What other factors appeared to influence learners’ behavior when they encountered unfamiliar words while reading?

METHODOLOGY

Subjects

Participants in the study were 10 intermediate-level students in a university ESL class from a variety of L1 backgrounds (French, Chinese, Farsi, Spanish, Vietnamese, and Arabic) who volunteered to take part in out-of-class research sessions.

Procedures

Pretest. Several weeks before their individual reading sessions and interviews, students were presented in class with a text on the subject of acid rain

and were asked to read it and circle all the words they did not know. These results (hereafter referred to as the pretest) were collected as an indication of the words in the target text that were unfamiliar to each student.

Individual Introspective Session. Individual research sessions lasted up to 2 hours and were all conducted by the same researcher. At the beginning of the session, participants were trained in think-aloud procedures. The first task was to describe in English what they were thinking about while looking at a colored picture. Further practice involved think-aloud reporting while reading a text in English on a topic similar to that of the target text and performing text-based comprehension tasks similar to those in the introspective study.

Following the training exercises, think-aloud protocols were collected for all students as they carried out two reading comprehension tasks based on the target text. The students had access to an English-English dictionary during the session. While participants were carrying out the tasks and thinking aloud, the interviewer kept notes, asked for clarifications, prompted the students during quiet periods, and questioned them about particular responses. (For example, “I can see you’re shaking your head, tell me what you’re thinking,” “Why have you put your finger on that word?,” or “You look puzzled.”) The interviewer did not supply the meanings of unfamiliar words when subjects appealed to her for assistance, in order to encourage and elicit their use of other lexical solving strategies.

Tasks

Two comprehension tasks—a question task and a summary task—were used to ensure that learners concentrated on understanding the text. They also provided an opportunity to investigate the influence of task type on learner strategy use and to examine whether the tasks differentially made words salient to the learners and engaged them in lexical processing.

The question task, which was a type of reading comprehension exercise frequently used in ESL instruction, required learners to answer questions based on the text, expressing their thoughts aloud as they did this (see Appendix A). Immediately after answering each question, they were also asked if they had encountered unfamiliar words while doing the task and, if so, how they had dealt with each of them. These comments yielded immediate retrospective protocols. The summary task required learners to read the text in segments and stop at the end of each paragraph to give a summary of its content. Students were also asked to verbalize what they were thinking while doing the task. Immediately after summarizing each paragraph, they were asked to indicate if they had encountered unknown words in doing the task and how they had dealt with each word. Half of the learners did the question task first, and half began with the summary task as a control for task-order effect.

Following completion of each task, learners were asked questions pertaining to the difficulty and interest levels of both the text and the exercise. They

were also asked which words they remembered working with and what they had done with each word. Finally, they were asked if they thought they had learned any of the words or learned more about words they already knew and, if so, how. This procedure yielded delayed retrospective protocols.

Analyses

All think-aloud protocols and interviews were transcribed and subsequent analysis was based on these written transcripts, the tapes, the notes made by the interviewer for each subject during each research session, and the participants' exercise sheets. Data analysis involved independent, then collaborative, readings and rereadings of all data by the researchers and assistant to extract and formulate the following information: (a) identification of the words learners reported as unknown while carrying out the two comprehension tasks; (b) identification of the unknown words that were ignored; (c) identification of the lexical processing strategies used each time learners decided to deal with an unknown word; and (d) development of a descriptive system for classifying the types of knowledge and information learners used when they attempted to infer word meanings, and classification of each case.

RESULTS

Findings are presented in the following order. First, information on the reading text is presented in terms of word features. This section is followed by information on words learners identified as unknown and then by information on the words learners ignored or attempted to understand under different conditions. The strategies used by learners are subsequently reported with an emphasis on inferencing. Following this, a taxonomy of knowledge sources used in inferencing is proposed. Throughout, the effects of task, text, and word features, as well as learner differences, are noted.

Characteristics of Words in the Text

Content words (nouns, verbs, and adjectives) made up 58% of the total number of words in the text (tokens) and 67% of the different lexical items (types) (see Appendix B). Of the content words, nouns were the most frequently occurring category (31% of the word tokens, 41% of the types), followed by verbs (16% of the tokens, 19% of the types), and adjectives (11% of the tokens, 17% of the types). The remainder were mainly function words (e.g., articles and discourse connectors) and a few adverbs, and these accounted for 42% of the tokens and 23% of the types.

Unknown Words Identified by Learners

Of the total number of words in the text (536 tokens), learners identified an average of 10.6 words as unknown in the pretest, 15.2 in the summary task

and 9.3 in the question task (Appendix B). The summary task thus appears to have generally made more unfamiliar words salient to these L2 readers than did the pretest or question task.

