

## Reading comprehension and vocabulary: what's the connection?

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Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe:  
All mimsy were the borogoves,  
And the mome raths outgrabe.  
“Beware the Jabberwock, my son!  
The jaws that bite, the claws that catch!  
Beware the Jubjub bird, and shun  
The frumious Bandersnatch!

Extract from *Jabberwocky* (*Through the Looking-Glass, and What Alice Found There* by Lewis Carroll, 1872)

It has been known for a long time that vocabulary knowledge and reading comprehension are strongly correlated (e.g., Davis, 1944, 1968; Thorndike, 1973). Reading *Jabberwocky* tells us quite a lot about this relationship, as does Alice's response to reading the poem: “*It seems very pretty,*” she said when she had finished it, “*but it's rather hard to understand!*” (You see she didn't like to confess even to herself, that she couldn't make it out at all.) “*Somehow it seems to fill my head with ideas – only I don't exactly know what they are! However, somebody killed something: that's clear, at any rate ...*”.

A moment of introspection about *Jabberwocky* indicates that the relationship between reading comprehension and vocabulary is likely to be rich, interactive and complex. On the one hand, it is clear that vocabulary is needed for comprehension. Without doubt, our lack of knowledge concerning the meaning of individual words impedes our understanding. At the same time, however, it is equally clear that we can construct some meaning from the text, despite the fact that many of the words are nonsense. In turn, this constructed meaning provides an emerging context that helps us construe possible meanings to some of the individual words.

These introspections are consistent with a very large number of studies that have observed a close relationship between reading comprehension and vocabulary knowledge. Across the age span, individuals with better vocabulary knowledge tend to show advanced reading comprehension relative to peers with less well-developed vocabulary knowledge. Reviewing this evidence, Tannenbaum, Torgesen and Wagner (2006) reported that the correlation between reading comprehension and vocabulary varied between approximately .3 to .8. The correlation strengthens as children get older (Torgesen et al., 1997) and factors such as test format and the dimension of word knowledge being assessed also impact on the magnitude of the correlation. Limitations in vocabulary knowledge have been suggested to be a putative cause of reading comprehension failure (e.g., Cromley & Azevedo, 2007) and many interventions for poor reading comprehension involve strategies designed to increase vocabulary knowledge (e.g., Beck, 1982). This aim of this chapter is to explore the links between vocabulary knowledge and reading comprehension, with particular reference to children identified as having specific deficits in reading comprehension. Before discussing this group of children in some detail, it is useful to review two general (and inter-related) issues. First, why might reading comprehension and vocabulary be associated and second, which aspects of the reading comprehension process might be most closely related to vocabulary knowledge?

#### ***Why are reading comprehension and vocabulary knowledge associated?***

It is very clear that reading comprehension and vocabulary knowledge are closely associated. What is less clear is how this association is best interpreted. One interpretation sees individual differences in reading ability being responsible for individual differences in vocabulary knowledge. According to this view, children learn the meaning of new words via reading, amongst other strategies. Consequently, better readers will develop larger vocabularies over time, whereas poor readers, who read less, lack print exposure and this serves to hamper vocabulary development (e.g., Cunningham & Stanovich, 1991, 1997; Nagy & Anderson, 1984; Nagy & Scott, 2000). An alternative view sees individual differences in vocabulary knowledge being responsible for individual differences in reading comprehension. On this view, if children have limited vocabulary knowledge, or if they are unable to access word

meanings rapidly and efficiently, this will be detrimental to their reading comprehension (e.g., Beck, Perfetti & McKeown, 1982; Daneman & Green, 1986). Longitudinal studies provide evidence to support both of these explanations with vocabulary knowledge predicting growth in reading comprehension and reading comprehension itself predicting growth in vocabulary knowledge (e.g., de Jong & vander Leij, 2002; Muter, Hulme, Snowling, & Stevenson, 2004; Seigneuric & Ehrlich, 2005).

