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Reading Disorders II: Reading Comprehension Impairment

Children with reading comprehension impairment (who are sometimes referred to simply as poor comprehenders) have a pattern of reading difficulties that contrasts sharply with that seen in dyslexia. These children recognize words accurately, but have problems understanding the meaning of what they can read aloud with normal accuracy and speed. These children have been much less studied and are less well recognized than children with dyslexia and we will say correspondingly less about this group.

Definition and Prevalence

As we noted in Chapter 2, DSM-IV does not distinguish between difficulties with reading comprehension and difficulties with reading accuracy. As the nature and origins of these two difficulties are quite different, it is crucial to make a clear distinction between them. Reading comprehension impairment is easy to define: In this disorder children show a marked deficit on standardized tests of reading comprehension in contrast to much better scores on tests of reading accuracy. A common criterion for selecting children for research studies has been to require children to have age-appropriate reading accuracy scores but reading comprehension scores at least one year below their expected level. Given the difficulties of interpreting age-equivalent scores (e.g., how much worse is a lag of 1 year's reading age in a child aged 7 years compared to a lag of 1 year's reading age in a child aged 14 years?), a more reasonable diagnostic criterion would simply be to demand that reading comprehension is at least one standard deviation below a child's reading accuracy score on a well-standardized test.

There have been no population-based studies of this disorder but it seemed from early studies that it might be relatively common. Stothard and Hulme (1992) and Nation and Snowling (1997) both identified roughly 10% of unselected samples of primary school children as having significant reading comprehension impairment in the presence of relatively good reading accuracy. However, our own more recent

research has suggested that the prevalence of this reading profile varies according to school setting, with fewer poor comprehenders in classrooms in more advantaged catchment areas.

Another factor that may affect the prevalence of poor comprehenders in population samples is the comprehension test used to assess reading. Different tests of reading comprehension place different demands on word-level decoding skills and hence vary in their validity as tests of reading comprehension (as opposed to decoding; Keenan & Betjemann, 2006; Nation & Snowling, 1997). For example, it is sometimes the case that comprehension questions can be answered solely based on general knowledge and without reference to the text.

In the UK, the test that has been most widely used for the assessment of reading comprehension is the Neale Analysis of Reading Ability (Neale, 1989, 1997) in which children read short passages and answer questions about them. Bowyer-Crane and Snowling (2005) analyzed the comprehension questions that make up this test and found that in addition to tapping literal facts they primarily required the use of cohesive inferences. Cohesive inferences are those that are needed to maintain links between different parts of a text (e.g., the processes that are involved in identifying the referents of pronouns) and are therefore critical to understanding. In contrast, the comprehension questions on another test of reading comprehension in use in the UK at the time (The Wechsler Objective Reading Dimensions (WORD); Wechsler, 1993) primarily assessed the ability to make elaborative inferences. Elaborative inferences are made to add information that is not contained in the text. While these undoubtedly lead to a richer or fuller representation of the text, they are not essential for comprehension. Bowyer-Crane and Snowling (2005) went on to show that some children who were considered to have comprehension difficulties according to performance on the Neale test scored within the normal range for comprehension on the WORD test.

The Development of Reading Comprehension: A Theoretical Framework

The role of language skills

To read and understand a text is a complex task drawing on many, if not all, of the processes involved in comprehending spoken language. As we have already said, there is a clear distinction between being able to decode, or read aloud, a passage and being able to comprehend it. Logically, adequate decoding is necessary, but not sufficient, for comprehension. This idea was formalized by Gough and Tunmer (1986) in their Simple View of Reading model. This model is expressed as the formula $R = D \times C$: Reading comprehension (R) is the product of (the result of multiplying together) decoding (D) and linguistic comprehension (C). The model formalizes the idea that an individual's reading comprehension is dependent on their decoding ability: If decoding is zero there can be no reading comprehension and, no matter how good decoding is, if language comprehension is zero there can be no reading comprehension (see Figure 3.1).

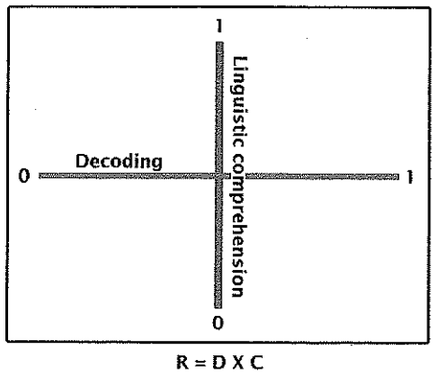


Figure 3.1 The Simple View of Reading model. (Adapted from Decoding, reading, and reading disability, in *Remedial and Special Education* (7) by Gough, P. and Tunmer, W. Copyright (1986) by Sage Publications Inc. Journals. Reprinted by permission of Sage Publications Inc. Journals via the Copyright Clearance Centre.)