Content words account for almost all (97–99%) of the unknown words identified in all task conditions, and, of these, nouns account for the highest percentage in all three task conditions (approximately 60%, whereas their representation in the text is 31%). Other words, which accounted for 42% of the words in the text, accounted for only 1–3% of the words identified as unknown in the different task conditions (see Appendix B).

Learners reported vocabulary difficulties more often during the summary task than during the question task. When their attention was focused on extracting selected information during the question task, most subjects (7 of 10) reported that they were not hindered by any difficult words for at least one of the questions. Only two of the participants made this comment for any paragraph of the summary task. A secondary effect is that of task order, with either task tending to elicit more reported unknown words when it was done first.

Learners varied considerably in the number of words they identified as unknown. The ranges for the two comprehension tasks were from 3 to 37 words for the summary task and from 3 to 24 for the question task. Intralearner patterns also varied, with some identifying more words for one task than the other, although, with only one exception, learners identified more unknown words for the summary task. For example, one learner identified 37 words for the summary task and 5 words for the question task; the exceptional student identified 17 for the question task and 9 for the summary task.

How Learners Dealt with Unknown Words

Ignored Words. Learners ignored (i.e., made no further reference to or explicitly said they would not bother with) approximately half the words they identified as unknown in both comprehension tasks (Summary = 56%, Question = 52%; see Appendix C). Task order did not appear to influence the proportion ignored. Learners reported ignoring unknown words for a variety of reasons, two important ones being that the words were not seen as relevant or necessary to performing a given task and because they were perceived in a more general way as unimportant.

It is also apparent that the nature of the task influenced which words learners ignored and which they attended to. Both tasks aimed to ensure that learners read the text for comprehension, but the summary task tended to focus learners' attention on what they perceived to be key words in each paragraph for summarizing its content, whereas words in the question items often directed them to specific sentences in the text that seemed related to answering the comprehension questions.

Strategies for Dealing with Unknown Words. Learners used three different strategies when they sought the meanings of unknown words. The first two, attempts at word retrieval and appeals for assistance, were used by some learners for a few words. By far, the most important strategy was inferencing, for which learners utilized various cues and kinds of knowledge in their attempts to figure out the meanings of the target words in context. The retrieval and appeal for assistance strategies are briefly described below, followed by a detailed discussion of inferencing.

Retrieval. Retrieval is the strategy of repeating the target word out loud or rereading it several times, perhaps in order to buy time, in an attempt to retrieve it from phonetic or graphic cues.³

(1) S: *Well, I don't know what "drawback" was but I just repeat it . . . at the end I knew what it meant. And that's all.*

Appeal for Assistance. This strategy involved directly asking the interviewer for assistance or verifying the meaning of the target word in a dictionary when in doubt.

(2) (verification)

S: *Yield is perhaps to harmless. No?*

(3) (direct appeal)

S: *Fossil fuel what's that mean? Can you pronounce this?*

I: *Fossil.*

In example 2, the learner uses a tag question to elicit a confirmation from the interviewer. In example 3, by asking for the pronunciation of the target word, the subject seems to try to tap a different input mode that might help him to infer the meaning of the target word. Learners may sometimes use both input modalities in trying to get the meaning. Such an attempt would be particularly pertinent when a learner recognizes a word in spoken form but not in written form, especially in a language with complex phoneme-grapheme correspondence such as English. This may often be the case in a second, as opposed to foreign, language learning context in which the spoken forms of many words may be more familiar than the written forms.

Inferencing

When learners actively tried to identify the meanings of unknown words, the main strategy they used was inferencing, which accounted for almost 80% of strategy use (see Appendix C). Further data analysis revealed that learners drew on varied knowledge and information—sometimes helpful, sometimes misleading—in the inferencing process. These sources, both linguistic (intra- and interlingual) and extralinguistic, represent the learners' own knowledge interacting with cues from the words themselves and the surrounding text.

Table 1 provides a summary of how learners reported dealing with the unfamiliar words they encountered while doing the two comprehension tasks—

Table 1. How learners dealt with unknown words: Effects of task type and order

Task order	Summary task						Question task									
	Words identified		Words ignored		Strategies used		Words identified		Words ignored		Strategies used					
	<i>M</i>	%	<i>M</i>	%	Inference	Other	<i>M</i>	%	<i>M</i>	%	Inference	Other				
Summary, question	94	18.8	10.6	56	7.6	79	2.0	21	34	6.8	3.8	56	3.4	81	0.8	19
Question, summary	43	10.8	5.8	54	5.5	73	2.0	27	59	11.8	5.8	49	6.0	77	1.8	23
Total	137	15.2	8.4	56	6.7	77	2.0	23	93	9.3	4.8	52	4.7	78	1.3	22

Table 2. Knowledge sources used in inferencing

Extralinguistic source	Linguistic sources	
	Major	Minor
World knowledge	Sentence-level grammatical knowledge Word morphology Punctuation	Discourse/text Homonymy Word associations Cognates

Note. See Table 3 for percentages.

that is, how many words (group total and average) they identified as unknown, how many of these they ignored (average and percentage of those identified), and, of the remainder, the number and percentage for which they attempted to infer the meaning. Because of the small number of occurrences of the retrieval and appeal for assistance strategies, these are grouped together as other strategies in the table. Table 1 indicates that task type and task order did not significantly affect learners' patterns of strategy use.

