Journal of Educational Psychology
2004, Vol. 96, No. 4, 671–681

0022-0663/04/$12.00 DOI: 10.1037/0022-0663.96.4.671

Individual Differences in the Inference of Word Meanings From Context: The Influence of Reading Comprehension, Vocabulary Knowledge, and Memory Capacity

Kate Cain
University of Essex

Jane Oakhill
University of Sussex

Kate Lemmon
University of Nottingham

Two studies investigated the ability to use contextual information in stories to infer the meanings of novel vocabulary by 9–10-year-olds with good and poor reading comprehension. Across studies, children with poor reading comprehension were impaired when the processing demands of the task were greatest. In Study 2, working memory capacity was related to performance, but short-term memory span and memory for the literal content of the text were not. Children with poor reading comprehension were not impaired in learning novel vocabulary taught through direct instruction, but children with both weak reading comprehension and vocabulary were. Implications for the relation between vocabulary development and text comprehension are discussed.

Since the early days of research on reading, a strong relation between reading ability and vocabulary knowledge has been acknowledged. However, the precise nature of the relation between these skills, the mechanisms by which vocabulary learning takes place, and the conditions to facilitate such learning are still far from clear. We report two studies that investigate the relation between children's text comprehension, their ability to acquire new word meanings, and the factors that influence vocabulary acquisition from written contexts.

Reading comprehension ability and word knowledge are highly correlated in both children and adults (Carroll, 1993). Theoretical explanations for this relation fall broadly into two camps, those that posit a causal relation with vocabulary influencing reading ability and those that propose a common variable underlying the development of these two skills. In support of the direct causal relation, Beck, McKeown, and colleagues found that instruction in word meanings improved comprehension and recall of texts containing the taught words (see Beck & McKeown, 1991, for a review). Stahl and Fairbanks's (1986) meta-analysis of vocabulary instruction research found modest but facilitatory effects even for standardized assessments of reading comprehension, which did not contain the target words. The proposed reason for this direct relation is that the size or richness of an individual's vocabulary or the speed of access to vocabulary items affects reading comprehension ability (see Daneman, 1988, or Perfetti, 1994, for reviews).

These aspects of an individual's vocabulary knowledge will affect text comprehension for most individuals under certain circumstances. However, not all research supports a direct causal relation between vocabulary knowledge and reading comprehension. Prior knowledge of a topic or relevant vocabulary can influence understanding of a text (Spilich, Vesonder, Chiesi, & Voss, 1979; Wittrock, Marks, & Doctorow, 1975), but limited vocabulary knowledge does not always lead to comprehension difficulties, (Freebody & Anderson, 1983) and vocabulary knowledge per se does not appear to be sufficient to ensure adequate comprehension of extended discourse (Pany, Jenkins, & Schreck, 1982). However, the major limitation of these causal theories is that they do not specify a mechanism for how vocabulary-related differences arise in the first place.

In our opinion, a more useful framework for studying the relation between vocabulary knowledge and reading comprehension is provided by theories proposing a common skill or mechanism that contributes to the determination of both. Vocabulary knowledge not only predicts reading comprehension level, it is also a good predictor of verbal IQ. Consequently, it has been proposed that the ability to acquire new information from context is the skill that mediates the relation between reading comprehension and verbal IQ and also reading comprehension and vocabulary knowledge (Jensen, 1980; Nippold, 2002; Sternberg & Powell, 1983). In an extension of this hypothesis, Daneman (1988) proposed that processing capacity, in part, determines the ability to learn from context.

Kate Cain, Department of Psychology, University of Essex, Colchester, United Kingdom; Jane Oakhill, Laboratory of Experimental Psychology, University of Sussex, Brighton, United Kingdom; Kate Lemmon, School of Psychology, University of Nottingham, Nottingham, United Kingdom.

Study 1 was supported by Economic and Social Research Council Grant R000 23 5438 awarded to Jane Oakhill and Peter Bryant. Study 2 was supported by a New Lecturer Grant from the University of Nottingham awarded to Kate Cain. We thank the schools in Brighton and Hove, Derbyshire, and Nottinghamshire for their participation in this work.

Correspondence concerning this article should be addressed to Kate Cain, Department of Psychology, University of Essex, Wivenhoe Park, Colchester, Essex CO4 3SQ, United Kingdom. E-mail: kcain@essex.ac.uk

Adults' ability to infer new word meanings from context is related to independent assessments of their vocabulary knowledge and memory capacity (Daneman & Green, 1986), but there is some debate over the importance of this skill for children. Children's acquisition of word meanings through context can be slight, with a likelihood of learning the meanings of 15% of unknown words encountered during undirected reading (Swanborn & de Glopper, 1999). Vocabulary gains through context can appear small when compared with the acquisition of word meanings through direct instruction (Jenkins, Matlock, & Slocum, 1989). Thus, although some researchers advocate instruction in the use of contextual cues (Nippold, 2002), others argue for a systematic program of vocabulary instruction (Biemiller & Slonim, 2001).

These two types of instruction need not be mutually exclusive. Direct instruction in word meanings might add those items directly to an individual's vocabulary, but the ability to use those words in all of their nuances is more likely to arise from repeated exposures, through which their meanings are refined (Jenkins et al., 1989; Nagy & Scott, 2000). If word meanings are learned incrementally, a reader might require both direct instruction and exposure to that word in multiple contexts to fully fix its meaning in his or her lexicon. A meta-analysis of studies investigating vocabulary teaching suggests that the most effective method of vocabulary instruction involves the presentation of words both in context and with definitions (Stahl & Fairbanks, 1986).

Differences between written and spoken language indicate that inference from written contexts might be important for vocabulary development. Written language is lexically richer than spoken language and may, therefore, provide a greater number of learning opportunities than are available in spoken contexts (Cunningham & Stanovich, 1998). Avid readers encounter considerably more words each year than their less well-read peers (Anderson, Wilson, & Fielding, 1988), and measures of 9–11-year-olds' exposure to print predicts significant growth in vocabulary (Echols, West, Stanovich, & Zehr, 1996). Practice at reading is likely to lead to more efficient access of word meanings. Regular reading can also provide instances to acquire, refine, and consolidate vocabulary knowledge through inference from context.

One text variable that affects a student's ability to acquire new word meanings from context is the distance between the target word and its cue (Carnine, Kameenui, & Coyle, 1984). In naturalistic texts, readers may have to integrate information from several idea units spaced throughout the passage rather than from a single adjacent idea unit in order to derive a complete meaning of an unknown word. Increasing the distance between the different pieces of information to be integrated increases the processing demands for the reader, which will adversely affect individuals with smaller memory capacity (Daneman, 1988; Daneman & Green, 1986). There is some evidence that 4th- to 6th-grade children's ability to learn from context is more strongly related to their working memory capacity than their chronological age (Cull's study; as cited in Daneman, 1988). In Cull's study, the distance manipulation was achieved by placing contextual cues either before or after the word to be learned, which may have led to different processing strategies. Thus, there is clearly a need to investigate the relation between memory capacity and inference from context without such a confound, an aim of the work reported here.

In relation to comprehension skill, distance between pieces of information to be integrated in a text adversely affects less skilled comprehenders' ability to resolve anaphors, detect inconsistencies, and infer new word meanings from context (Cain, Oakhill, & Elbro, 2003; Ehrlich & Remond, 1997; Oakhill, Hartt, & Samols, 2003). Less skilled comprehenders also experience working memory limitations (Yuill, Oakhill, & Parkin, 1989), suggesting that their difficulties with distance arise because of processing difficulties. The relation between memory skills and the ability to derive word meanings from context was explored further in the current study.

