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## *Children's Reading Comprehension Difficulties*

### **Kate Nation**

Comprehension is the ultimate goal of reading. Everyone agrees that reading comprehension is not a simple matter of recognizing individual words, or even of understanding each individual word as our eyes pass over it. All models of comprehension recognize the need for readers to build up a mental representation of text, a process that requires integration across a range of sources of information, from lexical features through to knowledge concerning events in the world (e.g., Garnham, 2001; Gernsbacher, 1990; Kintsch, 1998). Given the complex nature of reading comprehension, it is not surprising that some individuals have difficulties in this area. Individual differences in text comprehension have been observed in both developmental (e.g., Nation & Snowling, 1997; Oakhill, 1994) and college-aged populations (e.g., Gernsbacher & Faust, 1991; Long, Seely, & Oppy, 1999). Difficulty with reading comprehension has also been reported in a range of clinical disorders such as early onset hydrocephalus (Dennis & Barnes, 1993), autism (Snowling & Frith, 1986), nonverbal learning disorder (Pelletier, Ahmad, & Rourke, 2001), specific language impairment (Bishop & Adams, 1990), Turner's syndrome (Temple & Carney, 1996) and Williams syndrome (Laing, Hulme, Grant, & Karmiloff-Smith, 2001). Thus, there is no shortage of evidence pointing to the fact that some individuals experience reading comprehension difficulties.

The nature and origins of reading comprehension difficulties, however, are not so clear. The aim of this chapter is to review what is known about reading comprehension difficulties in children, with a view to addressing two major issues. First, although individuals who experience difficulty with reading comprehension can be identified, does it make sense to talk about specific reading comprehension difficulties? Second, what are the causes of reading comprehension failure? The focus of the chapter will be on children who appear to show selective impairments of reading comprehension. That is, their 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 identify cognitive systems that may be particularly crucial for the development of reading

comprehension, and that are relatively independent of the processes underlying the development of word recognition skills in reading.

### **“Specific” Deficits in Reading Comprehension?**

Are there individuals who show specific reading comprehension deficits? The answer to this seemingly simple question is not straightforward. The starting place is to separate reading into two component parts, one concerned with recognizing printed words, and one concerned with understanding the message that the print conveys. Although the correlation between word recognition and reading comprehension is substantial (e.g., Juel, Griffith, & Gough (1986) report correlations of .74 and .69 for first- and second-grade children), it is not perfect and some individuals perform adequately on one component but poorly on the other. 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. Stothard and Hulme (1992, 1995) and Nation and Snowling (1997) investigated populations of children selected in broadly similar ways. 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. Indeed, when populations of 7–10-year-old children have been screened in the UK, approximately 10% could be classified as poor comprehenders (Nation & Snowling, 1997; Stothard & Hulme, 1992; Yuill & Oakhill, 1991).

How might the “poor comprehender” profile be conceptualized? According to Hoover and Gough’s (1990) “simple view” of reading, reading comprehension comprises two sets of skills, those concerned with decoding or recognizing printed words, and those involved in linguistic comprehension. The relationship between decoding and linguistic comprehension is considered to be multiplicative: there can be no reading comprehension without the ability to decipher or recognize words, and similarly, reading comprehension will fail if children lack the linguistic comprehension to understand what it is they have decoded. Put simply, both decoding and linguistic comprehension are necessary, and neither skill on its own is sufficient, if successful reading comprehension is to follow. The essence of the simple model is captured beautifully by Gough, Hoover, and Peterson’s (1996) account of the elderly John Milton, who due to failing sight was unable to reread the Greek and Latin classics. His solution was to teach his daughters how to decode Greek and Latin. Having accomplished the basics of Latin and Greek letter-sound correspondences, they were able to read the texts aloud while their father listened. The product was, for Milton at least, successful reading comprehension.

Thus, according to the simple view, reading comprehension is the *product* of decoding and linguistic comprehension. It follows from this that children with poor reading comprehension must have deficits either in decoding, linguistic comprehension, or both. The logic of this view argues that reading comprehension deficits cannot be specific, but

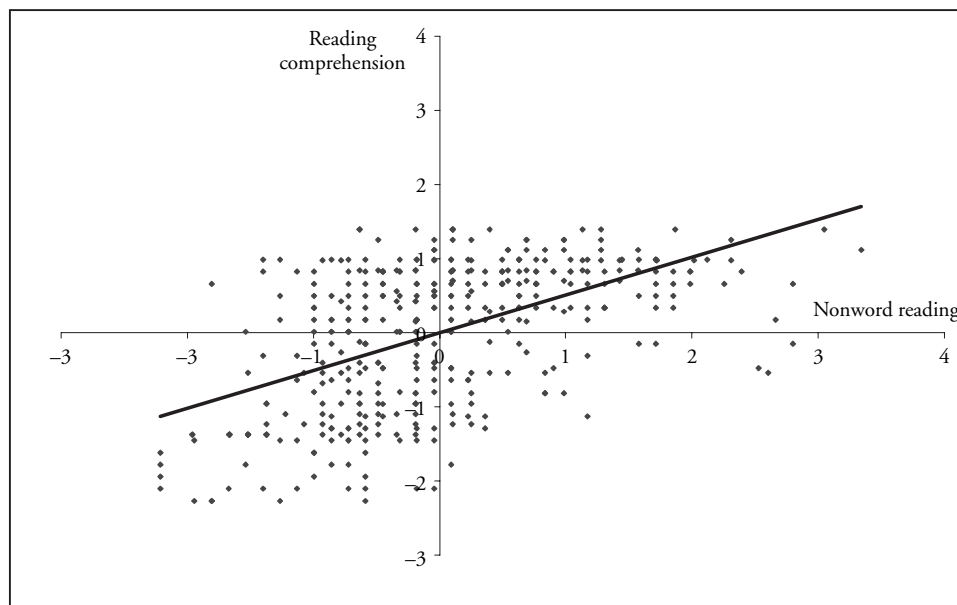
instead must be related to weaknesses in one or both of its component parts. For the children described above as having specific reading comprehension impairments, which component of reading comprehension is at fault?