Information on the effect of word category on strategy use for each task type is found in Appendix C. Verbs appear to elicit more inferencing in the question task than in the summary task (the percentage is the same for nouns). Also, adjectives seem to elicit more use of inferencing in the summary task than in the question task.

Knowledge Sources Used in Inferencing. The kinds of previous knowledge and available information from the text used by learners for inferring word meanings or knowledge sources were identifiable from the transcripts in over 80% of cases. These are listed in Table 2 in descending order of frequency of use.

Certain knowledge sources were used frequently by most learners, whereas some were used only rarely and by a few learners. Uses of each kind of knowledge in inferencing are exemplified below. It should also be noted that learners often used multiple sources of information while working on a word.

Sentence-level grammar. Learners frequently used their knowledge of relationships among sentence components including word-class information, often signaled by word order, in dealing with unknown nouns and adjectives. Such knowledge was the major type used by the learners as a group and by most individually:

- (4) I: *Would you like to say the word you're not sure of?*
 S: *Terpenes. ??? maybe. I don't know. I just guess.*
 I: *And what are you going to do with that word in order to try and understand the sentence?*
 S: *Because this sentence they told the tree emit hydrocarbons called. That means just the name of the ???. So I don't need to understand the exact meaning.*

In this example, the learner deduces the syntactic category of the word (i.e., noun) from his sentence-level analysis (i.e., relationships among speech parts).

Word morphology. Learners' knowledge of L2 word derivations (i.e., stems and affixes such as *-tion*, *-ly*) and of grammatical inflections (e.g., *-ed*, *-s*) were together the second most important knowledge source used in inferring the meanings of unknown words:

- (5) S: *I don't understand . . . I can guess the meaning of "drawback," but I don't very well understand the means of "drawback."*
I: *What did you do in order to try and guess at "drawback"?*
S: *Back. Is back, and draw . . . is . . . product picture . . . donc [therefore]. Drawback. Don't understand very well the means of "drawback."*

Punctuation. Learners sometimes used their knowledge of punctuation and capitalization rules to infer the meaning of the target word from a written text, particularly with proper nouns and commas separating items in a series:

- (6) S: *Oh, about ah . . . Oh, that is the name of the lake, no? "Adirondack." Is not the name of the lake?*
I: *Not the name. Here's your lake.*
S: *Lake. Oh, Panther.*
I: *But Adirondacks you can see it's a name also?*
S: *Because is capital letter A.*

World knowledge. Learner familiarity with the theme and topic of the text was an important source of clues for inferring the meaning of an unknown word:

- (7) S: *Oh . . . when the liquification . . . liquide devient [liquid becomes] . . . the snow become liquid . . . and it go liquid . . . I think so, I think I see the meaning.*
I: *How did you figure out the meaning? Or how did you see the meaning?*
S: *You know when the snow comes and where sun and the snow become liquid . . .*
I: *Okay, but how did you decide that that's what this word meant? Melts. You're describing it to me, but how did you, how did you . . . ?*
S: *Oh, because I see "enters lakes and rivers" and because fall snow go to enter lakes and rivers.*

In this example, both world knowledge and discourse knowledge (see below) may have been activated in the inferencing process.

Discourse and text. Learners occasionally used information from beyond sentence boundaries in guessing the meaning of target words. In our data this appeared limited to semantic information, but learners may have also used their knowledge of cohesive devices in making discourse-level semantic links:

- (8) S: *Question number 5. Have a ??? drawback. I guess the drawback is mean . . . improve. So I from the context I answer this question such as, because the answer*

was is start 1981. So if the government want to build some ??? he must be consulted or referred to the knowledge exchange or the issue of programs. In paragraph 4 the author say this writing is a continues and on extensions out distanced by growing knowledge of air pollution.

Two knowledge sources, discourse knowledge and world knowledge, appear to interact here as the learner tries to extract the meaning of the target word.

Homonymy. Learners use their knowledge of sound relationships or the phonetic similarity between the target word and another word in the learners' mental lexicon to guess the meaning of an unknown word. The association may be with an L1 word or another L2 word and is often misleading. (See also Haynes, 1993; Huckin & Bloch, 1993.)