Children with better language skills demonstrate superior performance on vocabulary learning tasks. Four-year-olds with larger vocabularies learn more words in experimental storybook reading tasks than those who start out knowing fewer words (Ewers & Brownson, 1999; Sénéchal, Thomas, & Monker, 1995). However, the probability of learning new words from context differs dramatically between good and poor readers (Nicholson & Whyte, 1992; Swanborn & de Glopper, 2002). Shefelbine (1990) found that 6th-grade students with the poorest vocabulary knowledge at outset learned the fewest words from context, even though they had the greatest room for improvement. He proposed that children with smaller vocabularies face two difficulties in expanding their vocabulary: (a) They have to learn more words, and (b) their understanding of the words they already know is less well developed.

Larger vocabulary size may indicate more efficient memory for word learning. Two different components of memory are implicated in word learning: phonological short-term memory, which is assessed by measures such as forward digit span and concerns the passive storage of verbal information, and verbal working memory capacity, which is assessed by tasks that involve the simultaneous storage and processing of verbal information, such as reading span (Gathercole, 1998).

Children with good phonological short-term memory are better able to accurately represent the sound structure of a new word, which may facilitate setting up a stable lexical entry for this new word (Gathercole, Hitch, Service, & Martin, 1997). The relation between verbal working memory capacity and vocabulary knowledge may be more complex. College students' vocabulary knowledge is related to their working memory capacity (Daneman & Green, 1986). Therefore, Daneman (1988) proposed that working memory processing capacity plays an important role in vocabulary acquisition. Others argue that semantic skills contribute to (verbal) working memory performance (Nation, Adams, Bowyer-Crane, & Snowling, 1999; but see Cain, Oakhill, & Bryant, 2004).

This review demonstrates a need to understand more fully the role that inference from context plays in children's vocabulary development and the different text and reader variables that affect this process. We report two studies that investigated schoolchildren's ability to infer the meanings of novel vocabulary items from context in relation to one text variable, the proximity of the target word and its useful context, and three reader variables, reading comprehension skill, prior vocabulary knowledge, and memory skills.

Study 1

The aim of this study was to investigate whether skilled and less skilled comprehenders differ in their ability to infer the meanings of novel vocabulary items from context. We manipulated the processing demands of the task by changing the proximity of the novel word and its useful context (near vs. far). It was predicted that children with weak reading comprehension skills would perform particularly poorly in the far condition, when the novel word and context were not adjacent and the processing demands of the task were high. An independent assessment of working memory capacity was taken. We predicted that the less skilled group would obtain significantly lower scores on this measure and that working memory capacity would be related to performance on the vocabulary inference task.

Method

Participants

Two groups of 9–10-year-olds participated in this study: 12 skilled comprehenders (7 girls, 5 boys) and 13 less skilled comprehenders (6 girls, 7 boys). Participants were recruited from urban schools with socially mixed catchment areas on the south coast of England. The majority of participants were from lower middle-class families. All were Caucasian, spoke British English as their first language, and had no known behavioral problems or learning difficulties.

Two tests were used to select participants: the Gates–MacGinitie Primary Two Vocabulary Test (Level 4, Form K; MacGinitie & MacGinitie, 1989), which provides an index of a child's ability to read and understand written words out of context, and the Neale Analysis of Reading Ability—Revised British Edition (Form 1; Neale, 1989), which provides scores for word reading accuracy in context and text comprehension. The Gates–MacGinitie is a group-administered test. It was completed by 227 children and was used to screen out exceptional readers: Children who obtained either very high or very low scores were excluded, and the remaining 74 average readers were assessed using the Neale Analysis.

The selected children obtained reading accuracy ages that were within 12 months of their chronological age. The 13 less skilled comprehenders obtained reading comprehension ages that were below their chronological ages and at least 8 months below their reading accuracy age (mean comprehension – accuracy difference = –24 months). In this way, we were able to exclude any child whose weak comprehension skills had arisen from word reading difficulties. The 12 skilled comprehenders obtained comprehension ages that were at or above that predicted by their reading accuracy age (mean difference = 11 months).

A series of t tests were conducted to confirm the group matching. An alpha level of .05 is used throughout this article. The skilled and less skilled groups differed significantly with regard to their reading comprehension age, as measured by the Neale Analysis (Ms = 128.5 and 94.8 months, SDs = 9.9 and 10.2, respectively), $t(23) = 8.43$, $p < .01$. The skilled and less skilled group did not differ significantly with regard to their age (Ms = 117.5 and 118.9 months, SDs = 4.2 and 3.1, respectively), $t(23) < 1$; Neale Word Reading Accuracy (Ms = 117.3 and 118.7 months, SDs = 9.0 and 7.0, respectively), $t(23) < 1$; Gates–MacGinitie scores (Ms = 35.3 and 34.5, SDs = 2.1 and 2.2, respectively), $t(23) < 1$; or the number of stories that they had read on the Neale Analysis (Ms = 5.5 and 5.6, SDs = 0.5 and 0.7, respectively), $t(23) < 1$. The latter measure was necessary to ensure that the difference in comprehension scores did not arise because the less skilled group had read fewer stories and, therefore, obtained lower comprehension scores simply because they had attempted fewer comprehension questions.

In addition, the groups were matched for Neale Word Reading Accuracy age using the regressed Neale Word Reading Accuracy scores to take into account the possibility that the two groups were selected from populations that differed in their reading-aloud ability. Adopting the most unfavorable assumption (that the mean accuracy age score of the population that the less skilled comprehenders was drawn from was equivalent to their comprehension age score and that the mean accuracy age score of the population from which the skilled group was drawn from was equal to their comprehension age score), we calculated regressed accuracy scores for all children. The reliability coefficients for the Neale Word Reading Accuracy scores are .90 for ages 96–119 months and .84 for ages 120–143 months. The skilled and less skilled groups did not differ significantly with regard to regressed Neale Word Reading Accuracy (Ms = 118.0 and 116.0 months, SDs = 8.1 and 6.5, respectively), $t(23) = 1.02$, $p = .32$. It is therefore unlikely that the Neale comprehension differences, or any differences on the experimental task, arose from differences in word reading ability.

Materials and Procedure

Vocabulary inference from context task. Eight short stories were written, each containing a made-up word with a novel meaning (i.e., not a synonym of a known word). The meaning of the unknown word could be derived from information contained in one or two sentences that occurred either immediately after the unknown word (near condition) or after some additional filler sentences (far condition). Thus, there were two versions of each story. An example of both versions of a story is shown in Table 1.

The child was read the following instructions:

> Today I have brought along some stories that I would like you to read out loud to me. The person who wrote them got a bit stuck at times and didn't always know the right word to put in, so they've put a funny word in the story instead. I want you to tell me what you think the word means. If you have any ideas when you get to the word, then tell me what you think the word means then. But don't worry if you haven't got any ideas. At the end of each story, I will ask you to explain the meaning of the word. For example, if I asked you what a

Table 1
Example of Text Used in the Vocabulary Learning From Context Task

Introduction	Informative context	Filler text	Ending
Lucy was taking her dog, Ben, to the park. First she had to find Ben's *wut.**	Her dad suggested taking a football, but that was not quite right. Their football was far too big to play catch with, and it had lost its bounce.	She searched all the rooms in the house, even the kitchen. During her hunt, she found all sorts of things: her hair band that had been missing for a month, an overdue library book, and even her grandma's false teeth!	Lucy decided that she had to be more tidy in the future.

Note. In the far condition, the filler text appeared where marked by the asterisk (*). The text as presented to the children was continuous, not blocked as above, and the novel word was not italicized in the text that the children saw. The information provided by the table headings (e.g., introduction, informative context, etc.) is included here for illustrative purposes only and was not included in the version presented to the children. Acceptable responses included the following: a ball (1 point); a small and/or bouncy ball (2 points).

bed was, you might tell me that it was "a long piece of furniture that we sleep in."