*Decoding difficulties as a source of poor reading comprehension*

According to the simple model, decoding skill can place a constraint on reading comprehension. A specific form of this hypothesis was proposed by Perfetti (1985) who claimed that when decoding is slow and effortful, resources are dedicated to word-level processing. By contrast, when decoding is automatic, resources are available for the task of comprehension. In line with Perfetti's "verbal efficiency" hypothesis, evidence demonstrates that reading comprehension is compromised when decoding is poor. Word reading speed and reading comprehension correlate in child as well as adult populations (Hess & Radtke, 1981; Jackson & McClelland, 1979), and Perfetti and Hogaboam (1975) found that children with poor reading comprehension were slower at reading words and nonwords than their classmates. Moreover, the relationship between decoding efficiency and reading comprehension is maintained over time, and measurements of nonword reading taken in early childhood predict later variations in reading comprehension measured in secondary school years and adulthood (Bruck, 1990; Perfetti, 1985).

As pointed out by Oakhill and colleagues, however, inefficient decoding is unlikely to be the only source of reading comprehension impairment. As noted above, some children have poor reading comprehension but show age-appropriate levels of text reading accuracy, leading to the conclusion that inadequate decoding cannot be the source of poor comprehenders' difficulties. However, the demonstration of adequate text reading accuracy does not necessarily imply efficient word-level *processing* (Perfetti 1994; Perfetti, Marron, & Foltz, 1996). Even when reading accuracy is adequate, if it is slow or inefficient, comprehension may be compromised. Thus, Perfetti argued it is necessary to show that poor comprehenders decode not just as accurately as control children, but that they do so with equivalent efficiency, if their comprehension problems are to be considered at all exceptional.

Such evidence was forthcoming from a study by Nation and Snowling (1998a) who found that poor comprehenders read nonwords as quickly as control children. This experimental finding is confirmed by observations that poor comprehenders perform at age-appropriate levels on standardized tests of nonword reading accuracy such as the *Graded Nonword Reading Test* (Snowling, Stothard, & McLean, 1996) and nonword reading efficiency such as the *Test for Word Reading Efficiency* (Torgesen, Wagner, & Rashotte, 1999; e.g., Marshall & Nation, 2003; Nation, Marshall, & Altmann, 2003). Importantly, Nation and colleagues have used the strategy of matching poor comprehenders to control children on nonword reading, thereby eliminating the possibility that group differences in reading comprehension can be accounted for by differences in decoding skill. It should be noted, however, that there are differences between poor comprehenders and typically developing children in some aspects of word reading. We will return to this point later. However, if we take the central tenet of the theory to be that inaccurate or slow decoding leads to poor reading comprehension, then the children described by Oakhill and by



**Figure 14.1** Scatterplot showing the relationship between reading comprehension and nonword reading in 411 7–10-year-old children (z-scores).

Nation and their colleagues (Nation & Snowling, 1997; Oakhill, 1994) are exceptions to the general pattern of association between these two factors. To illustrate this, figure 14.1 shows the relationship between nonword reading and reading comprehension in a sample of 411 7–10-year-old children; the two variables are plotted as z-scores, calculated across the whole sample of children. Children falling in the lower right quadrant show the poor comprehender profile of good nonword reading skills but poor reading comprehension.

#### *Linguistic comprehension as a source of poor reading comprehension*

According to the logic of the simple model of reading, if poor comprehenders do not have deficits in decoding, they should show deficits in linguistic comprehension. Generally, the relationship between reading comprehension and listening comprehension is very close, especially as children get older and reading comprehension becomes more constrained by knowledge and understanding, rather than basic word-level decoding (Stanovich, Cunningham, & Freeman, 1984). In adults, listening and reading comprehension are strongly correlated ( $r$ 's in the region of .9; Bell & Perfetti, 1994; Gernsbacher, Varner, & Faust, 1990). Although there are important differences between spoken language and written language (e.g., in the temporal characteristics of the two modalities), evidence suggests that listening and reading comprehension depend on very similar underlying processes. As Rayner, Foorman, Perfetti, Pesetsky, and Seidenberg (2001, p. 42) put it, "It can be reasonably argued that learning to read enables a person to comprehend written language to the same level that he or she comprehends spoken language."

As would be predicted by the strong relationship between written and spoken language comprehension, children selected on the basis of their poor reading comprehension usually show poor listening comprehension. Nation and Snowling (1997) asked children to listen to stories, and at the end of each passage of text the children were asked a series of questions. Some questions tapped literal understanding of what they had heard, whereas others required inferences to be made. Poor comprehenders performed less well than control children on this listening comprehension task. Consistent with these findings, Nation, Clarke, Marshall, and Durand (2004) found that poor comprehenders also performed less well than control children (matched for age, nonverbal ability, and decoding ability) on a number of spoken language tasks, including the Comprehension subtest taken from the *Wechsler Intelligence Scale for Children (WISC-III<sup>uk</sup>)* (Wechsler, 1992). This test requires children to formulate a response to a variety of hypothetical situations presented orally (e.g., “what should you do if you cut your finger?”). The poor comprehenders obtained scores well below those of the control children, and as a group their performance fell more than one standard deviation below age-expected levels on this standardized test.