- (9) I: *Melts?*
S: *Uh hum.*
I: *So what did you do with these words?*
S: *Yes, this is sentir [smell] . . . I know this word. No, no. I don't know melts. I smell, oh smell, no it's smell. I think smell uh I don't know this word.*

Word associations. Word associations were sometimes used by learners to infer the meaning of an unknown word:

- (10) S: *Maybe to yield, like the cars . . . yield. But I can't found the exac . . . maybe pass it over could help me. I don't know the word, that's all.*

Cognates. Some learners used their knowledge of word cognates (mainly English and French in this study) in inferencing:

- (11) S: *The paragraph 4 say that perhaps the . . . acid rain is . . . is most controversial environment issue. But the study . . . has . . . make, has made . . . to here, is not . . . suffisant [sufficient], in French. For clear the effect of . . . effect of this . . . question means acid rain on the environment. But I don't understand very well controversial. I think it, it don't have the means of controverse [controversial] in French. Because the controverse in the French is . . . don't understand controversial. I can guess, but, but . . . so . . .*

In this example, although it is evident that the learner is drawing on his knowledge of English and French cognates to infer the meaning of the unknown word, this knowledge seems to be more misleading than helpful in the process.

Factors Influencing Inferencing Behavior. A number of factors appear to mediate learners' attempts at inferencing and the knowledge sources they use.

Task characteristics. Table 3 shows the relationship between the major knowledge sources learners used and the task type (summary or question). (Task-order effects were negligible.) Of the eight sources identified, sentence-

Table 3. Knowledge sources in inferencing: Effects of task type on relative frequency of use

Tasks	Knowledge sources					Total
	Sentence-level grammatical knowledge	Word morphology	Punctuation	World knowledge	Minor sources	
Summary	38%	18%	8%	8%	27%	100%
Question	30%	15%	11%	11%	33%	100%
Summary + question	35%	15%	11%	9%	30%	100%

Note. Minor sources are listed in Table 2.

level grammatical knowledge was most often used in both task conditions, accounting for 23 of 60 (38%) cases in the summary task and 14 of 47 (30%) cases in the question task. Four of the eight knowledge sources—sentence-level grammatical knowledge, word morphology, punctuation, and world knowledge—accounted for most cases (around 70% for each task and overall). (See Appendix D for more details.)

The summary task led to the use of more diverse knowledge sources. The two comprehension tasks did not differ substantially in the relative degree to which each of the knowledge sources was used. In general, the first task elicited more varied knowledge sources but the overriding influence was task type.

Text characteristics. Text characteristics that evidently influenced learners in terms of both their motivation and their success in guessing meanings included the topic, informational content, and genre of the reading text. Most subjects readily categorized the text type as “scientific” and identified the topic as pollution. For one subject who indicated a strong background in organic chemistry, this knowledge allowed him to move through the question exercise quickly, confidently, and successfully. Background knowledge could be used with discourse strategies, which gave some subjects the confidence to tackle the task. Many of the subjects, however, commented that a scientific text on pollution was not relevant to their identified goals for learning English and contributed little to their vocabulary learning. The text type and topic were, if anything, unmotivating to students who had little background in the natural sciences.

Learner comments in the transcripts suggest that readers’ perceptions of the overall difficulty of the text strongly influence whether they attempt to infer individual word meanings. First, it appears that, if the text is too easy, with only a few unknown words, comprehension is generally possible without the learner stopping at individual words to puzzle out their meaning. On the other hand, a very difficult text will cause frustration and readers may give up entirely. Some of the students attempted to quantify their threshold level, or

Table 4. Knowledge sources: Effect of word category

Word categories	Knowledge sources				Total
	Sentence-level grammatical knowledge	Punctuation	World knowledge	Other sources	
Nouns (summary + question)	34%	18%	13%	34%	100%
Adjectives (summary + question)	44%	17%	11%	28%	100%
Verbs (summary + question)	30%	30%	10%	30%	100%

the number of new words per paragraph beyond which reading became difficult, frustrating, or impossible.

Word characteristics. The tendency of learners to use certain knowledge sources in inferring meanings of given categories of words is reflected in Table 4. (See Appendix E for details on the effects of word category on knowledge sources used in inferencing.)

Sentence-level grammatical knowledge was important in inferring meanings of all word categories; in the case of adjectives, word-order knowledge was often used to determine which words modified others. Word morphology cues were mainly used in verb inferencing (particularly the recognition of verb endings). Inferencing based on punctuation was limited to nouns, involving a few cases of capitalization (marking proper nouns) and commas (recognized as separating noun series).

Individual Differences in Strategy Use and Inferencing Behavior. Some individuals used only the inferencing strategy, whereas a few depended heavily on appeals for assistance. One student, for example, appealed to the interviewer or used a dictionary 11 times for the 19 words he dealt with in the two tasks.

In inferencing, learners also varied greatly in the range and patterns of knowledge sources they used. Thus, although sentence knowledge was in most cases the most frequently used source, it was used almost exclusively by some learners and not at all by one. Not surprisingly, its frequent use appeared to be related to previous formal study of grammar. For example, a student with an excellent formal English background used sentence-level grammatical knowledge 8 of 13 times for the summary task and 1 of 3 times for the question task. Only two learners used cognates (French to English), although many were fluent in French.