Reading comprehension impairment is defined as poor comprehension in the presence of adequate reading accuracy. So for these children the Simple View of Reading model makes a clear prediction that the problem must lie in linguistic comprehension (C). However, in turn, linguistic comprehension depends on the interaction of different subsystems of language, namely grammar (see Box 3.1), semantics (the system of language concerned with word meaning), and pragmatics (concerned with what is relevant in a given context).

A number of studies provide evidence that is consistent with the idea that children's knowledge of word meanings, as well as their ability to deal with the grammatical structure of language, is particularly critical for reading comprehension. Muter, Hulme, Snowling, and Stevenson (2004) conducted a longitudinal study of 90 children in the first 2 years of learning to read (between the ages of roughly 4 years 9 months and 6 years 9 months), described in Chapter 2. At school entry, reading skills, letter-sound knowledge, phonological awareness, and vocabulary knowledge were assessed. A year later these assessments were repeated and in addition tests of syntactic awareness and morphological generation were given to the children.

Syntactic awareness was assessed by a word order correction task (Tunmer, 1989) in which children heard a sequence of words presented in a nonsensical order and were asked to rearrange these words to form a meaningful sentence. For example, the experimenter might say, "Ben throwing was stones," and the child was expected to respond, "Ben was throwing stones."

The morphological generation task assessed children's ability to generate inflected and derived word forms using appropriate word endings to convey a change in meaning. For each item on the test the child was shown a picture and the experimenter then said two sentences, the first sentence included the word-stem and this was followed by a second sentence in which the final word (which was omitted) had to be inflected. Put simply, the child was required to supply the missing word and this always required the child to produce a new morphological form. For example,

Box 3.1 Grammar and morphology

Grammar is the system of language concerned with word order and morphology. Syntax deals with the rules for ordering words in sentences and how these in turn affect meaning. In English, word order is critical to the meaning of sentences. Morphology is the system of language dealing with meaning components of words, and how word meanings can be altered by manipulating these components. To take a very simple example the plural form of a noun in English is usually signaled by adding the plural morpheme (-s) to a word. So we have one cake, or three cakes; in this case we have added a morpheme "s" to the word cake to signal that we are talking about more than one cake. Both morphological and syntactic skills are critical to reading comprehension.

"Here is a tree, here are three ... [trees]," or "The burglar steals the jewels, here are the jewels he ... [stole]."

At the beginning of the study (age 4 years 9 months) and a year later, reading was assessed by measures of single word reading (decoding skill), and at the end of the study (after 2 years in school) all the children completed a prose reading test (Neale Analysis of Reading Ability) in which comprehension was assessed by asking questions about the passages the children had read. For the present purposes, the main question of interest is the extent to which variations in children's syntactic and morphological skills, as well as their vocabulary knowledge, predicted their ability to comprehend what they read at the end of the study. The findings of this are summarized in a path diagram in Figure 3.2.

What this figure shows is that, statistically, children's word reading skills (i.e., decoding skills) at age 5 years 9 months are a powerful predictor of their reading comprehension skills at 6 years 9 months, but after these effects are accounted for children's vocabulary knowledge and their grammatical (syntactic and morphological) skills are additional important predictors of reading comprehension. Together, word recognition skills, vocabulary, and grammatical skills account for 86% of the differences amongst children in reading comprehension skill at the end of the study. The results from this study are exactly as we would expect from the Simple View of Reading model. This pattern provides good support for a causal theory that sees reading comprehension skills depending upon word recognition skills, children's understanding of the meanings of words (vocabulary), and how combinations of words and word elements (syntax and morphology) are used to convey meanings.

The relative importance of decoding and language comprehension skills as predictors of reading comprehension skills appears to change with age. In the very early stages of learning to read, decoding skills are of great importance because at this stage of development there may be relatively large differences in how well children

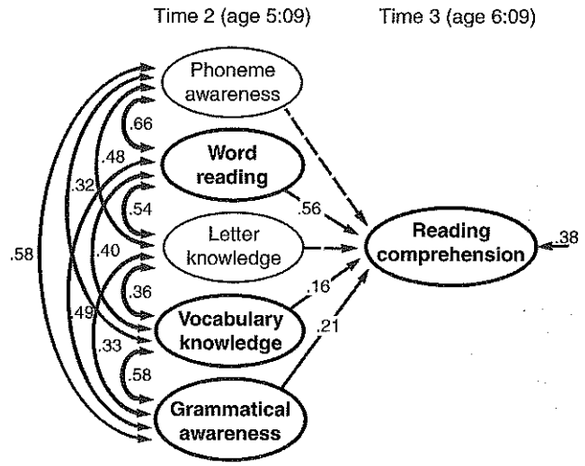


Figure 3.2 Longitudinal predictors of reading comprehension. (Muter, V., Hulme, C., Snowling, M. J., Stevenson, J., Phonemes, rimes, vocabulary and grammatical skills as foundations of early reading development, *Developmental Psychology*, 40, p. 675, 2004, published by American Psychological Association and adapted with permission.)

have mastered basic decoding skills. However, in older children who have had more reading practice, decoding may reach an adequate level for most children and then variations in linguistic comprehension may assume greater importance.