In summary, poor comprehenders do not have a comprehension impairment that is specific to reading. Rather, their difficulties with reading comprehension need to be seen in the context of difficulties with language comprehension more generally. Some theorists have gone further and intimated that since poor comprehenders’ performance is highly consistent across both written and spoken language, they should perhaps not qualify as having a reading impairment, so much as a more general language or cognitive deficit. However, the fact that poor comprehenders’ difficulties can be traced to more general difficulties with spoken language does not negate the fact that they have a reading difficulty. One can draw an analogy with developmental dyslexia. There is little doubt that dyslexic children have a reading problem. It is also the case however, that dyslexic children perform poorly on oral language tasks that involve phonological processing, such as phonological awareness, nonword repetition, rapid naming, name retrieval, and verbal short-term memory (e.g., Snowling, 2000). Some of these difficulties may be causally linked to their reading difficulties, others may be consequences, but the important point is that these difficulties do not draw attention away from the fact that children with dyslexia have “specific” difficulties with reading.

### **What Causes Poor Reading Comprehension?**

As Perfetti (1994, p. 885) makes clear, “there is room for lots of things to go wrong when comprehension fails.” Although it is the case that reading comprehension deficits are often associated with word-level decoding difficulties (e.g., Perfetti, 1985), discussion in this chapter continues to focus on children who have “specific” reading comprehension difficulties: specific in the sense that they are able to read text, words, and nonwords at age-appropriate levels, but their reading comprehension is impaired. However, even restricting discussion in this way leaves a number of possible reasons for these children’s difficulties to be considered.

Before reviewing these possible causes of reading comprehension failure, it is worth reflecting on some methodological issues surrounding the study of poor comprehenders. One issue concerns the choice of tasks used to reveal the poor comprehender profile. Oakhill and colleagues screen and select poor comprehenders from regular mainstream classrooms based on performance on the *Neale Analysis of Reading Ability* (NARA-II) (Neale, 1997). In this reading test, children read aloud short passages of text (generating a score for reading accuracy) and are then asked questions to assess their literal and inferential understanding of the text (generating a score for reading comprehension). Poor comprehenders are selected as children who show a significant discrepancy between their age-appropriate reading accuracy and their below-average reading comprehension. There are however, possible objections to this approach, not least that in this particular reading test (the NARA), reading accuracy and reading comprehension are not measured independently from one another. With this limitation in mind, Nation and colleagues have selected poor comprehenders according to performance on tasks that assess the two components of reading (accuracy and comprehension) separately. In these studies, poor comprehenders are selected and defined as those children who achieve poor reading comprehension scores on the NARA, but achieve age-appropriate scores on a standardized test of "pure" decoding (nonword reading).

A second methodological issue concerns the nature of the comparison group of control children. To ensure that any differences between poor comprehenders and control children are not a consequence of group differences in basic decoding skill, Nation and Snowling (1998a) advocated matching the two groups for nonword reading ability. Following the same logic, Nation and colleagues also match poor comprehenders and control children for nonverbal cognitive ability. This approach is not followed by other research groups (e.g., Yuill & Oakhill, 1991). However, as a minority of children selected as poor comprehenders show rather low cognitive ability (Nation, Clarke, & Snowling, 2002), failing to control for cognitive ability could result in spurious conclusions.

A final methodological note concerns the comprehension-age match design. Following the logic of the reading-age match design (e.g., Bryant & Goswami, 1986), Stothard and Hulme (1992) and Cain, Oakhill, and Bryant (2000a) reasoned that in order to identify candidate causes of poor reading comprehension, poor comprehenders should be compared with younger, normally developing children whose comprehension skills are at a similar level. If poor comprehenders show impairments in a particular cognitive or linguistic skill relative to younger control children matched for comprehension age, that skill is unlikely to be a simple consequence of comprehension level.

With these methodological issues in mind, we return to the question of what causes poor reading comprehension in children selected as poor comprehenders. Perfetti and colleagues (Perfetti, 1985, 1994; Perfetti et al., 1996) have argued that poor comprehension may be a consequence of inadequate processing, lack of knowledge, or some combination of both processing and knowledge-based weaknesses. Two sets of processes are considered essential to the comprehension process, and are described as "inevitable" sources of comprehension difficulty (Perfetti et al., 1996, p. 140); these are lexical processes and working memory resources, which together form the central elements of the verbal efficiency hypothesis. We begin by reviewing evidence concerning the performance of poor comprehenders on tasks tapping these skills.

*Lexical processes*

What is meant by lexical processes in this context? While some authors use the term to refer to the efficiency of sublexical processing, that is, the ability to make mappings between orthography and phonology, it is also used more broadly to capture, amongst other skills, phonological processing and lexical access (e.g., Perfetti, 1994). Research on poor comprehenders has revealed a systematic profile of strengths and weaknesses across different aspects of lexical processing. It is thus important to consider different aspects of lexical processing separately.

*Phonological skills.* It is well established that children's phonological skills are intimately related to the development of literacy (e.g., Goswami & Bryant, 1990) and a considerable body of evidence points to core phonological deficits characterizing individuals with poor reading (e.g., Snowling, 2000; Stanovich & Siegal, 1994). Shankweiler (1989) proposed that reading comprehension difficulties may be caused by a "phonological bottleneck." On this view, comprehension problems are a consequence of a child being unable to set up or sustain a phonological representation of verbal information when reading. Consistent with this, phonological skills do account for significant variance in reading comprehension performance (e.g., Gottardo, Stanovich, & Siegal, 1996). However, as noted by Cain, Oakhill, and Bryant (2000b), the relationship between phonology and reading comprehension may not be direct. Instead, the relationship between phonological skills and reading comprehension may be mediated by word recognition. In line with this view, a number of studies have demonstrated that phonological skills are not impaired in children with specific comprehension difficulties: across a range of different phonological processing tasks, including phoneme deletion, rhyme oddity, judgment and fluency, spoonerisms, and nonword repetition, poor comprehenders are indistinguishable from control children (e.g., Cain, et al., 2000b; Nation et al., 2004; Nation & Snowling, 1998a; Stothard & Hulme, 1995). Very clearly, a bottleneck in phonological processing cannot account for poor comprehenders' comprehension impairments.