Learners' Perception of the Value of Reading for Vocabulary Learning. Questions at the end of each research session also probed whether students thought the experience had been useful for learning new vocabulary and, in general, whether reading was a good way to build vocabulary knowledge. In

spite of the evidence of lexical learning in the data, none of the learners reported that they considered the reading and comprehension activities they had just completed to be an effective means of improving vocabulary knowledge. Learners' comments reflected that, for all of them, real vocabulary learning involved more than simply interpreting new items in context ("I just read them; I haven't learned them;" "I have seen more, but I'm not sure I learn more.").

DISCUSSION

The above findings provide new insights into the process underlying L2 vocabulary acquisition through reading, particularly with respect to the knowledge and contextual cues learners use in attempting to infer the meanings of new words they encounter. They permit a clearer understanding of previous findings about the kinds and degrees of lexical knowledge that are likely—or unlikely—to be internalized through reading. They also help to explain the mediating influence on input processing of text, word, learner, and task factors that other studies have shown to affect incidental word learning from reading. These factors influence whether a given word in a text is noticed by the learner, how much effort the learner expends in attempting to understand its meaning, the possibility of his or her successful inference of an appropriate meaning from previous knowledge and textual cues, and, finally, the likelihood of the learner's retention of a mental representation of the word form, inferred meaning, or other lexical information.

Input Processing

It is striking that, of the relatively few words identified by these learners as unknown in the pretest or two task conditions, more than half were ignored. That is, apparently no attempt was made to understand their meanings. Thus, only half the unknown words even reached the apperceived input stage conceptualized by Gass (1988), and still fewer had the potential of becoming comprehended input, let alone intake. On the other hand, it is clear that some words at least temporarily did become intake, and some were even spontaneously produced by learners in retrospective protocols. These findings mirror other studies that have demonstrated contextual word learning from reading. These studies also note what a small effect it is and how difficult it is to predict given word-learning outcomes.

The preponderance of content words among the words identified as unknown is notable as well. There are several possible interpretations for this finding. Because function words tend to occur with high frequency, it is likely that most are already somewhat familiar—at least in form—to these L2 readers. Learners thus do not identify them as unknown, even though an earlier study demonstrated that few ESL learners at a similar level had mastered the appropriate meanings and uses of certain discourse connectors in the reading

text employed in both studies (Paribakht & Wesche, 1997). Learners may not think that text comprehension requires an exact understanding of many of these words, although the need to understand particular content words, especially nouns, is more obvious to the students and they may therefore make a greater effort to understand them.

Characteristics of tasks, the reading text, and the words themselves all influence which words learners choose to deal with, as well as the level of input processing they may reach. These factors interact with individual learner characteristics. For example, learner perception of text difficulty or of the possibility of inferring the meaning of a given word based on textual cues and previous knowledge appears to strongly influence whether learners attempt to determine a word's meaning. Overall, however (assuming an accessible text), the most influential factor appears to be the comprehension task they perform—in this case, a guided one of answering specific text-comprehension questions or orally summarizing each paragraph. There is evidence that learners dealt with more words when doing the summary task than the question task (essentially those that they perceived to be key words). Furthermore, each task appeared to make different words salient to learners and might thus be expected to lead to differential vocabulary-learning outcomes. Moreover, the requirement to summarize in English probably led to a greater effort to understand certain words and a higher level of input processing, because summarizing involves production as well as comprehension. Even with this task, however, avoidance remained a frequent response. With respect to the question task, there is evidence that students sometimes answered the questions from the text without really understanding the answers. That is, a given comprehension question guided the subjects to what they perceived to be the correct answer, allowing them to ignore any other difficult vocabulary in the text and, in many instances, to simply copy the answer from the text. Such minimal input processing could hardly be expected to promote vocabulary learning. Even under the best of circumstances, when exact comprehension is achieved and learners do in fact retain new knowledge of the word form and its meaning, it is unlikely to go beyond recognition knowledge. This is presumably because most students do not go beyond the level of input processing required—that is, recognition of the word and some level of comprehension (or miscomprehension) of its meaning. Although the few new words that learners wrote down to answer the comprehension questions or uttered in paragraph summaries probably received deeper processing than those merely comprehended in context, even these were seldom spontaneously recalled by learners at the end of interview sessions. These findings offer some insight into those of the earlier experimental study (Paribakht & Wesche, 1997) in which lesser vocabulary gains were found from reading, compared with gains from reading accompanied by vocabulary exercises. In the former condition, learners' knowledge of novel lexical items generally reached the recognition level only, as measured by the VKS, whereas vocabulary activities led to higher-level use capabilities.