Children read the story up to the end of the sentence in which the unknown word appeared. The remainder of the text was kept covered with a piece of paper. The tester then asked the child what he or she thought the strange word might mean (e.g., "What do you think a *wut* might be?"). Responses were recorded verbatim and scored later. The child then completed the story. At the end, the child was asked, "What do you think a *wut* might be? You can stick with your first idea or you can change your mind." Each child read four stories in each condition, and the set was counterbalanced as completely as possible within group.

Working memory task. This task was similar to the Listening Span Test developed by Daneman and Carpenter (1980) and used with children by Siegel and Ryan (1989). The tester read aloud sentences that were missing their final word. The final word completion was constrained by the sentence context, and the task was to complete the sentence with a single word and remember that word for later recall. Children completed three trials at three levels of difficulty in which the number of trials (and, thus, the number of final words to be recalled) was increased: three sentences, four sentences, and five sentences. One point was awarded for each final word recalled in its correct position.

Results

The reliability of our experimental measures was assessed by calculating Chronbach's alpha over items. The reliability coefficients were both acceptable: Working Memory Listening Span task, $\alpha = .68$; Vocabulary Inference task, $\alpha = .79$.

Vocabulary Inference Task

Points were awarded for the quality of the definition of the unknown word: 0 points for an incorrect response, 1 point for a partially correct definition, and 2 points for a complete definition. Examples of responses and points allocated are shown in Table 1. All responses were scored by two independent raters, and disputes were resolved by discussion.

For each condition (near, far), a use of context score was calculated by subtracting the score obtained before the useful context from that obtained after context. These scores were analyzed in a two-way analysis of variance (ANOVA), with skill group (skilled, less skilled) and proximity (near, far) as factors. There was a main effect of skill group, $F(1, 23) = 18.01$, $p < .01$, because the skilled comprehenders obtained higher scores than the less skilled group in general (*M*s = 4.8 and 2.7, *SDs* = 1.3 and 1.2, respectively; $\eta^2 = .27$). There was a marginal effect of proximity, $F(1, 23) = 3.68$, $p = .07$, because scores obtained in the near condition tended to be higher than those obtained in the far condition (*M*s = 4.1 and 3.2, *SD*s = 1.9 and 2.1, respectively; $\eta^2 = .04$). These two factors were involved in a significant interaction, $F(1, 23) = 6.21$, $p = .02$, $\eta^2 = .07$). Planned comparisons were conducted to determine whether the proximity manipulation affected the performance of each skill group differently, as predicted. The scores obtained by the skilled group in the near ($M = 4.7$, $SD = 1.6$) and far ($M = 4.9$, $SD = 1.4$) conditions did not differ significantly, $t(11) < 1$. For the less skilled comprehenders, there was a significant difference between the scores obtained in the near condition ($M = 3.6$, $SD = 2.2$) and the far condition ($M = 1.7$, $SD = 1.4$), $t(12) = 2.67$, $p = .02$.

Working Memory Task

The total number of items recalled in their correct order was calculated for each participant. The skilled group recalled significantly more items ($M = 19.8$, $SD = 4.8$) than did the less skilled group (*M*s = 15.5, $SD = 3.4$), $t(23) = 2.62$, $p < .02$, $d = 1.04$. However, the working memory scores were not significantly correlated with performance in either condition (near, $r = .17$, $p > .10$; far, $r = .32$, $p < .12$).

Summary and Discussion

Children with weak reading comprehension skills were less able to infer the meanings of novel vocabulary items from context than were their skilled peers. The less skilled group's performance was affected by the proximity of the useful context and the novel word: They were much less likely to provide an appropriate meaning of the novel word when it was separated from the context by filler text. The skilled group was not affected by this manipulation. Although the interaction between the two factors was significant, the measurement of effect size shows that comprehension ability accounted for the greater proportion of the variance in performance on the vocabulary inference task.

Consistent with previous work (Cain et al., 2003), there was a relation between inference from context and reading comprehension skill, this time with an older sample of children. Contrary to previous research by Stothard and Hulme (1992), less skilled comprehenders had weak verbal working memory skills relative to the skilled group. However, other studies have found working memory differences between skilled and less skilled comprehenders (e.g., Yuill et al., 1989), and the Stothard and Hulme study may have lacked discriminatory power because of floor levels of performance. The estimate of effect size demonstrates that the difference in working memory scores between the skill groups was substantial. The less skilled group's performance on the vocabulary inference task was poorer in the condition that had the higher working memory demands, but working memory capacity and performance on the vocabulary inference task were not significantly correlated.

There were several limitations to the study, which prompted further investigation. The small number of participants (25) meant that the study lacked power. It is important to investigate the relation between memory and vocabulary inference with a more powerful design because of Daneman's (1988) claim that working memory capacity may account for individual differences in contextual learning (see also Biemiller & Slonim, 2001). Indeed, in the current study, the skilled comprehenders were not adversely affected by the proximity manipulation and obtained higher working memory scores than the less skilled group.

We did not check children's memory for the literal or factual content of the stories from which they inferred the novel vocabulary items. Thus, group differences may have arisen because the less skilled comprehenders had poorer memory for the text per se, rather than a specific difficulty with inferring new word meanings from context. The skilled comprehenders also made more lucky guesses in their initial explanations of the novel word. The mean total of lucky guesses for the skilled group and less skilled groups did not differ significantly (*M*s = 1.8 and 1.2, *SD*s = 1.1 and 1.2, respectively), $t(23) = 1.28$, $p = .21$. However, the skilled comprehenders may have taken advantage of some unintended contextual clues before the target context was encountered, thereby reducing the pool of possible target meanings of the novel words and enabling them to use the context more efficiently when encountered.

We can interpret our results in (at least) two ways: (a) Less skilled comprehenders have difficulties in inferring the meanings of new words from context, or (b) less skilled comprehenders have a more fundamental deficit with vocabulary acquisition in general. That is, less skilled comprehenders might simply find it hard to set up and/or maintain an integrated representation of a new label and its meaning. A second study was conducted to distinguish between these two hypotheses by including a direct instruction task (where participants are explicitly taught the meanings of new vocabulary items) to relate to performance on the vocabulary inference task. In addition, the study was designed to investigate individual differences in vocabulary knowledge, as well as comprehension, in relation to mechanisms for vocabulary learning.

Study 2

The first aim of this study was to explore how individual differences in both comprehension level and vocabulary knowledge affect the ability to learn new word meanings. Children with weak vocabulary skills learn fewer new vocabulary items from context than their more skilled peers even though they have the greatest room for gain (Shefelbine, 1990). We compared the performance of three groups: (a) skilled and (b) less skilled comprehenders matched for vocabulary knowledge and (c) less skilled comprehenders with weaker vocabulary skills than the two other groups. This design was used to determine whether children with poor comprehension and weak vocabulary experience a greater vocabulary learning deficit than the type of less skilled comprehender who participated in Study 1.

All children completed two experimental measures of vocabulary learning: the inference from context task used in Study 1 and a direct instruction task. In the latter, children were taught the meanings of novel words explicitly by reading out the new word together with its meaning. Two measures were derived: an ease of learning score, calculated from the number of repetitions required to learn the novel words, and a delayed recall score. From these scores, we can determine whether children who experience difficulties on the inference from context task also experience difficulties in setting up an integrated representation of a new label and its meaning (ease of learning) and/or find it hard to maintain this information over time (delayed recall).