*Semantic skills.* Despite adequate phonological skills, poor comprehenders do show weaknesses in some aspects of oral language. In a series of studies, Nation and colleagues compared poor comprehenders with skilled comprehenders matched for chronological age, decoding level, and nonverbal ability. Poor comprehenders were slower and less accurate at making semantic judgments, and they produced fewer exemplars in a semantic fluency task (Nation & Snowling, 1998a); under some conditions, differences in semantic priming (Nation & Snowling, 1999) and relative weaknesses in picture naming (Nation, Marshall, & Snowling, 2001) have also been observed. It is important to note, however, that the deficits observed in these experiments were not just symptoms of generally poor language; for instance, deficits in semantic judgment and semantic fluency were accompanied by normal levels of performance on parallel tasks tapping rhyme judgment and rhyme fluency.

What seems to unite those aspects of lexical processing that poor comprehenders find difficult is meaning. To judge whether two words mean the same, or to produce exemplars to a category label, clearly depends on an appreciation of word meaning (whereas,



in contrast, commonly used measures of children's phonological skills, such as rhyme judgment, phoneme deletion, and nonword repetition are tasks that can be performed without access to semantics). Such semantic impairments are consistent with mild-to-moderate deficits in receptive and expressive vocabulary that have emerged in some, but not all, studies (e.g., Nation et al., 2004; Stothard & Hulme, 1992). Thus, in line with Perfetti's verbal efficiency hypothesis, poor comprehenders do have impairments in lexical processing, but only when semantic aspects of lexical processing are taxed.

It is important to note that although Nation and Snowling characterized poor comprehenders as having poor lexical-semantic skills, subsequent research has revealed oral language weaknesses that are not necessarily restricted to the semantic or lexical domain. For example, Nation et al. (2004) found that poor comprehenders scored lower than control children on tests tapping morphosyntax and the understanding of nonliteral aspects of language, as well as vocabulary. These findings are consistent with earlier work by Stothard and Hulme (1992) demonstrating group deficits on a test of syntactic comprehension, the *Test for the Reception of Grammar* (TROG) (Bishop, 1983). Interestingly, not all studies find TROG-deficits in children with poor text-level reading comprehension (e.g., Yuill & Oakhill, 1991); however, inconsistent findings across studies are difficult to interpret as, typically, performance levels on the TROG have been close to ceiling. A new edition of the TROG (TROG-2; Bishop, 2003) contains more items, and is standardized through to adulthood. A recent study using this more sensitive test (Cragg & Nation, in press) provides clear evidence pointing to syntactic comprehension impairments in poor comprehenders (standard scores were 80 and 94 for the poor comprehenders and control children respectively).

In summary, there is considerable evidence supporting the view that poor comprehenders have oral language weaknesses. Nation et al. (2004) concluded that low-language characterized poor comprehenders as a group, and furthermore, a substantial minority of the sample met criteria for specific language impairment (SLI; see Bishop, 1997, for a review). Importantly, however, and unlike the majority of children with SLI, poor comprehenders showed no difficulty with phonological processing. Instead, their oral language skills were characterized by relative weaknesses in dealing with the nonphonological aspects of language, ranging from lexical-level weaknesses (vocabulary) through to difficulties with interpreting nonliteral language.

*Visual word recognition.* So far discussion has focused on aspects of lexical processing captured by children's oral language skills. According to Perfetti (1985, 1994), however, the ability to make mappings between orthography and phonology is a lexical processing skill that is vital to the reading comprehension process. On this view, the ability to decode and identify words accurately and efficiently allows resources to be devoted to comprehension processes. As discussed earlier, decoding efficiency is clearly related to reading comprehension in general terms. But is there any evidence to suggest that poor comprehenders' poor comprehension is a consequence of ineffective, resource-demanding decoding or word identification processes? The answer to this question seems to be no: as reviewed above, comprehension impairments remain even when care is taken to match poor comprehenders and controls for basic decoding skill (as measured by nonword reading accuracy and efficiency). And, when groups are matched in this way, poor



comprehenders show normal phonological processing skills, suggesting that their decoding is not underpinned by low-quality phonological knowledge.

Interestingly, however, even when poor comprehenders are closely matched to control children for decoding ability, subtle group differences in visual word recognition have been observed. Nation and Snowling (1998a) found that poor comprehenders were less accurate and efficient than control children at reading irregular words and low-frequency words; there were no group differences when reading regular words and high-frequency words. Drawing on Plaut, McClelland, Seidenberg, and Patterson's (1996) connectionist model of word recognition, Nation and Snowling proposed that word recognition is compromised in poor comprehenders due to weaknesses in vocabulary and semantic knowledge, as reviewed in the previous section.

To understand how these weaknesses in oral language may impact on the development of visual word recognition, we need to consider the role played by semantics in the word recognition process. According to Plaut et al.'s (1996) connectionist model of word recognition, reading development is best characterized by a division of labour between a phonological pathway (consisting of connections between phonological and orthographic representations) and a semantic pathway (connections between semantic representations, phonology and orthography). Although in the earliest stages of reading development, resources are devoted to establishing connections between orthography and phonology (akin to basic decoding or "sounding-out"), the semantic pathway becomes increasingly important later in development, especially for the efficient reading of exception or irregular words: words that are not handled so well by the phonological pathway alone.