Within each task, certain words tended to be chosen by many learners, whereas others were idiosyncratic. This outcome could be based on the fact that certain words were unfamiliar to most learners as well as the requirements of each task, which to some extent determined the new words learners needed.

Inferencing

The most common strategy used was inferencing. Neither task type nor task order significantly affected learners' patterns of strategy use. They used essentially the same types and proportions of strategies in all conditions, which suggests that, when dealing with lexical problems for comprehension, learners appeal to the same means for solution. Dictionary use was limited to certain learners. The interview situation did not encourage appeals to the interviewer for information, but in other situations this might also be an important strategy for accessing or confirming word meanings (Fraser, this volume).

Word category interacted with strategy use. Learners used more inferencing for verbs in the question task than in the summary task, the same percentage of inferencing for nouns in both tasks, but more inferencing for adjectives in the summary task than in the question task. These variations appear to be due to the nature of specific words in each word category that learners dealt with in the two tasks.

Learners used varied kinds of previous knowledge as well as textual cues when attempting to infer meanings of unfamiliar words, and they often used several knowledge sources together. For these advanced learners in a university setting, sentence-level grammatical knowledge was the type of knowledge most often used in lexical inferencing for both tasks and for all word categories, which suggests the importance of such knowledge in lexical processing for learners and conditions such as those in the study. The more frequent use of sentence-level grammatical knowledge for adjectives than for the other two word categories appeared to be due to the use of word-order knowledge to determine words that qualified others, thereby identifying their grammatical category. Other important knowledge sources were word morphology, punctuation, and world knowledge. In spite of the overall patterns, there were notable individual differences in the knowledge sources used. These differences appeared to be related to individuals' previous L2 learning experience, their L1, and their familiarity with the text topic.

Evidence for Vocabulary Learning

Data from both the order in which the two tasks were done and the retrospective interviews provided evidence for some incremental learning. Each task tended to elicit more reported unknown words when it was done first, which suggests that learners resolve some of their lexical problems in doing the first task and the knowledge carries over to the second task. In the interviews,

many learners mentioned at least a few new words they recalled from the text and comprehension tasks. It is also to be noted, however, that most learners did not consider the reading and comprehension tasks as useful for vocabulary acquisition.

It seems clear from the above discussion that vocabulary learning through reading is in some fundamental sense not “incidental,” at least from the learner’s perspective. Achieving any level of input processing by drawing on knowledge sources for information on the meaning of a word requires both attention to a given new word and effort on the part of the learner to find its meaning. However, if the meaning is not to fade quickly from the learner’s working memory, some deeper level of mental effort appears to be necessary. This corresponds to Hulstijn’s (in press) claim that the forging of word form and meaning associations is the vital first step toward subsequent retention.

Finally, vocabulary learning outcomes from reading will always be unpredictable because different learners attend to different words, invest different levels of effort into figuring out the meanings of unknown words while performing a task, and differ in the availability of previous knowledge and the tendency to use particular strategies that can help them to successfully solve their lexical problems.

CONCLUSION

Research Implications

Introspective data is valuable to complement and help explain findings of experimental studies. Think-aloud techniques give some insight into what learners think they are doing. They are particularly useful in task-oriented activities such as these that allow some confirmation of what they actually do.

Concurrent and retrospective think-aloud protocols provide different kinds of insights (e.g., allowing one to check more immediately what words learners remember just working with and to compare this with what they have to say at the end of the task session regarding what they think they have done and learned).

The importance of interviewer presence (as opposed to just a tape recorder) should not be underestimated. Prompts keep learners talking; the interviewer also observes, describes, and confirms certain behaviors that learners would not otherwise report. The interviewer can focus on issues of research interest.

An important issue is whether learners should use the L1 or the L2 in reporting their thoughts. The L1—or the possibility of using both the L1 and L2—might allow learners to focus more on the tasks and their thoughts than on formulation of thoughts in the L2 and might promote more sophisticated think-aloud descriptions. With a group of subjects from heterogeneous L1s, however, this is not often feasible.

Pedagogical Implications

The findings of this study add to our understanding of incidental vocabulary learning through reading and have a number of implications for vocabulary instruction. They demonstrate both the potential and limitations of the usefulness of reading programs as a vehicle for vocabulary expansion. If success is to be expected on both fronts, it is important that both learners and instructors understand how this can be achieved. A key point is that the kinds of tasks instructors set for learners—or that learners set for themselves—will largely determine what they attend to. In this study, even highly motivated students seldom went beyond the level of knowledge required for them to complete the comprehension tasks.