In line with this developmental view, Gough, Hoover, and Petersen (1996) reported a meta-analysis summarizing the patterns of correlations between reading comprehension, listening comprehension, and decoding skills across a wide range of ages. They found that from younger to older ages the correlation between decoding and reading comprehension tended to decrease (i.e., reading comprehension became progressively less dependent on decoding skills) while the correlation between listening comprehension and reading comprehension increased. It follows that some children who make a relatively good start in reading comprehension may succumb to difficulties when decoding skills assume less importance and language comprehension skills come to the fore. Just such a group of "late-emerging" poor readers has been described by Leach, Scarborough, and Rescorla (2003).

Skills involved in developing mental models of text

Psycholinguistic theories of reading comprehension describe the different cognitive processes that are necessary for proficient text processing. Kintsch and Rawson (2005) present a framework for thinking about the types of representations that are involved. The first level of text comprehension is a linguistic level; this refers to basic processes involved in recognizing and understanding words in a text, and assigning these words to their roles in sentences. Next the reader must construct a semantic representation of the intended meaning of a passage, and this requires processes

operating at levels higher than the word. Kintsch and Rawson distinguish between a Microstructure and a Macrostructure representation of a text. The Microstructure depends upon creating a set of interrelated idea units (or propositions) in memory. A proposition is an idea unit that will often correspond to a phrase in a text (e.g., *the dog bit the man* is a phrase that maps directly onto a proposition). Deriving the meanings of propositions depends upon knowing the meanings of individual words (in this case *dog*, *man*, and *bit*) and also using grammatical rules to derive the correct meaning from those words, given their form and the way that they are ordered in the sentence (the dog did the biting here, not the man, and this happened in the past). Creating a coherent Microstructure representation of a text is a complex business, and requires at the very least knowledge of vocabulary and grammar (syntax and morphology) and also the ability to use inferences. Inferences are often needed when we are reading. For example, anaphoric reference involves understanding the object that a pronoun stands for, so in a sentence such as *John asked Peter for his ball back*, the pronoun *his* refers to John, and not Peter.

At a still higher level, Kintsch and Rawson (2005) argue that the elements in a Microstructure representation of a text need to be structured into a Macrostructure or higher-level representation involving global topics (each of which might involve a whole set of propositions and their interrelationships). For example, a very simple story might involve a beginning where two characters are introduced, a middle where a surprising event occurs, and an ending where the reasons for the surprising event become clear (story resolution). In the case of such a very simple story the Macrostructure might involve just three global topics with direct connections between them. Children's knowledge of a wider range of story schemas and of different written styles (genre) aids successful comprehension (see Box 3.2).

In the early school years, stories typically relate to familiar themes that children will have heard when read to or in oral stories. In later primary grades, children need to appreciate that authors may portray events in different ways, sometimes re-ordering time sequences and veering from expected endings. Such appreciation must depend upon experience and it is easy to see that fluent readers who read a lot will develop this awareness, while poor readers, or children who are not read to very much, will be at a disadvantage.

Both the Microstructure and Macrostructure representations are part of what Kintsch and Rawson (2005) refer to as the textbase; they are derived directly from the language on the page and they represent the different levels needed by the reader to understand the intended meaning conveyed by the passage. If a reader only had the Microstructure representation of the text they would be lost in the detail of the passage; creating a Macrostructure representation involves abstracting the broad topics in the passage (gist) and representing their interrelationships.

Pragmatic skills: Going beyond the information given

We should note at this point that both listening comprehension and reading comprehension depend upon an area of language we have not yet dealt with:

pragmatics. Pragmatic skills are related to our ability to use language appropriately to convey meanings, and make inferences that go beyond the "information given" to infer a speaker's (or writer's) intended meaning. Adequate comprehension of a passage often involves relating what we have read to our general knowledge. This involves what Kintsch and Rawson call a situation model. If we read about events in a kitchen as a meal time approaches and a mother in this passage says to her child "the table needs setting," a reasonable gloss might be "please help by putting the plates and cutlery on the table so that we can eat" but that is much more than we have read. Clearly many literary devices, such as irony, depend upon multiple layers of possible meanings that need to be processed, held in mind, and reconciled with some broader understanding of a writer's intended meaning. Reading comprehension, like language comprehension on which it is built, is a highly interactive and constructive process that draws on working memory resources. It is therefore not surprising that it is common to find that children who have reading comprehension problems also have problems understanding spoken language.