With this framework as a backdrop, it is possible to hypothesize how children's spoken language ability influences the way in which their reading systems are established. For example, dyslexic children with impaired phonological skill are thought to come to the task of learning to read with poorly specified phonological knowledge in the spoken domain. As a result, they find it difficult to forge adequate connections between orthography and phonology and consequently find decoding (especially nonword reading) difficult (Harm & Seidenberg, 1999; Snowling, 2000). Poor comprehenders have no such difficulty: their strong phonological skills allow them to develop an efficient and well-specified phonological pathway. In contrast however, relative weaknesses in vocabulary and semantic knowledge may constrain the development of the semantic pathway. A weak semantic pathway in Plaut et al.'s simulations lead to problems with irregular and low-frequency words – exactly the profile of word recognition that has been observed in poor comprehenders (Nation & Snowling, 1998a). It is important to note, however, that group differences were very subtle. The poor comprehenders were reading words and nonwords at age-appropriate levels as measured by standardized tests, and their phonological skills were well developed. It seems unlikely that such children are devoting excessive resources to word identification and decoding, or that their reading comprehension is severely compromised by inefficient word-identification processes.

In summary, a number of conclusions concerning the status of lexical processing in children selected as having "specific" reading comprehension impairments can be drawn. First, there is very little evidence to suggest that they have difficulty with phonological processing, or that their comprehension impairment is a consequence of either a phonological processing or a basic decoding bottleneck. Although central to Perfetti's verbal effi-

ciency hypothesis, it is clear that these skills are not compromised in children selected as having a specific reading comprehension problem. However, other aspects of lexical processing are weak in poor comprehenders. Deficits in semantic processing are apparent, and these may be related to more general weaknesses with linguistic comprehension.

### *Working memory*

Language comprehension places heavy demands on working memory resources. Whether reading or listening, representations of words and sentences must be held in memory while other aspects of the text or discourse are processed and background knowledge is activated and integrated (see e.g. Kintsch & Rawson, this volume). Support for the relationship between comprehension and working memory comes from a number of sources, including observations that college students selected on the basis of low working memory span achieve lower comprehension scores than their "high span" peers, and perform less well on various components of comprehension such as pronoun resolution (Daneman & Carpenter, 1980, 1983). Most relevant for this chapter are investigations of working memory in poor comprehenders. Three studies have addressed this issue directly. Yuill, Oakhill, and Parkin (1989) asked children to read aloud triplets of numbers and then to recall the final digit in each triple. Poor comprehenders performed less well than control children, leading Yuill et al. (1989) to suggest that deficits in nonlinguistic working memory may underlie the reading comprehension problems seen in this group of children. However, as the counting span task required children to read and recall digits, the data are more suggestive of a verbal memory deficit than a nonlinguistic one. On a test of nonlinguistic spatial memory span, Nation, Adams, Bowyer-Crane, and Snowling (1999) found no differences between poor comprehenders and a control group.

To investigate verbal working memory in poor comprehenders further, Stothard and Hulme (1992) adapted Daneman and Carpenter's (1980) listening span task. They reasoned that this task would tap verbal working memory, as its task requirements (responding to short sentences and then recalling the last word of each sentence) are similar to some of the simultaneous processing and storage demands of language comprehension itself. Rather surprisingly, however, they found no group differences: poor comprehenders, age-matched controls and younger children with approximately the same level of comprehension as the poor comprehenders all performed at a similar level. From these data, Stothard and Hulme concluded that working memory deficits are unlikely to be a common cause of reading comprehension difficulties. Subsequent data, however, suggest that this conclusion was premature. The children in Stothard and Hulme's study were aged 6–7 years, and it is clear that they found the listening span task demanding because performance was close to floor. Nation et al. (1999), using the same materials as Stothard and Hulme, did observe substantial listening span deficits in 10-year-old poor comprehenders in line with the findings reported by Yuill et al. (1989). Taken together, these findings are consistent with the general relationship between verbal (but not spatial) span and reading comprehension in children (e.g., Seigneuric, Erlich, Oakhill, & Yuill, 2000).

Given the relative difficulty poor comprehenders have with the processing and storage of verbal material, it is tempting to suggest that these verbal working memory deficits

may underpin their poor text comprehension. However, issues of causality are far from clear. It is generally accepted that in a complex memory span task such as listening span, individuals' storage capacity is a function of how efficient they are at the computational – or processing aspects – of the task (e.g., Daneman & Tardif, 1987). As, by definition, poor comprehenders have poor language comprehension, verbal working memory weakness may be a consequence of poor language comprehension, rather than a cause of it. For example, the listening span task used by Nation et al. (1999) required children to listen to sentences and to make a decision about their content (the processing component of the task), and then to remember the final word in each successive sentence (the storage component of the task). As poor comprehenders tend to perform less well than control children on measures of sentence comprehension (Cragg & Nation, in press; Stothard & Hulme, 1992), differences in verbal memory are perhaps not surprising.

In summary, although further research is needed to fully understand issues of causality, it is clear that the relationship between language comprehension and verbal memory in poor comprehenders is an intimate one, as highlighted in a recent investigation of sentence repetition. Marshall and Nation (2003) asked poor comprehenders and controls to repeat sentences (of increasing length and complexity) verbatim. Two findings were clear. First, poor comprehenders repeated fewer sentences correctly. Thus, even though the task required only straightforward verbatim repetition (rather than a complex span procedure), verbal memory weaknesses were nevertheless evident. Second, the nature of the errors made by poor comprehenders differed from those made by control children. While both groups of children were likely to maintain the surface aspects of the sentences, poor comprehenders were less likely to maintain the meaning (or gist) of the target sentences. A possible interpretation of this finding is that the children simply did not understand the sentences as well as control children did, thus reducing the accuracy or reliability with which they were able to represent (and therefore remember) the content of sentences.

#### *“Higher-order” discourse-level processes*

In addition to lexical processing and working memory deficits, a range of discourse-level deficits have been implicated in poor reading comprehension. Two sets of processes that have attracted considerable research will be reviewed here: inference making and comprehension monitoring processes.