Pedagogical implications of this study for L2 reading programs that aim at vocabulary expansion thus involve at least three issues:

1. The importance of selecting appropriate texts: Criteria include interest and relevance of topics, as well as a manageable difficulty level. In this study, the rather technical, science-oriented text proved to be of little interest and considerable difficulty for several students who had no background in environmental issues, and the result was lack of persistence in trying to understand it. Theme-related texts appear useful because words appear repeatedly and take on salience and importance, thereby enriching the meanings from varied contexts.
2. The importance of setting appropriate tasks—that is, tasks that assure that learners do what they need to do in order to develop their vocabulary knowledge (i.e., involving deeper, varied processing): In this case it would mean setting tasks requiring word-level as well as global text comprehension and calling attention to words of particular instructional interest.
3. The potential usefulness of building learner awareness of how new vocabulary knowledge may be accessed through reading and related activities (see Fraser, this volume).

These findings support other research showing that, in general, a reading approach is useful for vocabulary development if recognition of key content words related to a given theme (i.e., those found repeatedly in the texts) is the goal and if the text, word, task, and learner factors that play a role in successful input processing and retention are favorable.

NOTES

1. Introspective and think-aloud methods of data collection have gained increasing prominence in SLA research as a complement to so-called objective data (Færch & Kasper, 1987; Mann, 1982). The strongest argument for using introspective data is that there is no other way to access learners' thoughts and perceptions. However, not all learners are equally able to introspect and to report their thoughts. They also vary in their willingness to do so. The latter problem is compounded by limited communicative abilities in the L2. There is also the possible effect of the introspection procedures themselves on the learners' cognitive processes—in this case, inferencing behavior. All of these factors threaten the reliability of the data gathered. Data dependability can be improved by training subjects in think-aloud procedures and, when possible, conducting the introspection in the learner's language of choice. Finally, such data must be understood as capturing particular instances rather than as constituting a representative sample of the phenomenon under study.

2. A second introspective study using *Reading Plus* procedures explored how learners fulfilled the tasks set for them by the various types of text-based vocabulary activities (Wesche & Paribakht, 1998b).

3. An ellipsis (...) indicates a pause and question marks (???) indicate an inaudible word. S refers to student and I to interviewer. English translations of French words are provided in brackets.

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APPENDIX A

READING TEXT AND COMPREHENSION QUESTIONS

Acid Shock

Read the following text and answer the comprehension questions:

- a) After you answer *each* question, tell us whether you had to use words in the text which you did not know well enough to answer the question.
- b) If so, which words?
- c) What did you do with each of them in order to answer the questions?

1. For almost half the year, most of northeastern North America is covered in a thick layer of snow. Hibernating among the snowflakes, awaiting the bears of springtime, is a potent dose of sulfuric acid that, when released in the spring runoff, packs the knockout wallop of a heavy-weight prizefighter.
2. As the snow melts and enters lakes and rivers, parts of these bodies of water can become as much as 100 times more acidic in a very short time. "While this acid bath usually only lasts for a few days to a few weeks, the pH values are often acutely lethal even in lakes that otherwise do not appear to be in danger," Dr. David Schindler of the Freshwater Institute in Winnipeg—a pioneer researcher into effects of acid rain on fish—told an Ontario government committee investigating acid rain. As an example, Dr. Schindler pointed out that Panther Lake in the Adirondacks normally has a pH of 7. But in the spring runoff, it drops to a pH of 5.
3. Yet the air pollution picture is not totally bleak. Continuing research offers some hope of improvement. In late 1986 two scientists reported a chemical process capable of eliminating nitrogen oxides from diesel exhaust gases and coal-fired boilers. The hot gases, passed over a nontoxic chemical called cyanuric acid, break down into harmless nitrogen and water. If later research supports the findings, a giant step could be taken toward eliminating a major contributor to acid rain and man-made ozone.
4. Perhaps the most controversial environmental issue of the decade is acid rain, but that too is clouded in mystery. "We are in the infancy of understanding the full effects of an atmosphere acidified by burning fossil fuels," Dr. Chris Bernabo, an air-quality expert, told me. "In order to really understand it, we must conduct years of research."
5. The federal Clean Air Act of 1970, amended in 1977, expired in 1981. As of this writing it continues on extensions, outdistanced by the growing knowledge about air pollution.
6. We live on a forgiving planet, with mechanisms to deal with natural pollutants. Decay, sea spray, and volcanic eruptions annually release more sulfur than all the power plants, smelters, and other industries in the world. Lightning bolts create nitrogen oxides just as automobiles and industrial furnaces do, and trees emit hydrocarbons called terpenes. Their release triggers a bluish haze that gave the Blue Ridge its name.
7. For millions of years the ingredients of such substances have been cycling through the ecosystem, constantly changing form. They pass through plant and animal tissues, to sink into the sea, return to the earth, and are vaulted aloft in some geologic event to begin the cycle again. An atom of oxygen completes the cycle approximately once every 2,000 years. A portion of the next breath you take could have last been breathed by Jesus.
8. Can the earth assimilate the additional 70 million tons of sulfur that we release each year? What happens to plants that absorb the additional nitrogen oxides (NO_x) we create with our miniature lightning bolts inside car cylinders? Can the atmosphere take on the extra load of carbon dioxide (CO₂), methane, man-made ozone, and chlorofluorocarbon refrigerants that scientists say could raise global temperatures by the greenhouse effect?
9. Such chemical increases can be accommodated somehow, over time. Earth has plenty of that, but do we?