Poor phonological short-term memory can lead to vocabulary learning difficulties by impairing the ability to retain a new phonological label and establish a new lexical entry for that word. We assessed short-term memory in order to relate it to performance on the direct instruction task (although previous work has found no difference between skilled and less skilled comprehenders on measures of short-term phonological memory; Oakhill, Yuill, & Parkin, 1986).

We included two measures of working memory capacity: the listening span measure used in Study 1 and a counting span measure (Case, Kurland, & Goldberg, 1982). The latter task measures processing capacity without the element of sentence comprehension evident in the listening span task. Thus, we were able to examine whether processing capacity in general, as opposed to processing capacity for text, was related to performance on the vocabulary inference task. We predicted that both measures of working memory would be related to comprehension skill and also to task performance on the vocabulary inference task, particularly in the far condition where the processing demands are greatest. In addition, we could test whether the weak vocabulary group experienced a greater impairment on the verbal working memory task than the comparison group of less skilled comprehenders (see Nation et al., 1999).

We included two memory questions after each text. These required recall of information stated explicitly in the text. Thus, we were able to investigate whether the less skilled comprehenders were specifically impaired in their ability to infer the meanings of novel vocabulary items from context, or whether they were more generally impaired in their memory for the text from which the inference has to be drawn. In order to assess the relative influence of word meaning acquisition, memory capacity, and memory for the text on the vocabulary inference task, we controlled for these measures in our statistical analyses.

Method

Participants

Three groups of 9–10-year-olds participated in this study: one group of skilled comprehenders, one group of less skilled comprehenders, selected in the same way as those who participated in Study 1, and another group of less skilled comprehenders with weaker vocabulary skills relative to both other groups (weak vocabulary group). Participants attended urban schools with socially mixed catchment areas near the city of Nottingham, England. The majority of participants were from lower middle-class families. Eighty-three percent of the sample were Caucasian; the rest were British Asian. All spoke British English as their first language and had no known behavioral problems or learning difficulties.

The following tests were used in the selection process: Form 1 of the Neale Analysis of Reading Ability—Revised (NARA–II; Neale, 1997) and the Gates–MacGinitie Primary Two Vocabulary Test (Level 4, Form K; MacGinitie & MacGinitie, 1989), both used in Study 1. In addition, we administered: the Graded Nonword Reading Test (GNWRT; Snowling, Stothard, & McLean, 1996), which measures children's decoding ability; the British Picture Vocabulary Scale—Second Edition (BPVS; Dunn, Dunn, Whetton, & Burley, 1997), which assesses receptive vocabulary; and the Word Association subtest from the Clinical Evaluation of Language Fundamentals—Revised (CELF–R; Semel, Wiig, & Secord, 1987), which measures semantic fluency. Group characteristics are reported in Table 2.

The 12 less skilled comprehenders (7 girls, 5 boys) and the 12 skilled comprehenders (9 girls, 3 boys) did not differ significantly on the vocabulary measures, Gates–MacGinitie, $t(22) < 1$; BPVS, $t(22) = 1.93$, $p = .07$; CELF–R Word Association subtest, $t(22) < 1$, on the measures of word reading and decoding ability, regressed NARA–II Word Reading Accuracy scores, $t(22) = 1.34$, $p = .19$; GNWRT scores, $t(22) < 1$, or on chronological age, $t(22) < 1$. The less skilled comprehenders obtained significantly lower NARA–II comprehension scores than those of the skilled group, $t(22) = 9.77$, $p < .01$.

The group of less skilled comprehenders with weak vocabulary skills (5 girls, 7 boys) obtained comparable regressed NARA–II Word Reading Accuracy scores with those obtained by the other groups (both ts < 1.0). The weak vocabulary group obtained lower NARA–II Comprehension scores compared with the skilled group, $t(22) = 9.45$, $p < .01$, but did not differ from the less skilled comprehender group on this measure, $t(22) = 1.22$, $p = .23$.

The weak vocabulary group was selected to have poorer vocabulary skills than the other groups, Gates–MacGinitie: skilled versus weak vocabulary group, $t(22) = 5.42$, $p < .01$, less skilled versus weak vocabulary, $t(22) = 6.13$, $p < .01$; BPVS: skilled versus weak vocabulary, $t(22) = 5.31$, $p < .01$, less skilled versus weak vocabulary, $t(22) = 6.13$, $p < .01$. Group differences on the Word Association task only reached significance for the comparison between the skilled comprehenders and the weak

Table 2
Group Characteristics for Study 2

Measure	Skilled comprehenders *M*	Skilled comprehenders *SD*	Less skilled comprehenders *M*	Less skilled comprehenders *SD*	Weak vocabulary group *M*	Weak vocabulary group *SD*
Chronological age	115.0[a]	3.5	116.3[a]	4.3	115.6[a]	4.5
Gates–MacGinitie (max. = 45)	34.5[a]	2.7	34.1[a]	2.2	30.2[b]	0.5
BPVS	108.8[a]	2.6	106.3[a]	3.8	100.2[b]	5.0
CELF–R	42.0[a]	7.8	38.7[a,c]	7.5	36.0[b]	5.8
GNWRT (max. = 24)	19.4[a]	2.2	18.4[a]	4.1	19.3[a]	2.9
Reading accuracy	125.5[a]	7.3	125.7[a]	6.8	129.9[a]	11.5
Reading comprehension	127.7[a]	9.9	96.7[b]	5.6	92.1[b]	8.5
Number of stories	6.0[a]	0.0	6.0[a]	0.0	5.8[a]	0.4

Note. $n = 12$. Means in the same row that do not share superscripts differ at $p < .05$ in the t tests. max. = maximum; Gates–MacGinitie = Gates–MacGinitie Vocabulary subtest; BPVS = British Picture Vocabulary Scale (standardized scores); CELF–R = Word Association subtest from the Clinical Evaluation of Language Fundamentals—Revised; GNWRT = Graded Nonword Reading Test; Reading accuracy and reading comprehension = age-equivalent (in months) scores obtained on the Neale Analysis of Reading Ability—Revised (NARA–II); number of stories = stories completed on NARA–II.

vocabulary group, $t(22) = 2.11$, $p < .05$. The other group comparisons did not reach significance (both ts < 1.0).[1]

Materials and Procedure

Sixteen stories, each with a different novel word, were used in this study. Each story contained contextual clues from which the target definition could be inferred. Eight of these stories had been used in Study 1; the other eight were written for this experiment. Texts used in the first study were modified to reduce the opportunity for fortuitous guesswork before the target context was encountered. Pilot work indicated that, for all texts, the meanings of the novel words could only be determined from the useful context (i.e., none of them were guessed correctly).

The 16 novel word items were divided into four groups of four words. Four lists of experimental items were created, using a Latin square rotation, so that each list comprised eight novel words to be presented in stories and eight different novel words to be presented in the direct instruction task. Thus, each child was presented with different words in the two tasks, which were administered in separate sessions.

Vocabulary direction instruction task. For this task, a procedure adapted from Cain, Oakhill, Barnes, and Bryant (2001) was used. Children were told the following:

> Today I want you to pretend that there is a make-believe place called Gan, which is different from where we live. Some things on Gan have different names from the names that we use. I am going to tell you about these things, and I want you to try to remember what they are.

Eight novel words and their meanings were then read aloud, for example, "A small bouncy ball is called a *wut*." After the eight items had been read aloud, children were tested for their verbal recall of the novel word meanings with specific questions, for example, "On Gan, what is a *wut*?" This test provides an index of how easily participants acquired the meanings of the novel words. Wrong answers were corrected immediately and the questions to test these items repeated after the complete set of items had been presented, so that only items that were recalled incorrectly were presented more than once. A delayed test of memory for these items was administered after a short filler task (forward digit span).