In terms of pragmatic language skills, to read with comprehension the reader has to share the same frame of reference as the writer, as well as differentiating what is relevant from what is less so and make inferences that go beyond the literal meaning to extract the writer's intended message. One aspect of pragmatic competence that is particularly important for reading comprehension is the ability to appreciate another person's thoughts and beliefs. This skill is usually referred to as mentalizing or "theory of mind". Theory of mind has its roots in the preschool period when children begin to appreciate the feelings of another person (empathize). However, more advanced understanding is required in order to appreciate linguistic devices such joking, lying, criticism, and irony. Such nonliteral themes are often conveyed in stories. A child who lacks theory of mind will often extract an incomplete understanding of story events. We will return to consider pragmatic aspects of text

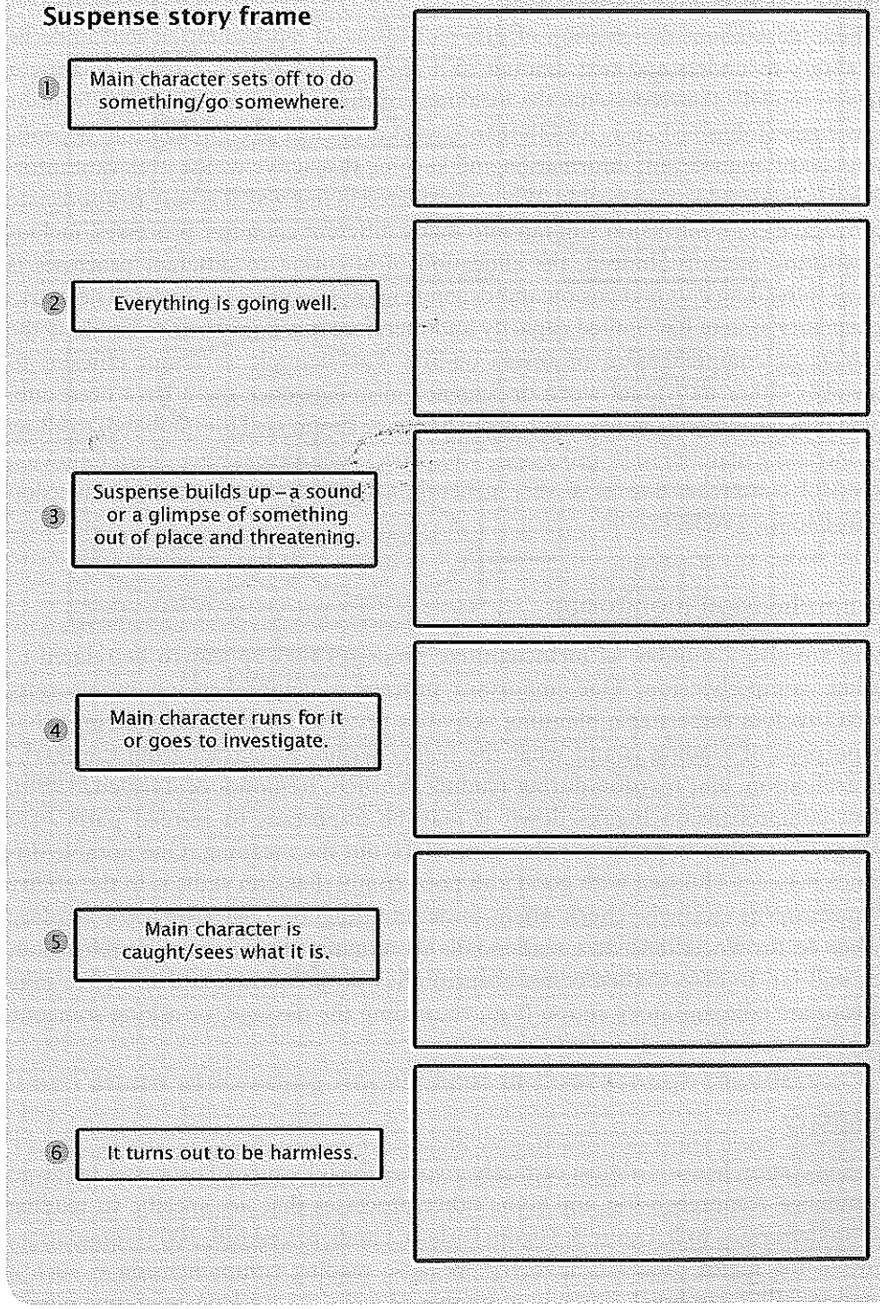
Box 3.2 Story schema

Story schemas can be thought of as templates or protocols depicting typical story structures. At a very basic level, a story consists of a beginning (e.g., Once upon a time), a middle (What happened), and an end (e.g., They all lived happily ever after). A more detailed story schema would include the characters and the setting, the event, responses to it, its resolution, and the end of the story setting. Well-known story schemas may depict common experiences, such as a birthday party, a trip to the zoo, or a day at school. Such schemas are a kind of "road map" that can be used to guide comprehension processes.