An additional possibility is that vocabulary and reading are related because they share common processes. Vocabulary growth requires the development of mappings between the semantic meaning of a word and its phonological form (McGreggor, 2004) and in a similar vein, reading depends upon the development of mappings between semantic, phonological and orthographic units of representation (Plaut, Seidenberg, McClelland & Patterson, 1996; Perfetti, 2007). Within this view, specific underlying processes may be impaired in poor readers and it is these weaknesses that lead to *both* poor reading and to poor vocabulary. For example, Sternberg and Powell (1983) suggested that the relationship between reading comprehension, vocabulary and general intelligence may be mediated by the ability to acquire new information from context. Domain general cognitive skills such as working memory may also serve to mediate the relationship between vocabulary and reading comprehension.

#### *Component reading skills*

Reading comprehension is a complex skill (Kintsch & Rawson, 2005; Perfetti, Landi & Oakhill, 2005). Readers need to recognize or decipher individual words, access their meanings and interpret grammatical structure. Rarely is a text completely literal: readers need to draw on general knowledge and an appreciation of pragmatic factors in order to understand the intended message. Successful reading demands that readers construct a coherent and integrated mental representation of the text, rich in referential relations (e.g., Gernsbacher, 1990; Kintsch, 1998; van der Broek, 1994).

Given that vocabulary correlates with reading comprehension, an important question is whether there are particular aspects of the reading comprehension process that are more closely correlated with vocabulary. To illustrate, consider a child who has great difficulty reading words. They are slow, inaccurate and effortful. Not surprisingly, they also have difficulty understanding text. They also show low-for-age vocabulary knowledge. Here we observe an association between poor reading comprehension and poor vocabulary, but it is impossible to know whether this is a consequence of vocabulary being associated with the child's word reading problems or with their comprehension-level problems, or with both.

It is helpful to think about reading comprehension as comprising two sets of component parts, one concerned with recognising printed words, and one concerned with understanding the message that the print conveys (e.g., Hoover & Gough, 1990). From this perspective it is possible to ask whether vocabulary shares its association with reading comprehension via word-level reading, comprehension-level processes, or both. Ricketts, Nation and Bishop (2007) investigated this question by assessing vocabulary knowledge and component reading skills in a group of 8-9-year old children. They found that vocabulary was important for both aspects of reading. In terms of word-level reading, vocabulary knowledge was most associated with reading words rather than nonwords, particularly words with irregular or unusual print-sound correspondences. Vocabulary also showed a moderate-to-strong correlation with reading comprehension and regression analyses revealed that vocabulary knowledge accounted for a large portion of unique variance (17.8%) in reading comprehension, even after variance associated with chronological age, nonverbal IQ and word-level reading was controlled.

Further discussion of the association between vocabulary and word-level reading can be found elsewhere (e.g., Nation, in press a) but for present purposes, Ricketts et al.'s findings are important as they show that the association between vocabulary and reading comprehension is not just a consequence of factors associated with word-level reading. Instead, something more specific about the comprehension process appears to be related to children's vocabulary knowledge.

## **Children with poor reading comprehension**

### ***Who are poor comprehenders?***

Many children who have difficulties understanding written text will also have difficulty reading the words in the text (e.g., Perfetti, 1985). However, given that the correlation between word reading and reading comprehension is far from perfect (for example, Juel, Griffith & Gough (1986) report correlations of .74 and .69 for first- and second-grade children), it is not that rare to find children who perform adequately in one component but not the other. The focus of

the remainder of this chapter will be on children who appear to show selective impairments of reading comprehension. That is, their word reading accuracy is within the normal range for their age, but their comprehension of what is read is substantially below average. Studies of such children allow us to explore the relationship between comprehension processes and vocabulary in a relatively clean way, independent of the processes that might be related to individual differences in word reading ability.