Vocabulary inference from context task. The procedure followed was the same as that used in Study 1, with two additional questions after each story to assess memory for facts in the text.

Short-term memory. A forward digit span task was administered using lists of digits that increased in length, starting with two digits. Four trials were presented for each list length, with items recalled in order of presentation. Testing ceased when two or more trials of a certain list length were incorrectly recalled. The score entered into the analysis was the total number of trials correctly recalled before testing ceased (Pickering & Gathercole, 2001).

Working memory. Two assessments of working memory capacity were administered: The listening span measure used in Study 1 and a counting span task modified from Pickering and Gathercole (2001). In each task, children completed four trials with two, three, four, and five items per trial (sentences or dots).[2]

Results

The reliability of our experimental measures was assessed by calculating Chronbach's alpha over items. In all cases, the reliability coefficients were acceptable: listening span = .72, counting span = .65, vocabulary direct instruction tasks (for Lists 1–4) = .79–.87, vocabulary inference (for Lists 1–4) = .78–.84, vocabulary inference task memory questions = .76. The forward digit span retest reliability coefficient was .82 (Pickering & Gathercole, 2001). We present the analysis of each assessment individually, followed by the results of a set of multiple regressions designed to determine the relative contribution made by the memory and learning variables to performance on the vocabulary inference task.

Performance on the Individual Tasks

Direct instruction task. An ease of learning score was calculated by awarding 1 point for each item correctly recalled the first time, 2 points for items requiring a second presentation trial, 3 points for three trials, and so forth. The score obtained was the sum of the learning trials required until perfect recall was achieved.

[1] Two less skilled comprehenders were absent from this test session.

[2] We included the easier two-level trials in the second study, because we were not sure at the outset whether the less skilled comprehenders with weak vocabulary skills would have significantly greater working memory impairments than the other two groups.

This score reflects ease of learning the word definitions: 8 denotes perfect learning and recall, and higher scores indicate that the definitions of some words had to be repeated. Means (with standard deviations) for the skilled, less skilled, and weak vocabulary group were 16.5 (4.9), 17.3 (3.8), and 22.6 (8.7), respectively. A delayed memory score was calculated from responses after the filler task, using the 0–2 point scale described in Study 1 for the context task. This score reflects ability to retain the taught word definitions. In order, the means (with standard deviations) for the skilled, less skilled, and weak vocabulary group were 9.2 (3.9), 7.8 (3.7), and 7.0 (2.8), respectively.

These two scores were treated as the dependent variables in two separate one-way ANOVAs, with skill group (skilled, less skilled, weak vocabulary) as a between-subjects factor. In the ease of learning analysis, there was a significant effect of skill group, $F(2, 33) = 3.44$, $p < .05$, $\eta^2 = .208$. The weak vocabulary group required significantly more repetitions than both the skilled comprehenders, $t(22) = 2.42$, $p < .05$, $d = 0.86$, and the less skilled group, $t(22) = 2.09$, $p < .05$, $d = 0.79$, both large effects. The skilled and less skilled groups did not differ on this measure, $t(22) < 1$. In the analysis of the delayed recall scores, the effect of skill group was not significant, $F(2, 33) = 1.19$, $p = .10$.

Vocabulary inference from context task: Memory for literal and factual content. The responses to the questions tapping memory for literal and factual content were scored as either correct or incorrect, and the total was calculated (maximum = 16). These scores were entered into a one-way ANOVA, with skill group as a between-subjects factor. The skilled, less skilled, and weak vocabulary groups obtained comparable means (and standard deviations) of 14.1 (1.3), 13.5 (2.0), and 13.3 (1.5), respectively. The effect of skill group was not significant, $F(2, 33) = 1.04$, $p = .20$.

Vocabulary inference from context task: Vocabulary learning scores. Each definition of a novel vocabulary item was awarded a score of 0–2 points following the same scoring criteria described above. The difference between the scores obtained before and after the useful context was calculated. In the near condition, the means (and standard deviations) for skilled, less skilled, and weak vocabulary groups were 4.17 (1.95), 3.92 (1.93), and 2.75 (1.45), respectively. In the far condition, the means (and standard deviations) for skilled, less skilled, and weak vocabulary groups were 4.08 (1.37), 2.21 (1.72), and 1.04 (1.57), respectively. These scores were entered into a two-way ANOVA, with skill group (skilled, less skilled, weak vocabulary) and proximity (near, far) as factors. There was a highly significant effect of skill group, $F(2, 33) = 7.97$, $p < .01$, $\eta^2 = .22$, and a highly significant effect of proximity, $F(1, 33) = 15.57$, $p < .01$, $\eta^2 = .09$, qualified by a significant interaction, $F(2, 33) = 3.37$, $p < .05$, $\eta^2 = .04$. Planned comparisons revealed that the skilled comprehenders performed comparably in both conditions, $t(11) < 1$, whereas both the less skilled and the weak vocabulary group obtained lower scores in the far relative to the near condition, $t(11) = 3.26$, $p < .01$, and $t(11) = 3.42$, $p < .01$, respectively.

Short-term memory. The forward digit span mean scores (and standard deviations) for the skilled, less skilled, and weak vocabulary groups were 13.92 (2.50), 14.91 (3.08), and 14.75 (1.91), respectively. These data were treated as the dependent variable in a one-way ANOVA, with skill group as a between-subjects factor.[3] The effect of skill group did not reach significance, $F(2, 32) < 1$, and this variable is not included in any further analyses.

Working memory. The mean scores (and standard deviations) obtained on the listening span task were 29.58 (10.55), 14.75 (7.86), and 16.08 (8.12) for the skilled, less skilled, and weak vocabulary groups, respectively. These data were entered into a one-way ANOVA, with skill group as a between-subjects factor. There was a highly significant effect of skill group, $F(2, 33) = 6.32$, $p < .01$, $\eta^2 = .12$. Planned comparisons revealed that the skilled group obtained significantly higher scores than the less skilled comprehenders, $t(23) = 3.25$, $p < .01$, $d = 1.27$, and the weak vocabulary group, $t(23) = 2.88$, $p < .01$, $d = 1.11$. The difference between the two poor comprehender groups was not significant, $t(23) < 1$.

In the counting span task, the skilled, less skilled, and weak vocabulary groups obtained mean scores (and standard deviations) of 42.75 (8.75), 36.92 (7.96), and 38.58 (7.87), respectively. A one-way ANOVA did not reveal a significant effect of skill group, $F(2, 33) = 2.56$, $p = .09$.

Relations Between the Different Assessments

We conducted three sets of fixed-order hierarchical multiple regression analyses to address two crucial questions: (a) Do either comprehension or vocabulary skills explain unique variance in the vocabulary inference task over and above the contribution made by ease of vocabulary learning (assessed by the direct instruction task), factual memory for the text, or working memory? (b) Do comprehension and vocabulary predict independent variance in performance on the vocabulary inference task?

To explore the contribution made by ease of learning, and the further contributions made by comprehension and vocabulary ability, to performance on the near condition of the vocabulary inference task, we conducted a pair of analyses as follows. In the first analysis of the pair, ease of learning scores were entered in the first step, vocabulary scores in the second, and comprehension in the third. In the second analysis of the pair, the order of Steps 2 and 3 was reversed. A parallel set of analyses was conducted, with performance in the far condition as the dependent variable. A second comparable set of analyses was conducted, with memory for the text controlled for in the first step and a third set with working memory performance entered in the first step. We report results for each of the learning and memory variables in turn. For brevity, we only report significant results.