Below is an example of a story schema taken from *The Story Maker's Chest* (Carbett, 2005).

Box 3.2 (*cont'd*)

Suspense story frame



comprehension in Chapter 8 on autism. Poor reading comprehension is a frequent characteristic of children with autism; indeed many such children conform to the behavioral profile of the "poor comprehender" and are referred to as "hyperlexic" (Nation, 1999).

These ideas about the creation of different forms of representation that underlie our ability to understand text amount in a sense to the reader actively creating a "mental model" that represents the meanings of the passage and relates it to prior knowledge (Johnson-Laird, 1983). Moreover, proficient comprehension depends upon identifying relevant information and keeping this active whilst irrelevant information is rendered less accessible. When considered in this way it is easy to appreciate that reading comprehension will tap into many different cognitive processes, including working memory. Indeed, the allocation of attention to different processes is critical to reading comprehension and depends upon executive processes. The working memory system has limited capacity and therefore it is important to combine the products of comprehension processes on-line. For example, it is not efficient to remember either individual word or sentence meanings once these have been integrated into meaningful chunks. Such detail has to be suppressed (or inhibited) to allow new incoming material to be processed. This process of losing surface detail following successful comprehension is a very general feature of language comprehension (Gernsbacher, 1985).

Comprehension monitoring

There are also a number of metacognitive processes that appear to be related to reading comprehension. One important process is comprehension monitoring, which involves three steps: planning activities prior to reading (considering what the purpose of reading is and what the reader wishes to extract from the text) , self-evaluation, and revision during reading (Ehrlich, Remond, & Tardieu, 1999). When comprehension breaks down it may be important to re-read parts of a passage, or engage in problem solving, to work out the meaning. One notable difference between children with good and poor comprehension skills is in the ability to monitor or actively check their understanding of what they are reading (Baker & Brown, 1984). If a reader fails to monitor their own comprehension, they will fail to detect when comprehension has broken down and so fail to take appropriate compensatory action (e.g., re-reading the passage, or asking someone what an unknown word means).

Summary

Reading comprehension almost certainly involves the full range of processes involved in language comprehension and some other processes that are specific to reading comprehension as well. Figure 3.3 (from Perfetti, Landi, & Oakhill, 2005) summarizes some of the major processes involved. Because reading comprehension is such a complex skill it can break down in a number of ways. As we have seen, one potent cause of reading comprehension failure is poor decoding. However, the children we

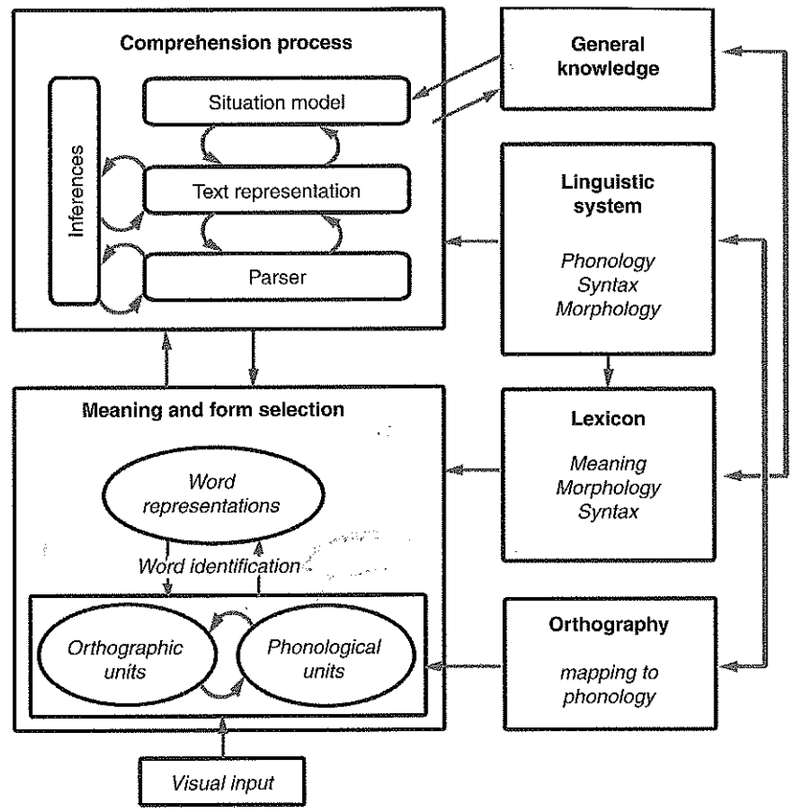


Figure 3.3 Processes involved in text comprehension. (Perfetti, C. A., Landi, N., and Oakhill, J. (2005). The acquisition of reading comprehension skill. In Snowling, M. J. and Hulme, C. (Eds) *The Science of Reading: A Handbook*, p. 229. Oxford, Blackwell.)

are concerned with in this chapter have reading comprehension problems that are not attributable to difficulties in word recognition or decoding. We now turn to consider the profile of reading skills shown by these children.