Oakhill and colleagues (Oakhill, 1994; Yuill & Oakhill, 1991) were the first to describe children who obtained normal-for-age text reading accuracy, but showed impaired reading comprehension. At a simple level of description level, these children (who will be referred to in this chapter as *poor comprehenders*) read accurately but have specific difficulty understanding what they read. Typically, poor comprehenders are rare in clinically-referred samples of children with reading difficulties (e.g., Leach, Scarborough, & Rescorla, 2003; Shankweiler, Lundquist, Katz et al., 1999). However, this is probably a reflection of referral bias. Also, the nature of finding children with specific comprehension difficulties will be tightly constrained by the nature of the reading comprehension test used to select and define groups (e.g., Keenan, 2006). Repeatedly, we find that when populations of 7-10 year old children have been screened in the UK, approximately 10% can be classified as poor comprehenders (Nation & Snowling, 1997; Stothard & Hulme, 1992; Yuill & Oakhill, 1991). A similar profile of poor reading is also seen in adulthood (Perfetti, Wlotko, & Hart, 2005; Landi & Perfetti, 2007) and has been reported in children learning to read languages other than English (e.g., Cornoldi, de Beni, & Pazzaglia, 1996; De Beni, Palladino, Pazzaglia & Cornoldi, 1998; Mergherbi & Erlich, 2005).

There is a growing literature documenting poor comprehenders' abilities and disabilities; comprehensive reviews are provided by Cain and Oakhill (2007) and Nation (2005). Although many questions remain, a number of consistent findings have been reported. One consistent finding is that unlike children with poor word reading, poor comprehenders do not show impairments in phonological awareness or phonological processing (Cain, Oakhill & Bryant, 2000; Nation, Clarke, Marshall & Durand, 2004; Nation & Snowling, 1998). They do however show impairments in listening comprehension (Nation & Snowling, 1997; Yuill & Oakhill, 1991) and in oral language more generally (Nation et al., 2004). Poor comprehenders show a variety of text-level impairments such as problems with making inferences, using cohesive devices and monitoring comprehension (Bowyer-Crane & Snowling, 2005; Cain & Oakhill, 1999; Cain, Oakhill, Barnes & Bryant, 2001). Narrative comprehension and production are compromised (Cain, 1999; Cragg & Nation, 2006) and there is also evidence of impairments in working memory, particularly verbal working memory (Cain, 2006; Nation, Adams, Bowyer-Crane & Snowling, 1999; Yuill, Oakhill and Parkin, 1989).

#### *Poor comprehenders and vocabulary: correlate, cause or consequence?*

Given that reading comprehension is closely associated with vocabulary knowledge, one might expect poor comprehenders to show impairments in vocabulary. There is some evidence suggesting that they do. For example, Nation and Snowling (1998) investigated poor comprehenders' semantic skills – their knowledge of and sensitivity to word meanings. Poor comprehenders were slower and less accurate at judging whether pairs of words were synonymous, and they generated fewer exemplars than their peers in a category fluency task. Poor comprehenders are also slower and less accurate at providing the name for objects pictured on a computer screen, especially if the items are low in frequency (Nation, Marshall & Snowling, 2001). Mild-to-moderate deficits in expressive and receptive vocabulary as measured by standardised tests have also been observed (Catts, Adlof & Weismer, 2006; Nation et al., 2004; Ricketts et al., 2007).

These data appeal to the view that poor reading comprehension may a consequence of lack of vocabulary knowledge. However, there are a number of reasons why this conclusion is likely to be only partially correct. First, not all poor comprehenders show poor vocabulary on standardised tests (Cain, Lemmon & Oakhill, 2004), consistent with the more general observation that poor comprehenders are a heterogeneous group, and that there are likely to be multiple routes to comprehension failure (Cain & Oakhill, 2007; Nation, 2005). Second, it is clear that poor comprehenders' difficulties with text-level processes remain, even when care is taken to make sure that they are familiar with all of the relevant vocabulary and background knowledge (Cain et al., 2001). Third and most importantly, vocabulary weaknesses in poor comprehenders may be as much a consequence of the reading comprehension impairment as a cause. Without longitudinal data, it is impossible to assess issues of causality. However, given the highly reciprocal relationship between reading comprehension and vocabulary described earlier, it seems likely that reciprocal links will be seen when longitudinal data charting the early development of comprehension and vocabulary are examined in children with a poor comprehender reading profile.