Ease of learning. Neither ease of learning nor reading comprehension ability was a significant predictor of performance in the near condition. The only variable that predicted significant variance in the near condition was vocabulary in the following analysis: Step 1, ease of learning, $R^2 = .004$, *ns*; Step 2, vocabulary, $\Delta R^2 = .119$, $p < .05$; Step 3, comprehension, $\Delta R^2 = .022$, *ns*. Although vocabulary predicted a substantial proportion of variance in this analysis, it did not explain significant variance in the paired analysis, when entered in the third step after comprehension.

A different pattern of data was found for the analyses in which performance in the far condition was the dependent variable. Again, ease of learning did not account for significant variance at the first step ($R^2 = .004$, *ns*). When entered at the second step, vocabulary predicted unique variance ($\Delta R^2 = .156$, $p < .02$) and comprehension predicted additional variance when entered at the

[3] One less skilled comprehender was absent from this test session.

third step (ΔR^2 = .140, p < .02). With the order of Steps 2 and 3 reversed, only comprehension predicted unique variance: Step 2 comprehension, ΔR^2 = .276, p < . 01; Step 3 vocabulary, ΔR^2 = .020, *ns*. The increment in R^2 indicates that comprehension skill predicted a substantial proportion of variance in performance in the far condition.

Memory for the text. Neither memory for the text, vocabulary knowledge, nor reading comprehension ability explained significant variance in performance in the near condition of the vocabulary inference task. The comprehension and vocabulary variables did explain independent variance, with comprehension being the stronger predictor. For Analysis 1: Step 1, memory for the text, R^2 = .016, *ns*; Step 2, vocabulary, ΔR^2 = .205, p < .01; Step 3, comprehension, ΔR^2 = .141, p < .02. When the order of Steps 2 and 3 was reversed, comprehension explained a sizeable proportion of the variance when entered at Step 2 (ΔR^2 = .322, p < .01), but vocabulary did not explain further variance when entered at Step 3 (ΔR^2 = .023, *ns*). As before, the increment in R^2 indicates that comprehension skill predicted substantial variance in performance in the far condition.

Working memory. Comparable with the previous analysis, neither working memory, vocabulary knowledge, nor reading comprehension ability explained significant variance in performance in the near condition of the vocabulary inference task. In the prediction of scores obtained in the far condition, comprehension was found to explain a greater proportion of variance than did vocabulary ability. In addition, working memory explained significant variance. For Analysis 1: Step 1, working memory, R^2 = .191, p < .05; Step 2, vocabulary, ΔR^2 = .112, p < .05; Step 3, comprehension, ΔR^2 = .075, p = .062. When the order of Steps 2 and 3 was reversed, comprehension explained unique variance when entered after working memory at Step 2 (ΔR^2 = .164, p < .01). Vocabulary did not explain further variance when entered at Step 3 (ΔR^2 = .022, *ns*).

Working memory capacity explained variance in the ability to infer the meanings of vocabulary items in the far condition, and it was also related to comprehension level. These analyses also demonstrate a less substantial increment in R^2 attributable to comprehension skill, when entered after working memory scores. To determine whether working memory made a unique contribution to performance on this task over and above the variance attributed to comprehension and vocabulary, we conducted a final analysis. Comprehension and vocabulary were both entered at the first step and explained a sizeable proportion of the variance (R^2 = .361, p < .01). Working memory did not explain any significant variance when entered at the second step after these variables (ΔR^2 = .017, *ns*), indicating that the effect of working memory capacity was mediated by the variance it shared with reading comprehension skill.

Summary and Discussion

In the direct instruction task, children with both weak vocabulary and comprehension skills required more repetitions to learn the definitions of new words than both skilled comprehenders and less skilled comprehenders with good vocabulary skills. The size of these effects was substantial. However, the three groups' ability to retain this knowledge was comparable, at least over a short delay. It should be noted that children were only likely to remember the partial definition, indicating that the meanings for the new vocabulary items were not fully represented in long-term memory. There was no evidence from the multiple regression analyses that performance on the direct learning task was related to the ability to infer word meanings from context.

In the vocabulary inference task, there was a sizeable effect of comprehension skill. Furthermore, both groups of less skilled comprehenders were adversely affected by the distance manipulation: They were less able to infer the correct definition of a novel word from its useful context in the far condition. As in Study 1, the skilled comprehenders' performance was not affected by the distance manipulation. However, the two groups of less skilled comprehenders were as able as the skilled comprehenders to answer the memory questions after each story, and there was no evidence from the multiple regression analyses that memory for the text affected performance on the vocabulary inference task.

Both groups of less skilled comprehenders had comparable working memory skills and performed more poorly on the verbal working memory assessment than did the skilled comprehenders. A relation between vocabulary knowledge and verbal working memory was not found. The multiple regression analyses indicate that the impaired memory capacity of the less skilled comprehenders was a major determinant of their poor performance in the far condition of the vocabulary inference task.

Both groups of less skilled comprehenders were impaired on the vocabulary inference task, but only the weak vocabulary group was impaired on the direct instruction task. These two tasks appear to be tapping different skills. From the multiple regression analyses, we can conclude that performance on the direct instruction and the vocabulary inference tasks was relatively independent: The ease of learning measure did not explain significant variance in the vocabulary inference task. Individual differences in vocabulary knowledge and comprehension skill were more important predictors. Comprehension ability was consistently related to performance in the far condition, partly because of the variance it shared with working memory capacity. Initial vocabulary knowledge was a less important predictor of performance and did not predict unique variance in performance when entered after reading comprehension level.

General Discussion

Our understanding of the relations between reading comprehension skill, vocabulary knowledge, and vocabulary acquisition is extended in several ways by these results. Children with weak reading comprehension skills were consistently poorer at inferring the meanings of novel vocabulary items from context, relative to their same-age skilled peers. A major source of difficulty was the processing demands of the task. Poor comprehenders with weak vocabulary skills relative to their peers experienced additional sources of difficulty in learning new vocabulary items, namely, in the acquisition of word meanings through direct instruction and vocabulary inference in general. These findings and their implications are discussed, in turn.

Children with text comprehension problems are poor at generating a range of inferences (Cain & Oakhill, 1999; Cain et al., 2001; Oakhill, 1982, 1984). They are particularly impaired at making inferences that are necessary to construct a well-integrated and coherent representation of the meaning of a text. We have shown that less skilled comprehenders are also poor at using inferential processing to work out the meanings of single new words when explicitly directed to do so, particularly when the processing demands of the task are high.

There was no evidence that less skilled comprehenders with good vocabulary skills experienced more widespread difficulties with vocabulary acquisition: Their scores on the direct instruction task were comparable with those of the skilled comprehenders. However, the poor comprehenders with weak vocabulary skills were impaired on the direct instruction task, requiring a greater number of repetitions to learn new word meanings. Their subsequent retention of this information was comparable with that of the other groups. There was no evidence for phonological short-term memory deficits in either group of less skilled comprehenders. The weak vocabulary group's difficulties in learning new words might lie in the setting up of new lexical entries, a proposal that warrants further investigation.

One possible source of impaired performance on the vocabulary inference task is memory limitations. Both groups of less skilled comprehenders performed poorly on the working memory assessments relative to the skilled group. Furthermore, the comprehension scores explained unique and sizeable variance in the far condition of the vocabulary inference task, which appeared to be related to its high processing demands and the variance shared between reading comprehension ability and working memory. Working memory capacity might influence vocabulary acquisition from context because it is a crucial factor in an individual's ability to integrate different information across a text (Daneman, 1988). It appears to be an important determinant of performance for the less skilled comprehenders with good vocabulary skills.