*Inference making.* To understand language, it is often necessary to make inferences – to go beyond what is stated explicitly in the text or discourse to infer the intended message. Even very straightforward texts require inferences to be drawn. This point is nicely illustrated by Oakhill (1994) in her description of how the following story “can only be understood against a background knowledge about birthday parties, the convention of taking presents to them, the need for money to buy presents, and so on” (p. 822):

*Jane was invited to Jack's birthday.  
She wondered if he would like a kite.  
She went to her room and shook her piggy bank.  
It made no sound.*

As this example makes clear, failure to draw inferences is likely to seriously impede comprehension. Numerous studies have demonstrated that poor comprehenders have difficulty drawing inferences when reading or listening, and it has been argued that such difficulties are causally implicated in children's poor reading comprehension (Cain & Oakhill, 1999; Oakhill, 1982, 1984; for review, see Oakhill, 1994).

Before accepting that poor comprehenders' reading difficulties are the consequence of problems with making inferences, it is important to establish that poor inference making is not an artefact of other factors. For example, to resolve an inference often requires the reader to hold information in memory across a number of sentences. Potentially, therefore, poor comprehenders may fail to make inferences not because they are unable to do so, but simply because of failure to remember premises presented earlier in the text. To test this idea, Oakhill (1984) compared children's ability to answer comprehension questions requiring an inference under two conditions. In one condition, the text remained in full view, and children were allowed to look back at the text; in a second condition, the text was removed and comprehension questions had to be answered from memory. Poor comprehenders' ability to draw inferences remained limited, even when the text was made available for the children to look back at. Following a similar procedure, Cain and Oakhill (1999) replicated these findings. They also included a condition in which poor comprehenders were encouraged (with direct prompting) to search the text in order to find the information needed from which to make an inference. Interestingly, poor comprehenders' performance increased, leading Cain and Oakhill to suggest that it is not so much the case that poor comprehenders cannot make inferences, but rather that they fail to do so spontaneously.

The problems that poor comprehenders have making inferences raises a number of issues that have been addressed by Cain, Oakhill, and colleagues. First, linguists and psycholinguists distinguish between different types of inference (e.g., Singer, 1994). Do poor comprehenders have difficulty with all types of inference? Two types of inference have been studied in detail in poor comprehenders: cohesive inferences and elaborative inferences. Cohesive inferences are needed to establish and maintain links between premises within the text and are necessary if adequate comprehension is to follow. Elaborative inferences are made when information external to the text is integrated with information contained in the text; these inferences are not always essential, but they are thought to enrich the readers' representation of the text. Generally it appears that poor comprehenders perform less well than controls on both types of inference, although presenting the text for the children to refer back to results in greater improvement for cohesive than elaborative inferences (Cain & Oakhill, 1999; Cain, Oakhill, Barnes, & Bryant, 2001). A different form of inferencing was assessed by Oakhill (1983). Instantiation refers to the process whereby a specific meaning of a word is constructed, depending on context. For example, long-term recall of a sentence such as "the fish attacked the swimmer" is enhanced following a cue such as the noun *shark*, relative to the original (but less context specific) noun, *fish*. Consistent with their tendency to draw fewer elaborative inferences, poor comprehenders are also less likely to make instantiations than control children (Oakhill, 1983).

A second issue concerns whether it is the *process* of inference making per se that is impaired for these children or, alternatively, is it that they lack the relevant knowledge needed to make the inference? To disentangle the effects of group differences in back-

ground knowledge from group differences in inference making skills, Cain et al. (2001) taught a novel knowledge base to groups of poor comprehenders and control children. Specifically, 12 pieces of information about the imaginary planet *Gan* were read to the children (e.g., the ponds on *Gan* are filled with orange juice; bears on *Gan* have bright blue fur). Cain et al. then tested acquisition of the knowledge base using a forced-choice picture recognition task, and a verbal recall task. Any items that were not recognized or recalled correctly were retaught. The children then listened to a story tapping the knowledge base and were asked questions that required either a cohesive or an elaborative inference to be made. Poor comprehenders were poor at generating both types of inference, even though they did not differ in terms of world knowledge relevant to the text. Importantly, it is interesting to note that the poor comprehenders were also poor at answering literal questions about the stories, suggesting that their lack of understanding is not just a consequence of failure to make inferences. Nevertheless, the results of this study are clear in showing that even when relevant background is familiar, poor comprehenders draw fewer inferences than do skilled comprehenders.

Arguably, a limitation of the research pointing to poor inference making as a cause of poor reading comprehension is its circularity: since children in these studies were selected as poor comprehenders precisely because they performed poorly on a standardized test of discourse comprehension containing a high proportion of inference-based questions, it might be considered unsurprising that they performed less well than control children on experimental tasks tapping inference-making ability. To address the issue of causality, Cain and Oakhill (1999) utilized the comprehension-age match design described earlier. They compared the inference-making abilities of 7–8-year-old poor comprehenders with those of normally developing children aged 6–7 years. The two groups of children did not differ in terms of comprehension scores on the test used to screen participants, the *Neale Analysis of Reading Ability*. Nevertheless, poor comprehenders made fewer inferences on the experimental tasks than the younger children, leading Cain and Oakhill to conclude that poor inference-making ability is a candidate cause of poor reading and language comprehension.