A rather different approach to investigating the relationship between vocabulary and reading comprehension is provided by studies examining new vocabulary learning in poor comprehenders. These studies are interesting as they address learning – how vocabulary is acquired and how children may differ in this – rather than the product of learning – how many words a child “knows” according to a standardised instrument. Broadly, these studies can be separated into two types, those investigating whether meaning can be inferred from context and those investigating lexical learning. As these studies stem from different theoretical backgrounds, it is more straightforward to consider them in detail separately before considering synergies between them.

### ***Inferring meaning from context***

Context provides a powerful cue to discovering the meaning of new words. Indeed, given the number of words that children acquire, and the speed with which they learn them, something other than direct learning must be taking place. There is good evidence that young children draw on a variety of contextual cues to support vocabulary learning (Bloom, 2000; Tomasello, 2003). Once children begin to learn to read, text provides many opportunities for vocabulary development and it is known that reading provides a more effective context for learning new words than oral conversation (Nagy & Anderson, 1984). A single encounter with a new word in text can be enough to allow its meaning to be inferred and learned (Nagy, Herman & Anderson, 1985), although multiple encounters in different contexts are likely to be needed too, if readers are to develop a full appreciation of the range of nuances in meaning a word may have (Nagy & Scott, 2000).

Given that poor comprehenders have difficulty making inferences and constructing a well-integrated and coherent representation of the meaning of text, it is reasonable to expect that they may have difficulty inferring the meaning of new words from context. This prediction was assessed by Cain et al. (2004). Children read short stories containing a single exposure to novel word. The meaning of the novel word could be inferred from information contained immediately after the novel word (near condition), or following a few filler sentences (far condition). After reading the story, poor comprehenders were less able to explain the meaning of the novel word than control children, especially in the far condition. These findings suggest that poor comprehenders are less skilled at inferring the meaning of new words from context, especially when the processing demands of the task are high – that is, when information across sentences needs to be remembered and integrated, if word meaning is to be inferred.

Cain et al. (2004) also investigated poor comprehenders' ability to learn the meaning of new words via direct instruction. In this condition, children were read a definition that explained the meaning of the new word explicitly, for example, “a small bouncy ball is called a *wut*”. Those poor comprehenders who showed relative weaknesses in existing vocabulary knowledge (as assessed by the *British Picture Vocabulary Scales*, a UK version of the *Peabody Picture Vocabulary Test*) were poor at learning new words via direct instruction; those poor comprehenders with good-for-age vocabulary as assessed by the standardised test were able to learn the meaning of new words via direct instruction as well as control children.

In summary, Cain et al.'s study provides evidence that poor comprehenders are less able to infer the meaning of new words from text. This is an important finding – and a worrying one with respect to the longer-term outcome for poor comprehenders. It suggests that their vocabulary will decline with age, relative to controls, as they fail to acquire the meanings of new words from their encounters with text. While impairments in inferring the meaning of new words were pervasive across all children with poor reading comprehension (Cain et al., 2004), only some poor comprehenders showed difficulty learning new vocabulary via direct instruction. This finding suggests that some children with poor reading comprehension may have additional difficulty establishing new lexical representations – an issue to which we now turn.

### ***Lexical learning in poor comprehenders***

Perfetti et al. (2005) investigated individual differences in learning the meanings of new words in college students who differed in reading comprehension skill. Skilled and less-skilled comprehenders were provided with definitions for very rare and previously unfamiliar words such as *gloaming* and *flexion*. Learning was assessed via a meaning judgement task. Less-skilled comprehenders made significantly more errors suggesting that they learned the new words less well than skilled comprehenders. In addition, Perfetti et al. examined ERP responses to the newly acquired words. Skilled comprehenders showed a greater familiarity response (indexed as a P600 marker of episodic memory) to new words, and a different N400 response showing that they were more sensitive to the meaning of the newly acquired words than less-skilled comprehenders.