There may be different underlying reasons for the weak vocabulary group's difficulties on the inference task. This group derived the least number of definitions on the vocabulary inference task in both conditions (although they were not significantly poorer on this task than were the less skilled comprehenders). Initial vocabulary knowledge explained performance on this task over and above ease of learning, measured by the direct instruction task. Thus, the weak vocabulary group's difficulties on the vocabulary inference task appear to be independent of their difficulties on the direct instruction task. They may have lacked strategic knowledge about how to derive words from context. McKeown (1985) found strategy knowledge differences between 5th graders with good and poor vocabulary skills: Those with high vocabulary knowledge had a more sophisticated understanding of the relation between context and new words than did the children with low vocabulary skills and were more likely to use more than one piece of information to constrain the meanings of new words.

McKeown's (1985) study and our own used paradigms to assess deliberate learning from context, in which the reader is explicitly requested to derive the meaning of the target item. These tasks contrast with an incidental learning paradigm, in which participants are not aware of the purpose of the task and learning is measured later. Deliberate learning paradigms do not reflect natural reading, where word learning is incidental to the purpose of reading. However, their great strength is their ability to measure an individual's potential. As Swanborn and de Glopper (1999) stated, "Knowing how to derive word meanings from context is a necessary condition for incidental word learning" (p. 279). We have identified a group of poor readers who lack proficiency in this basic skill. Programs of instruction in learning word meanings from context meet with relative success (Fukkink & de Glopper, 1998) and can benefit even poor readers (Stahl & Fairbanks, 1986). Work is now needed to establish whether the performance of the two different groups of less skilled comprehenders can be improved through training in the knowledge and use of skills required to infer words from context.

We compared the performance of two groups of poor comprehenders, with good and poor vocabulary skills. Many researchers of reading comprehension difficulties regularly match their skilled and less skilled groups on measures of vocabulary knowledge as well as word reading (e.g., Cain et al., 2001; Ehrlich & Remond, 1997; Stothard & Hulme, 1992). However, these children may experience difficulties in learning new word meanings under certain conditions. Teachers and caregivers can and do facilitate word learning for younger children by highlighting unknown vocabulary in shared reading experiences (Elley, 1989; Sénéchal, Cornell, & Broda, 1995). As children get older and become independent readers, such opportunities diminish and the ability to infer from context may become an increasingly important means of vocabulary learning. We propose that poor comprehenders with good vocabulary skills may have acquired the same apparent vocabulary skills as their skilled peers through direct instruction and possibly inference from context in considerate texts, where new words and contextual clues to the meaning of those words are in close proximity. As children become more independent readers and move from reading books with controlled vocabularies, the opportunities for word learning from context will increase. The less skilled comprehenders' vocabularies might not increase at the same rate as those of the skilled comprehenders, who have greater opportunities for learning from context because of their more efficient processing capacities and because they may have more reading experience. The other group of poor comprehenders, those who already have weak vocabulary skills, face additional difficulties in acquiring vocabulary. These children appear to lack the strategic knowledge needed to infer the meanings of new words and also appear to require more encounters with new words to consolidate lexical entries. We found support for both of the hypotheses outlined in the *Summary and Discussion* section of Study 1: Some less skilled comprehenders' primary deficit lies in inferring the meanings of new words (particularly in inconsiderate contexts), whereas other less skilled comprehenders experience an additional difficulty, that of setting up a representation between a new label and its meaning.

In the introduction, we outlined different accounts of the relation between vocabulary knowledge and reading comprehension. We have examined how they may be related because they both develop through shared skills and processes, namely, inference making and working memory. A direct (and causal) link between vocabulary and reading comprehension is implied by models of reading that emphasize the importance of fluency and automaticity of access to word meanings on text comprehension (see Daneman,1988, and Perfetti, 1994, for reviews). We did not explore the latter hypothesis in the current work, and the available evidence for such a relation is equivocal. Some studies find semantic deficits in populations of poor comprehenders (Nation & Snowling, 1999), whereas others do not (Yuill & Oakhill, 1991). In Study 2, the skilled and less skilled comprehenders did not differ on the measure of semantic fluency (Word Association subtest from CELF–R) that has discriminated groups in other work (Nation & Snowling, 1998).

A complex relation between vocabulary and comprehension level is apparent. It is important that researchers differentiate vocabulary knowledge from ease of access to that knowledge when they investigate this relation. Some training programs result in gains in vocabulary knowledge, but not all of them lead to corresponding increases in comprehension skill (e.g., Mezynski, 1983). Different factors such as instruction method and reader variables affect the efficacy of vocabulary instruction (Stahl & Fairbanks, 1986); thus, the failure of some training studies might be because the period of instruction was not sufficiently extensive to improve fluency and access to the word meanings. There is evidence that both the number of words known by an individual and the ease with which word meanings can be accessed influence text comprehension. Further work is now needed to tease apart the contribution made by word knowledge and access to that knowledge in relation to comprehension skill.

There are several limitations to the current study. As discussed above, we did not assess incidental learning for the vocabulary items; rather children's attention was directed to the target word. Thus, performance on this task does not necessarily reflect a child's ability to learn new word meanings from text in everyday reading situations: It most probably overestimates their ability. Further research is needed to investigate whether skilled comprehenders also show an advantage in the incidental learning of new words. Second, as noted above, children were likely to infer the partial rather than the full meanings of the unknown words. This was probably a consequence of our design, which only provided children with a single exposure. Other work has demonstrated that children benefit from repeated exposures to new words in context (Jenkins et al., 1989). Future work should address whether good and poor comprehenders differ in the number of exposures they require to fully learn a new vocabulary item and/or whether good comprehenders' advantage in the current study was the result of a superior fast-mapping mechanism. Third, our paradigm did not enable the assessment of causal relations. Although we speculate that inference from context, a skill associated with good reading comprehension, is a plausible facilitator of vocabulary growth, longitudinal investigations are necessary to test this hypothesis.

In summary, children with reading comprehension deficits are poor at inferring the meanings of novel word items from context. Although there is some disagreement about the relative importance of learning from context as a means of vocabulary acquisition (e.g., Biemiller & Slonim, 2001), there is a wealth of research to support a strong relation between leisure reading and vocabulary knowledge (e.g., Cunningham & Stanovich, 1998). In light of that research and our current findings, we agree with the suggestions of researchers such as Nagy and Scott (2000) and Nippold (2002) that there is a role for instruction in the use of contextual cues in the curriculum to aid the increase and consolidation of vocabulary knowledge. A deficit in learning from context may impede the vocabulary development of children with weak comprehension skills as they become independent readers. Clearly, there is a need to study the relation between learning from context, comprehension skill, and vocabulary acquisition over time.

References

Anderson, R. C., Wilson, P. T., & Fielding, L. G. (1988). Growth in reading and how children spend their time outside of school. *Reading Research Quarterly, 13,* 285–303.

Beck, I., & McKeown, M. (1991). Conditions of vocabulary acquisition. In R. Barr, M. L. Kamil, P. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 789–814). Mahwah, NJ: Erlbaum.

Biemiller, A., & Slonim, N. (2001). Estimating root word vocabulary growth in normative and advantaged populations: Evidence for a common sequence of vocabulary acquisition. *Journal of Educational Psychology, 93,* 498–520.

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure. *Reading and Writing, 11,* 489–503.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference-making ability, and their relation to knowledge. *Memory and Cognition, 29,* 850–859.

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96,* 31–42.

Cain, K., Oakhill, J. V., & Elbro, C. (2003). The ability to learn new word meanings from context by school-age children with and without language comprehension difficulties. *Journal of Child Language, 30,* 681–694.

Carnine, D., Kameenui, E. J., & Coyle, G. (1984). Utilization of contextual information in determining the meaning of unfamiliar words. *Reading Research Quarterly, 19,* 188–204.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. New York: Cambridge University Press.