The Pattern of Reading Impairment in Poor Comprehenders

The diagnosis of reading comprehension impairment depends upon identifying children whose reading comprehension skills are much worse than expected for their level of reading accuracy. It is probably fair to say that many such children go unnoticed at school because they can read aloud accurately and fluently. The basic reading profile of a poor comprehender would be a child who reads a passage accurately but answers questions about the meaning of the passage very poorly.

At a more detailed level, children with reading comprehension impairment show some subtle differences on measures of reading accuracy that can be explained in terms of the cognitive deficits that underlie their reading problems. Nation and Snowling (1998a) gave poor comprehenders and reading-age-matched controls sets of words varying in frequency and regularity to read aloud. Although the two groups read high-frequency words equally well, the poor comprehenders made more errors when reading words of low-frequency and there was a trend for them to read exception words less well than controls. These differences, though small, are striking given that the two groups were well matched for decoding ability on a nonword reading test and did not differ in phonological skills. Within the triangle model (discussed in Chapter 2), children who have weak semantic skills should have particular difficulty in the later stages of learning to read when the use of the semantic pathway is vital to progress. In English, this translates into a problem reading words that are not dealt with well by the "phonological pathway;" the difficulty reading low-frequency words and exception words is consistent with the hypothesis that they have a subtle impairment of the semantic pathway (see also Ricketts, Nation, & Bishop, 2007).

When reading text, words benefit from the context in which they occur. Nation and Snowling (1998b) assessed the use of context in poor comprehenders by comparing them to children with dyslexia and normally developing readers matched for single word reading ability. A measure of contextual facilitation in reading was provided by asking the children to read aloud a set of exception words, either in isolation or following a spoken sentence context. The sentence contexts were selected so that they placed a constraint on the final word to be read but did not make the task so easy that the child could simply guess the word correctly (e.g., we end our assembly with a "hymn;" I went shopping with my mother and "aunt"). Performance was assessed by both accuracy and response time.

The three groups of children (poor comprehenders, children with dyslexia, controls) did not differ in the accuracy with which they read the target words in isolation, confirming that they were adequately matched for single word reading ability. However, there were differences in the effect of context. While, all children benefited from the sentence context, the size of this facilitation was greater in children with dyslexia than the controls matched for reading level; in contrast the poor comprehenders showed a smaller facilitation effect than controls.

In terms of the triangle model, semantic activation from the sentence frame primes the semantic pathway and facilitates the pronunciation of unfamiliar words (see Figure 3.4). Whereas children with dyslexia who have poor decoding skills benefited significantly from the availability of context, poor comprehenders showed little benefit. Interestingly, in the sample as a whole, the size of the contextual facilitation effect correlated with listening comprehension. As expected, the poor comprehenders who showed little effect of context had poor listening comprehension.

In summary, although children with reading comprehension impairment can be described as having intact decoding skills, the experimental studies described above reveal subtle differences in the way that these children's reading skills have developed in comparison to typically developing children.

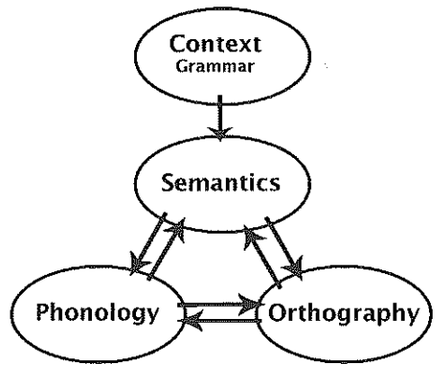


Figure 3.4 The Triangle model of Seidenberg and McClelland (1989). (Seidenberg, M. S. and McClelland, J. A distributed, developmental model of word recognition. *Psychological Review*, 96, p. 526, 2004, published by American Psychological Association and adapted with permission.)

Cognitive Explanations of Reading Comprehension Impairment

Given the pattern of reading difficulties shown by children with reading comprehension impairment (intact decoding and impaired comprehension), there are clear hypotheses about the language profiles we would expect these children to display. Since problems in decoding in dyslexia are so closely associated with phonological difficulties, we would expect phonological abilities to be normal in children with reading comprehension impairment. Conversely, we would expect the semantic and syntactic skills of these children (and possibly their pragmatic skills) to be impaired. Broadly, these expectations are confirmed by research. This leads to a causal model of reading difficulties (see Figure 3.5) in which different classes of oral language skills are causes of different types of reading difficulties. According to this model, impairments of phonological skills will lead to problems in developing word recognition skills in reading, and this in turn may hinder children's reading comprehension skills. Conversely, poor vocabulary and grammatical (morphosyntactic) skills may be a quite separate cause of problems with reading comprehension for some children whose reading accuracy skills are quite adequate (this is the pattern seen in children with reading comprehension impairment).