*Comprehension monitoring.* Comprehension monitoring refers to a set of metacognitive control processes that individuals can draw upon as they read or listen. In skilled reading, comprehension monitoring results in an assessment of whether comprehension has been successful, and repair strategies may be initiated if miscomprehension is detected. In short, comprehension monitoring refers to a set of strategies that indicate that a reader is engaged with the text. Oakhill and Yuill (1996) described three strands of evidence pointing to deficits in comprehension monitoring in children selected as having specific reading comprehension difficulties. First, they are less likely to resolve anomalies in text. For example, Yuill et al. (1989) presented scenarios containing an apparent anomaly (e.g., a mother is pleased that her son is not sharing sweets with his younger brother). Resolving information (that the younger son is on a diet) was presented later in the scenario. Children were then asked whether the mother had behaved appropriately, and why she took the action she did, the rationale being that these questions can only be answered correctly if the different sources of information are integrated. While poor comprehenders were able to resolve anomalies well when the two pieces of information were adjacent in the story,

their performance fell dramatically when the two filler sentences intervened between the two premises. These findings suggest that poor comprehenders are able to integrate information adequately, but fail to do so when the task is made more demanding by increasing its memory load.

A rather different second strand of evidence pointing to comprehension monitoring deficits in poor comprehenders come from an anomaly detection task in which children are asked to underline any meaningless words or phrases (Yuill & Oakhill, 1991). Even when they were explicitly instructed that a text contained nonsense words and phrases, poor comprehenders were less likely to detect them than control children. In addition, poor comprehenders were less likely to detect inconsistencies in a text, particularly when the inconsistencies within the text were separated by a number of sentences. Taken together, these findings suggest that poor comprehenders are not engaged in constructive comprehension monitoring; they fail to notice when comprehension has gone astray and are thus not well placed to initiate repair strategies.

Observing that poor comprehenders are less likely to monitor their own comprehension does not, on its own, establish comprehension monitoring as a cause of reading comprehension failure. Instead, faulty comprehension monitoring may well be a *consequence* of faulty comprehension rather than a cause of it. Indeed, comprehension monitoring ability is not a static or fixed variable; de Sousa and Oakhill (1996) found that poor comprehenders' comprehension monitoring ability increased substantially when they engaged in a more interesting task. In contrast, comprehension monitoring levels were fairly constant for the skilled comprehenders, regardless of the task's interest level. These findings caution against the view that comprehension monitoring is a processing weakness implicated in reading comprehension failure.

In summary, studies by Oakhill and colleagues have provided numerous demonstrations of the difficulties that poor comprehenders have with discourse-level processes. Moreover, it has been proposed that poor inference skills are a likely cause of poor comprehension (e.g., Cain & Oakhill, 1999). However, on a number of counts, Perfetti has questioned the validity of the view that specific deficits in higher-level skills are *causally* implicated in reading comprehension impairments (e.g., Perfetti, 1994). His preferred account is that poor inference making or failure to detect anomalies are not examples of structural or specific deficits that cause a comprehension problem. Rather, *they are* the comprehension problem, a problem that stems from weaknesses in "the operation of basic processes that identify words, activate their meanings, configure phrases, assemble meanings and so forth" (Perfetti et al., 1996, p. 159). Before considering this perspective further, it is necessary to move away from processing factors to consider the other potential cause of comprehension failure; that is, differences in knowledge.

### *Knowledge*

Knowledge is essential to comprehension. Without an appreciation of the meanings of words, there can be no comprehension. Moving beyond the meaning of individual words, domain knowledge is also considered crucial for comprehension. Appreciation of the



domain that is being referred to in a text allows the reader to move from a word- or propositional-level representation of the text to one which integrates this knowledge with a broader body of background knowledge, thus allowing the reader to build a potentially inference-rich mental model of the situation or event (see Kintsch & Rawson, this volume). Prior knowledge about a text predicts comprehension of it (Spilich, Vesonder, Chiesi, & Voss, 1979) and it is plain that complete lack of knowledge will result in a complete lack of comprehension (recall the example described earlier of Milton's daughters reading aloud Latin and Greek with no comprehension). But, is it the case that there are systematic deficiencies in poor comprehenders' knowledge base that can account for their faulty comprehension?

As reviewed earlier, there is evidence suggesting that poor comprehenders have relative weaknesses in expressive and receptive vocabulary (Nation et al., 2004), indicative of lack of knowledge at the word level. Although it seems likely that lack of vocabulary knowledge may contribute to impaired comprehension, it is unlikely to be the whole story: comprehension weaknesses are still apparent when care is taken to include vocabulary that is familiar, and when domain knowledge is to some extent controlled by teaching the children a novel knowledge base from which comprehension is subsequently assessed (Cain et al., 2001; although it should be noted that in this study poor comprehenders took longer to learn the knowledge base, and showed poorer retention of it over time. Although this was controlled statistically in their analyses, it cannot be ruled out that differences in knowledge base (perhaps in terms of the quality of its representation) may have existed between the two groups).

Rather than describe knowledge as being present or absent, a different approach is to ask whether individuals differ in the extent to which they activate knowledge spontaneously, or bring it to bear rapidly and efficiently at the appropriate time. For example, Nation and Snowling (1998a) reported that poor comprehenders were slower to make semantic judgments than control children. In a similar vein, Cain and Oakhill (1999) reported that poor comprehenders' ability to make inferences increased when they were assisted to find the relevant part of the text. These two observations are both examples of instances when poor comprehenders had the required knowledge, but failed to deploy it either quickly or spontaneously. Alternatively, however, these observations could be interpreted as indicative of lack of knowledge in that it is only when knowledge is thoroughly understood and properly integrated that it can be reflected on rapidly, or used to trigger inferences.

### *Low-level versus high-level processing, and processing versus knowledge*

As reflected in the above review, the literature on specific reading comprehension difficulties has concerned itself with dichotomies. Are poor comprehenders' difficulties best understood in terms of processing deficits or lack of knowledge? If poor comprehenders have processing weaknesses, are they "low level" or "high level"? However, it is not clear whether these dichotomies are useful or psychologically valid. Two examples will be used to illustrate what is meant here, one concerning word meaning and vocabulary and one concerning verbal memory.