Nation, Snowling and Clarke (2007) also investigated individual differences in lexical learning. Building on an earlier study by Aguiar and Brady (1991), we examined phonological learning (mappings between a new phonological label and its referent) and semantic learning (mappings between meaning and form). Given the profile of language



strengths and weaknesses revealed by previous studies of poor comprehenders, we made specific predictions concerning poor comprehenders lexical learning. Given that poor comprehenders have normal phonological skills (e.g., Cain et al., 2000; Stothard & Hulme, 1995), we predicted that they poor comprehenders would show normal phonological learning. They did. They took a similar number of trials to learn to associate a new label such a *corbelyeon* with picture of a novel referent. In contrast to normal phonological learning, we predicted that poor comprehenders would show impaired semantic learning, following our earlier observations of semantic weaknesses (in synonym judgement for example, Nation & Snowling, 1998). Consistent with this prediction, poor comprehenders learned less about the meaning of the new referents, and they were less able to recall the correct name for an object, given its definition. The poor comprehenders also appeared to have difficulty consolidating the meanings of newly acquired items and their recall of these was less good than that of skilled comprehenders one week after training.

Ricketts, Bishop and Nation (2008) extended these findings by examining poor comprehenders' learning of new orthographic forms (i.e., written words). They contrasted orthographic learning and semantic learning across the same items by the same children. Orthographic learning was defined as the ease of learning the new spelling-sound relations associated with each of the new words. Here, poor comprehenders learned the new orthographic forms as readily as control children. Semantic learning was defined as the ability to associate meaning with the new orthographic forms. Poor comprehenders were less able to correctly pair the newly acquired words with their correct referents one week after training, demonstrating weaknesses in this aspect of word learning.

Taken together, these three studies (Perfetti et al., 2005; Nation et al., 2007; Ricketts et al., 2007) show that children and adults with poor reading comprehension are less adept at learning new words. More specifically, the aspect of learning that appears to be most fragile concerns meaning. In all three studies, less-skilled comprehenders made some links between new words and their semantic properties. Importantly however, there was evidence of some difficulties with developing rich and durable semantic representations. Such differences in lexical learning might be responsible for the vocabulary deficits that characterize some poor comprehenders, including those poor comprehenders with lower levels of existing vocabulary knowledge who failed to benefit from direct instruction strategies in Cain et al.'s (2004) study.

What do these studies of vocabulary learning in people with reading comprehension impairments tell us? Most generally, they again highlight the complex and highly reciprocal relationship between reading comprehension and vocabulary. To some extent, they also show the limitations of trying to address issues of causality or developmental primacy in terms of what came first, comprehension deficit or vocabulary deficit. Clearly, reading comprehension will fail if a child does not understand the meaning of enough of the words in a text, just as our own comprehension of the Jabberwocky poem is compromised. One could argue that as many poor comprehenders have low vocabulary knowledge, this is sufficient to explain their reading comprehension deficit. However, the question then arises as to why poor comprehenders have weak vocabulary knowledge. Cain et al.'s study lends support to the idea that an individual's ability to learn new words or acquire new information from context mediates the high correlations observed between verbal ability, reading comprehension and vocabulary knowledge (e.g., Sternberg & Powell, 1983). In turn, this demonstrates how 'higher-level' processes such as the ability to make inferences and integrate information within a text can influence the acquisition of basic 'lower-level' knowledge such the meaning of a new word. Notwithstanding this, it also seems clear that children with strong vocabulary knowledge will be well-placed to engage in higher-level processes as they read (Perfetti, 2007). Thus, it is perhaps not surprising to find that children who are poor at making inferences tend to have weaker vocabulary skills relative to children who are skilled at making inferences, and vice versa.

### ***Flexibility, efficiency, and online processing***

So far, this chapter has considered vocabulary as a variable that indexes the number of words a child knows. Very clearly however, this is far too simplistic. To support comprehension, vocabulary knowledge also needs to be flexible and efficient. Let us take each of these issues in turn.