Case, R., Kurland, D. M., & Goldberg, J. (1982). Operational efficiency and the growth of short-term memory span. *Journal of Experimental Child Psychology, 33,* 386–404.

Cunningham, A. E., & Stanovich, K. E. (1998). What reading does for the mind. *American Educator, 22*(1 & 2), 8–15.

Daneman, M. (1988). Word knowledge and reading skill. In M. Daneman, G., MacKinnon, & T. G. Waller (Eds.), *Reading research: Advances in theory and practice* (Vol. 6, pp. 145–175). San Diego, CA: Academic Press.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19,* 450–466.

Daneman, M., & Green, I. (1986). Individual differences in comprehending and producing words in context. *Journal of Memory and Language, 25,* 1–18.

Dunn, L. M., Dunn, L. M., Whetton, C., & Burley, J. (1997). *British Picture Vocabulary Scale—Second Edition*. Windsor, England: NFER-Nelson.

Echols, L. D., West, R. F., Stanovich, K. E., & Zehr, K. S. (1996). Using children's literacy activities to predict growth in verbal cognitive skills: A longitudinal investigation. *Journal of Educational Psychology, 88,* 296–304.

Ehrlich, M. F., & Remond, M. (1997). Skilled and less skilled comprehenders: French children's processing of anaphoric devices in written texts. *British Journal of Developmental Psychology, 15,* 291–309.

Elley, W. B. (1989). Vocabulary acquisition from listening to stories. *Reading Research Quarterly, 14,* 174–187.

Ewers, C. A., & Brownson, S. M. (1999). Kindergarteners' vocabulary acquisition as a function of active vs. passive storybook reading, prior vocabulary, and working memory. *Reading Psychology, 20,* 11–20.

Freebody, P., & Anderson, R. C. (1983). Effects on text comprehension of differing proportions and locations of difficult vocabulary. *Journal of Reading Behavior, 15,* 19–39.

Fukkink, R. G., & de Glopper, K. (1998). Effects of instruction in deriving word meanings from context: A meta-analysis. *Review of Educational Research, 68,* 450–469.

Gathercole, S. E. (1998). The development of memory. *Journal of Child Psychology and Psychiatry, 39,* 3–27.

Gathercole, S. E., Hitch, G. J., Service, E., & Martin, A. J. (1997). Phonological short-term memory and new word learning in children. *Developmental Psychology, 33,* 966–979.

Jenkins, J. R., Matlock, B., & Slocum, T. A. (1989). Two approaches to vocabulary instruction: The teaching of individual word meanings and practice in deriving word meaning from context. *Reading Research Quarterly, 24,* 215–235.

Jensen, A. (1980). *Bias in mental testing.* New York: Free Press.

MacGinitie, W. H., & MacGinitie, R. K. (1989). *Gates–MacGinitie Reading Tests.* Chicago: Riverside.

McKeown, M. G. (1985). The acquisition of word meaning from context by children of high and low ability. *Reading Research Quarterly, 20,* 482–496.

Mezynski, K. (1983). Issues concerning the acquisition of knowledge: Effects of vocabulary training on reading comprehension. *Review of Educational Research, 53,* 253–279.

Nagy, W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (Vol. 3, pp. 269–284). Mahwah, NJ: Erlbaum.

Nation, K., Adams, J. W., Bowyer-Crane, C. A., & Snowling, M. J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology, 73,* 139–158.

Nation, K., & Snowling, M. J. (1998). Semantic processing and the development of word-recognition skills: Evidence from children with reading comprehension difficulties. *Journal of Memory and Language, 39,* 85–101.

Nation, K., & Snowling, M. J. (1999). Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. *Cognition, 70,* 81–83.

Neale, M. D. (1989). *The Neale Analysis of Reading Ability—Revised British Edition*. Windsor, England: NFER-Nelson.

Neale, M. D. (1997). *The Neale Analysis of Reading Ability—Revised (NARA–II)*. Windsor, England: NFER-Nelson.

Nicholson, T., & Whyte, B. (1992). Matthew effects in learning new words while listening to stories. *National Reading Conference Yearbook, 41,* 499–503.

Nippold, M. A. (2002). Lexical learning in school-age children, adolescents, and adults: A process where language and literacy converge. *Journal of Child Language, 29,* 474–478.

Oakhill, J. V. (1982). Constructive processes in skilled and less-skilled comprehenders' memory for sentences. *British Journal of Psychology, 73,* 13–20.

Oakhill, J. V. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology, 54,* 31–39.

Oakhill, J. V., Hartt, J., & Samols, D. (2003). *Comprehension monitoring and working memory in good and poor comprehenders*. Manuscript submitted for publication.

Oakhill, J. V., Yuill, N. M., & Parkin, A. (1986). On the nature of the difference between skilled and less-skilled comprehenders. *Journal of Research in Reading, 9,* 80–91.

Pany, D., Jenkins, J. R., & Schreck, J. (1982). Vocabulary instruction: Effects of word knowledge and reading comprehension. *Learning Disability Quarterly, 5,* 202–215.

Perfetti, C. A. (1994). Psycholinguistics and reading ability. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 849–894). San Diego, CA: Academic Press.

Pickering, S. J., & Gathercole, S. E. (2001). *The Working Memory Test Battery for Children*. London: Psychological Corporation.

Semel, E., Wiig, E. H., & Secord, W. (1987). *Clinical Evaluation of Language Fundamentals—Revised.* San Diego, CA: Psychological Corporation.

Sénéchal, M., Cornell, E. H., & Broda, L. S. (1995). Age-related differences in the organization of parent–infant interactions during picture-book reading. *Early Childhood Research Quarterly, 10,* 317–337.

Sénéchal, M., Thomas, E., & Monker, J.-A. (1995). Individual differences in 4-year-old children's acquisition of vocabulary during storybook reading. *Journal of Educational Psychology, 87,* 218–229.

Shefelbine, J. L. (1990). Student factors related to variability in learning word meanings from context. *Journal of Reading Behavior, 22,* 71–97.

Siegel, L. S., & Ryan, E. B. (1989). Development of working memory in normally achieving and subtypes of learning disabled children. *Child Development, 60,* 973–980.

Snowling, M. J., Stothard, S. E., & McLean, J. (1996). *Graded Nonword Reading Test.* Bury St. Edmunds, England: Thames Valley Test Company.

Spilich, G. J., Vesonder, G. T., Chiesi, H. L., & Voss, J. F. (1979). Text processing of domain-related information for individuals with high and low domain knowledge. *Journal of Verbal Learning and Verbal Behavior, 18,* 275–290.

Stahl, S. A., & Fairbanks, M. M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research, 56,* 72–110.

Sternberg, R. J., & Powell, J. S. (1983). Comprehending verbal comprehension. *American Psychologist, 38,* 878–893.

Stothard, S. E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing, 4,* 245–256.

Swanborn, M. S. L., & de Glopper, K. (1999). Incidental word learning while reading: A meta-analysis. *Review of Educational Research, 69,* 261–285.

Swanborn, M. S. L., & de Glopper, K. (2002). Impact of reading purpose on incidental word learning from context. *Language Learning, 52,* 95–117.

Wittrock, M. C., Marks, C., & Doctorow, M. (1975). Reading as a generative process. *Journal of Educational Psychology, 67,* 484–489.

Yuill, N., & Oakhill, J. (1991). *Children's problems in text comprehension: An experimental investigation*. Cambridge, England: Cambridge University Press.

Yuill, N. M., Oakhill, J. V., & Parkin, A. J. (1989). Working memory, comprehension skill and the resolution of text anomaly. *British Journal of Psychology, 80,* 351–361.

Received March 19, 2003
Revision received May 4, 2004
Accepted May 14, 2004 ■