There are now a number of studies demonstrating vocabulary weaknesses in children selected as having poor reading comprehension (e.g., Nation et al., 2004; Nation & Snowling, 1998a; Stothard & Hulme, 1992). In some ways, weak vocabulary is a clear index of lack of knowledge and, as noted above, comprehension will fail if children simply do not understand the words they read or hear. However, the question then arises as to why poor comprehenders have weak vocabulary knowledge. Lack of vocabulary knowledge is associated with weaknesses in verbal IQ, and, consistent with this, poor comprehenders achieve lower verbal IQ scores than control children (Nation, et al., 2002). However, as a substantial component of verbal IQ is vocabulary knowledge, this observation does not help us understand the nature of poor comprehenders' difficulties. More interesting is the notion that an individual's ability to learn new words or acquire new information from context is a vital skill that mediates the high correlations observed between verbal ability, reading comprehension, and vocabulary knowledge (e.g., Sternberg & Powell, 1983).

Cain, Oakhill, and Elbro (2004) examined the ability of poor comprehenders to learn new words from context by presenting stories containing a novel word (whose meaning was discernible from context) and asking children to define the novel words, either before the context allowed word meaning to be inferred, or afterwards. Poor comprehenders were less likely to offer definitions for the novel words, especially when the distance between the word and the information needed to infer its meaning was lengthened by inserting filler sentences. This study is interesting, as it 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 as the meaning of a new word. In turn, knowledge of word meanings and their speedy activation during reading (or listening) may well assist children's "higher-level" processing during language comprehension (Nation & Snowling, 1998b, 1999). 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.

The overlap between processing and knowledge is also demonstrated when we consider the possibility that long-term memory may contribute to poor comprehenders' deficits on memory span tasks. A well-replicated finding is that poor comprehenders perform equivalently to control children on straightforward tasks of verbal short-term memory capacity (i.e., recall tasks such as forward digit span that do not require an additional processing component; e.g., Stothard & Hulme, 1992). Similarly, poor comprehenders show normal effects of word length and phonological similarity in short-term memory (Nation et al., 1999; Oakhill, Yuill, & Parkin, 1986). Taken together, these findings demonstrate that poor comprehenders do not have deficits in short-term verbal memory capacity. Importantly however, the extent to which poor comprehenders show normal short-term recall depends critically on the nature of the items to be recalled. Nation et al. (1999, Experiment 2) compared short-term serial recall for lists of concrete words (e.g., *tooth*, *plate*, *fruit*) and abstract words (e.g., *luck*, *pride*, *wise*). Although poor comprehenders and controls did not differ in memory span for concrete words, poor comprehenders recalled fewer abstract words. It is established that the availability of semantic information influences short-term recall, and that concrete words may receive more "semantic support" than abstract words during short-term recall (Walker & Hulme, 1999). Within this theoretical framework, Nation et al. (1999) suggested that as poor

comprehenders have semantic weaknesses, they benefit less from semantic support, especially when the semantic contribution to recall is stressed by asking them to recall abstract rather than concrete words, and under these circumstances short-term recall – usually reported as an area of strength – is compromised.

These two examples highlight the inherent difficulty (and perhaps even futility) of distinguishing between knowledge and processing as sources of poor comprehenders' difficulties. Within an interactive (and developing) language system, it seems likely that difficulties at one level will influence performance at another; similarly, long-term knowledge will influence processing efficiency, and individual differences in processing will lead to differences in long-term knowledge. Nagy and Anderson (1984) have argued that from the beginning of third grade, the amount of free reading children engage in is the major determinant of vocabulary growth. Preliminary data (Cain, 1994, cited in Oakhill & Yuill, 1996) suggest that poor comprehenders have substantially less reading and reading-related experience than control children. Although Cain's data need to be interpreted cautiously due to the sample size being very small, they are consistent with a view that sees individual differences in reading comprehension failure becoming compounded over time. Thus, Matthew effects (see the glossary at end of this volume) are likely: poor comprehenders may read less, and learn less from their reading experiences than their peers; therefore impacting on subsequent reading and learning opportunities over time and leading to the formation of weak "intellectual habits" (Perfetti et al., 1996).

## Summary and Conclusions

Comprehension is complex and multifaceted, and it is thus no surprise that the population of children identified as having reading comprehension difficulties form a heterogeneous group. Even when discussion is limited to those children who have well-developed decoding ability, as in this chapter, heterogeneity is still apparent (Nation et al., 2002, 2004). However, it is possible to draw some clear conclusions. Children with "specific" comprehension problems do exist, and they are not unusual (Yuill & Oakhill, 1991), although they are rare in clinically referred populations (e.g., Leach et al., 2003; Shankweiler, et al., 1999).

While it is clear that decoding inefficiency will lead to reading comprehension difficulties (e.g., Perfetti, 1985), not all children who have comprehension difficulties have impairments in basic decoding, nor do they experience a phonological bottleneck; the children described in the studies reviewed in this chapter decode well, and they have appropriate phonological processing skills. Poor comprehenders do, however, have weaknesses in other aspects of language skill with deficits at both lower (e.g., vocabulary knowledge) and higher levels (e.g., inference generation, understanding figurative language) being reported (Nation et al., 2004). Although it is possible to describe different tasks according to whether they tap low-level or high-level processes, it is argued here that the distinction between different levels of processing may not be useful, at least until longer-term longitudinal data become available.

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One of the difficulties facing the researcher interested in understanding the nature of poor comprehenders' difficulties is that typically, the children are selected for study on the basis of their reading profile. Consequently, we know very little about the development of language in preschool or preliterate children who go on to become poor comprehenders. Long-term longitudinal studies are needed if we are to understand better the precursors to, and consequences of, "specific" difficulties with reading comprehension.