Flexibility is important because children need to know more about a word than its pronunciation and its standard "dictionary definition" (Miller, 1999). They need to learn that words can have more than one meaning or can be associated with different senses. To capture fully the subtleties of word meaning, children need to be sensitive to both the range of information a word can denote, and to the context in which it occurs, so that the precise meaning of a particular word in a particular context can be comprehended and other irrelevant meanings be inhibited (e.g., Gernsbacher & Faust, 1991). We know that some poor comprehenders show lower levels of vocabulary knowledge than control children (e.g., Cain et al., 2004; Nation & Snowling, 1998; Ricketts et al., 2007); there is also evidence

that they have some difficulty with flexibility too. *Multiple Meanings* is a subtest of *The Test of Word Knowledge* (TOWK; Wiig & Secord, 1992) in which children are presented with a set of words with multiple meanings (e.g., bat) and are required to provide two distinct definitions for each word (e.g., the thing you hit a ball with and an animal that flies). Poor comprehenders perform less well on this test than controls, scoring in the below average-to-low average range according to standardised norms (Nation & Snowling, 1998; Ricketts et al., 2007). Similarly, poor comprehenders have difficulty with comprehending figurative language (Nation et al., 2004) and processing idioms (Cain, Oakhill, & Lemmon, 2005). A goal for future work is to understand why poor comprehenders find these tasks difficult.

Related to flexibility is efficiency. Even if a child knows the meaning of a word, if they are slow to access or process its meaning, this may well have consequences for on-going comprehension. Using a variety of behavioural and ERP measures, Landi and Perfetti (2007) found that college-aged less-skilled comprehenders showed differences in efficiency when making meaning decisions about pairs of words. Similarly, children selected as poor comprehenders show differences in patterns of semantic priming to their peers (Nation & Snowling, 1999). An important feature of both of these studies is that they used simple vocabulary, well within the range of participants (e.g., *dog, cat, brother, sister*). Despite this, reader group differences were seen in priming between pairs of words and the time taken to make meaning judgements (and in underlying ERP signatures). This suggests that possession of vocabulary knowledge for a word is not an all or nothing factor. Instead, as Perfetti (2007, p. 359) notes, what is important is “the ability to retrieve word identities that provide the meanings the reader needs in a given context”. This conclusion leads to a rather different perspective on the relationship between reading comprehension and vocabulary knowledge. Rather than think about whether vocabulary weaknesses can cause comprehension impairments, or whether lack of comprehension can lead to vocabulary deficits, a more profitable approach may be to try to understand more about how children process language as they read. To date, most research has assessed reading comprehension and vocabulary knowledge offline. Typically, children are asked to read stories and answer questions about them, or are asked to provide definitions of words, or to match words to pictures. While these methods reveal whether or not a child has a comprehension or vocabulary problem, they can not tell us *why*. Take as an example a child who finds it difficult to comprehend sentences containing ambiguous words. This could be a reflection of lack of knowledge, as perhaps the child only knows one meaning. Or, it could be a difficulty with using context to activate the appropriate meaning or alternatively, a difficulty with using context to inhibit or suppress contextually-irrelevant interpretations. Offline measures that ask children to answer questions or provide definitions can only ever measure the endpoint of comprehension, not the actual process itself.

In contrast to offline tasks, online tasks allow inferences to be made about the processing of language itself, not just its endpoint. Our understanding of the temporal dynamics of sentence processing in skilled adults has long been informed by online measures such as reading time (Rayner, 1998). To borrow an example from Altmann (1997), when participants read a sentence such as “Sam told the writer that he couldn’t understand to get some help from a decent editor”, eye movements during the reading of “to get” are disturbed, relative to when they read the same words in the almost identical sentence: “Sam asked the writer that he couldn’t understand to get some help from a decent editor”. This is because in the first sentence, the verb “told” sets up an expectation that the word “that” will introduce a message, rather than an embedded clause. Disruptions to eye movements are indicative of the processing difficulty participants experience as they read something that is not expected.