Phonological skills

The causal model of reading difficulties shown in Figure 3.5 implies that there is no direct relationship between phonological impairments and the profile of reading impairments found in poor comprehenders. In fact, the only way in which poor phonological skills can affect reading comprehension in this model is via word

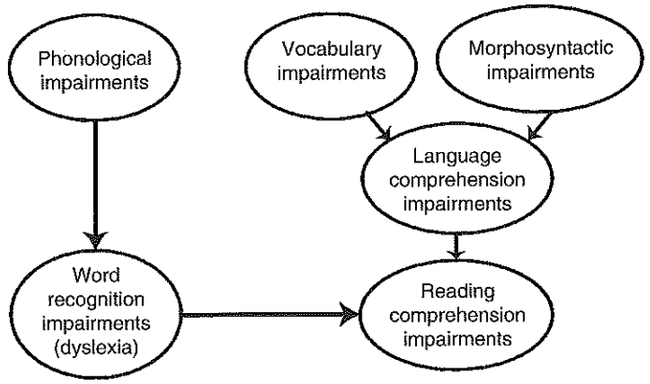


Figure 3.5 Path diagram showing causes of reading comprehension impairment.

recognition difficulties (dyslexia). Stothard and Hulme (1995) compared the phonological skills of a group of children with reading comprehension impairments to those of a group of age-matched controls. They also included a younger group of children matched in terms of reading comprehension on the attainment test (a so-called comprehension-age-matched design). The poor comprehenders' performance on a Spoonerism task (swapping phonemes between corresponding positions in spoken words; e.g., after hearing "Shopping List" the child has to say "Lopping Shist") was equivalent to the performance of the age-controls (and both groups were better than the comprehension-age-matched controls). The poor comprehenders also read nonwords as well as the age-matched controls, showing that they were as adept at using phonological information for decoding isolated words. Similarly, the poor comprehenders spelled words well, and both groups showed identical levels of phonetic accuracy in their spelling, that is, both groups were quite accurate in representing the sound structure of words that they failed to spell correctly. These results show, as expected, that poor comprehenders have intact phonological skills that underpin the development of their decoding and spelling skills, a finding that has since been replicated by a number of authors (e.g. Cain, Oakhill, & Bryant, 2000; Catts, Adlof, & Ellis Weismer, 2006; Nation & Snowling, 1998a).

As we saw in studies of dyslexia, another way of assessing children's phonological skills is to use measures of verbal memory. Neither Stothard and Hulme (1992) nor Cain, Oakhill, and Bryant (2004) found memory differences between poor comprehenders and age or comprehension-age-matched control groups on simple span tasks, and Nation, Adams, Bowyer-Crane, and Snowling (1999) found that poor comprehenders recalled lists of short and long words and nonwords as well as age-matched (CA) controls (following the procedures used by Roodenrys, Hulme & Brown, 1993, with typically developing children). However, in a second experiment, the methods used by Walker and Hulme (1999) were used to assess the possible importance of semantic coding to the recall of word sequences. Here the poor

comprehenders and controls were given lists of concrete (e.g., tooth, plate) and abstract words (e.g., luck, pride) to recall. The typically reading controls showed a large advantage in recalling the concrete words, an effect that demonstrates that access to a semantic representation of the words is important for this memory task (Walker & Hulme, 1999). Although the poor comprehenders recalled the concrete words as well as CA controls, they had significant difficulty recalling the abstract words. These results suggest that poor comprehenders have problems in the representation of abstract words, consistent with a deficit in the semantic system but not with phonological memory processes.