I. Comprehension

1. (paragraph 1) What pollutant can one find in snow on the ground?

2. (paragraph 2) What happens when the snow melts in the spring?

3. (paragraph 3) A chemical process is mentioned. Gases from _____ and _____ are exposed to _____ to yield _____ and _____.

4. (paragraph 4) Why do they say acid rain is controversial?

5. (paragraph 4) What is the main drawback of the Clean Air Act?

6. (paragraph 5) Name the natural pollutants and the product released into the atmosphere.

<i>Pollutant</i>	<i>Product</i>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

7. (paragraph 5) Why is the expression “forgiving planet” used?

8. (paragraph 6) What does the expression “such substances” refer to?

9. (paragraph 6) Give an example of a geologic event that could cause particles found deep in the layers of the earth to be vaulted aloft. _____

10. (paragraph 7) What pollutants do humans create?

11. (paragraph 7) What is the general message of the last sentence of the text?

APPENDIX B

WORDS IN TEXT AND UNKNOWN WORDS IDENTIFIED BY LEARNERS BY WORD CATEGORY AND TASK TYPE

Word categories	Task types											
	Words in text				Pretest			Summary task			Question task	
	Tokens		Types		Number of tokens	% of total identified	Number of tokens	% of total identified	Number of tokens	% of total identified	Number of tokens	% of total identified
<i>n</i>	%	<i>n</i>	%									
Nouns	166	31	124	41	6.4	60	9.2	61	5.7	61	61	
Verbs	84	16	55	19	1.5	14	3	20	2.1	23	23	
Adjectives	59	11	50	17	2.4	23	2.9	19	1.3	14	14	
Total content words	—	58	—	67	—	97	—	99	—	98	98	
Other (function words, adverbs)	227	42	70	23	0.3	3	0.1	1	0.2	2	2	
Total	536	100	299	100	10.6	100	15.2	100	9.3	100	100	

APPENDIX C

HOW LEARNERS DEALT WITH UNKNOWN WORDS: EFFECTS OF WORD CATEGORY AND TASK TYPE

Word category	Summary task (N = 9)						Question task (N = 10)									
	Unknown words identified		Percentage of UWs ignored	Strategies used		Unknown words identified	Percentage of UWs ignored	Strategies used		Unknown words identified	Percentage of UWs ignored	Strategies used				
	n	%	Inferencing	Other	n			%	Inferencing			Other	n	%	Inferencing	Other
Nouns	83	9	5.5	60	3.8	79	1	21	57	6	2.8	49	3.1	83	0.7	18
Verbs	27	3	1.6	52	1.3	71	0.6	29	21	2	1.2	57	0.9	100	0	0
Adjectives	26	3	1.5	46	1.4	77	0.4	24	13	1	0.7	54	0.6	50	0.6	50
Other	1	—	*	*	*	*	*	*	2	—	*	*	*	*	*	*
Total	137	15	8.4	56	6.7	77	2	23	93	9	4.8	53	4.7	78	1.3	22

Note. *Indicates that the numbers were too small to report.

APPENDIX D

KNOWLEDGE SOURCES IN INFERENCE: EFFECTS OF TASK TYPE

Task type	Knowledge sources														Total				
	Punctuation		Homonymy		Morphology		Word associations		Sentence-level grammatical knowledge		Discourse knowledge		Cognates		World knowledge		Unknown		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Summary (<i>n</i> = 9)	5	8	2	3	11	18	3	5	23	38	3	5	1	2	5	8	7	12	60
Question (<i>n</i> = 10)	7	15	2	4	5	11	0	0	14	30	1	2	1	2	5	11	12	25	47
Total	12	11	4	4	16	15	3	3	37	35	4	4	2	2	10	9	19	18	107

APPENDIX E

KNOWLEDGE SOURCES IN INFERENCING: WORD CATEGORY AND TASK EFFECT

Word category (Total summaries and questions)	Knowledge sources														Total <i>n</i>				
	Punctuation		Homonymy		Morphology		Word associations		Sentence- level grammatical knowledge		Discourse knowledge		Cognates			World knowledge		Unknown	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%
Noun	12	18	0	0	7	10	2	3	23	34	4	6	1	2	9	13	9	13	67
Adjective	0	0	2	11	3	17	0	0	8	44	0	0	1	6	0	0	4	22	18
Verb	0	0	2	10	6	30	1	5	6	30	0	0	0	0	1	5	4	20	20