Very few studies have used eye movement methods to track reading processes in typically-developing children (see Joseph et al., in press, for a recent findings). At the time of writing, there have been no published reports of such studies with poor comprehenders. Yet, the utility of eye movement methodology to the study of children with poor reading comprehension is obvious. Potentially, they provide opportunities to understand more about the interactions between word knowledge and comprehension as children read. More generally, they can tell us about precisely when comprehension breaks down, and perhaps point to the reasons why (Nation, in press b; Rapp et al., 2007).

An example of the utility of online methods is provided by a study that used eye movement methodology to explore individual differences in comprehension processes when children listened to spoken language. Nation, Marshall and Altmann (2003) used the visual word paradigm to assess poor comprehenders’ sensitivity to verb argument structure. This paradigm (e.g., Tanenhaus, Spivey-Knowlton, Eberhard and Sedivy, 1995) involves recording participants’ eye movements as they view a visual scene (which might comprise an array of real objects or objects presented on a computer screen). At the same time, they are listening to spoken stimuli that describe aspects of the visual scene. As participants tend to look at objects that serve as potential referents for the linguistic expressions they hear, eye movements can reveal how long participants take to establish reference. Experimental manipulations (of the language, or of the scene) then allow the experimenter to compare processing in different conditions, moment by moment, as the language unfolds in real time, allowing competing hypotheses to be evaluated.

As noted earlier, to fully capture of the subtleties of word meaning children need to be sensitive to the range of information a word can denote so that the precise meaning of a particular word in a particular context can be comprehended. Our experiment used the visual world paradigm to investigate one aspect of this – sensitivity to verb argument structure. When listening to a sentence such as “Jane watched her mother eat the cake”, 10-year-old children fixated the picture of the cake (the only edible object in the array) well before the acoustic onset of the word *cake*. In more neutral sentences such as “Jane watched her mother choose the cake”, the probability of looking at the cake (relative to other objects in the visual array that were also choosable) only increased once the acoustic token of the word *cake* began to unfold. This demonstrates that skilled comprehenders are highly sensitive to information contained in verbs and that this information is used to guide subsequent processing. How about poor comprehenders? Interestingly, poor comprehenders also showed this effect suggesting that they too were very rapidly able to integrate information contained in the verb with contextual information provided by the visual scene. However, although less-skilled comprehenders showed equal sensitivity to the contextual constraints offered by verbs, they also made more eye movements overall. We suggested that this may reflect difficulties in memory (with more looks being needed to ‘refresh’ traces of either the language or of the objects in the scene), or possibly differences in allocation of attentional resources in children. This suggestion raises the possibility that less-skilled comprehenders construct their initial sentence representations adequately but that differences arise later in processing. For example, they may fail to integrate, elaborate and link new information into their developing representations of the text. Eye movement methodology offers excellent potential for exploring these possibilities further (see also Rapp et al., 2007).

## Summary

There are close and intimate links between reading comprehension and vocabulary. This is nicely illustrated when we consider children with poor reading comprehension, many of whom have concomitant weaknesses in vocabulary. It is possible that lack of vocabulary may be at least in part causally implicated in their reading comprehension deficit. Equally however, it is important to remember that lack of vocabulary knowledge may be a consequence of reading comprehension impairments. There are few longitudinal studies of poor comprehenders but it seems likely that when more longitudinal data are available, reciprocal links between reading comprehension and vocabulary will be evident. Experiments have revealed that many poor comprehenders find it difficult to infer the meaning of new words from context, and some show impairments in lexical learning. These findings hint at potential causes of vocabulary weaknesses – and potential starting points for effective intervention. They also highlight reciprocal interactions between ‘high level’ skills such as inference and ‘low level’ skills such as vocabulary. Very few studies have examined reading processes in children using online methods such as eye tracking. These methods offer great promise for revealing the underlying processes and strategies that guide children’s comprehension as they read text, and for revealing how these differ in children who fail to comprehend.

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