Working memory deficits in poor comprehenders

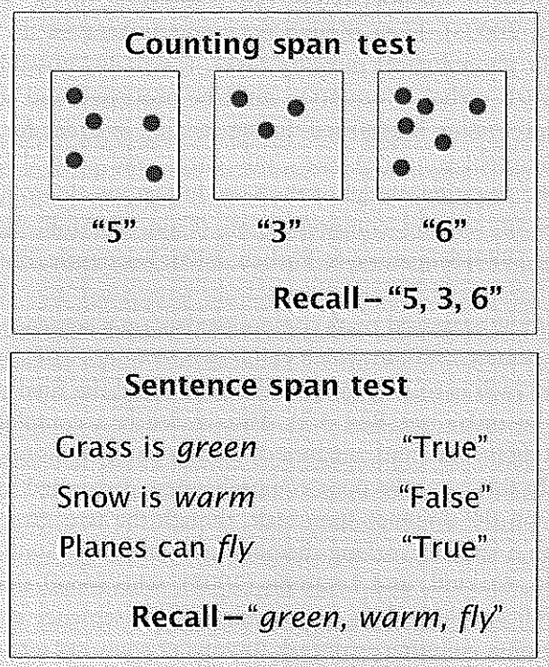
Phonological short-term memory is just one component of the working memory system (Baddeley, 2003a). Even though poor comprehenders do not differ from normal readers in phonological memory tasks, it remains possible that they will have difficulty when verbal information must be processed and stored simultaneously. Just such processing is required during reading in order for the products of sentence-level comprehension processes, inferences, and general knowledge to be integrated into the situation model of the text. In fact, working memory skills are strong correlates of reading comprehension (Cain, Oakhill, & Bryant, 2004; Leather & Henry, 1994; Seigneuric & Ehrlich, 2005; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000).

Nation et al. (1999) assessed poor comprehenders on a sentence span task (after Daneman & Carpenter, 1980) in which children hear a series of sentences and have to decide whether each is true or false, and finally recall the final words from each of the sentences in order (see Box 3.3). This is clearly a complex task involving language processing (syntax and semantics), memory and attention, as well as executive processes. In this case, the poor comprehenders performed more poorly than the CA controls on the sentence span task, though the two groups performed at identical levels on a spatial working memory span measure. Similar findings were obtained by Cain, Oakhill, and Lemmon (2004), who found that poor comprehenders had significant difficulties on a version of the sentence span task but performed normally on a counting span task (involving counting sets of dots and then recalling the numbers counted).

An important observation made by De Beni, Palladino, Pazzaglia, and Cornoldi (1998) is that poor comprehenders not only recall fewer items correctly in verbal working memory tasks, but they also make more intrusion errors than skilled comprehenders, that is, they included in their responses more items from the memory lists that have been processed but must now be suppressed. In a study to investigate this tendency (De Beni et al., 1998, Experiment 2), two groups of adults differing in reading comprehension skills but similar in logical reasoning ability completed a listening span task in which they had to monitor word strings for the names of animals before recalling the last word in each string at the end of the span task in the usual way. Thus, this task did not require sentence processing as in the typical listening span task but tapped similar executive processes (monitoring for animal names).

Box 3.3 Examples of working memory tasks

Two tasks that are commonly used by experimental psychologists to assess working memory are counting span and sentence span. In counting span the person is shown a sequence of cards with dots on and has to count the number of dots on each card. They then recall the sequence of counts. This is a classic working memory task since it involves combining processing (counting the dots) and storage (holding previous counts in memory in order to recall them). Similarly, in the sentence span task the person hears a sequence of sentences, and has to judge whether each sentence is true before recalling the final word from each sentence.



The counting span and sentence span tasks.

Once again, the two groups of participants differed in span and in the total number of words recalled; however they also differed in the intrusion errors they made. While the good comprehenders made similar proportions of intrusion errors consisting of animal and nonanimal names, the poor comprehenders produced a higher number of intrusions from animal names. Thus, poor comprehenders appear to have difficulty with the inhibition of once activated but currently irrelevant information.

Developing this argument further, Palladino, Cornoldi, De Beni, and Pazzaglia (2001) suggested that in order to comprehend text well a reader has to continuously

monitor and update the contents of working memory in order to choose relevant information and suppress that which is not relevant. This, they argued, means more than just automatically updating the text representation at a local level and extends to the conscious use of updating strategies. In order to investigate whether good and poor comprehenders differ in their ability to update the contents of working memory, Palladino et al. (2001) carried out a series of five experiments using various updating tasks (see Box 3.4). The basic paradigm used in all five experiments was the same. Lists of words were presented at the rate of one per second and the participant had to monitor the words in the list (e.g., judge the size of each item represented by the words in the list). At the end of each list, the participant (who was an undergraduate student of above or below average comprehension skill) had to respond with, for example, the three or the five smallest items. At the end of the experiment, they were unexpectedly asked to recall all of the items presented.

The experiment yielded a number of different measures. Of most importance here are the number of items correctly recalled from the lists presented for updating and the number of intrusion errors (words presented in the list but not the target ones). In general, poor comprehenders performed more poorly on the updating task and made

Box 3.4 The memory updating task

In one version of the memory updating task used by Palladino et al. (2001) (see text), participants were presented with lists of words comprising familiar animals or objects together with abstract words. The task was to monitor the size of the concrete words (animals/objects).

The following is an example of the list containing animals (which was presented in Italian):

Meeting
Sense
Woodpecker
Passion
Law
Cow
Happiness
Amount
Caterpillar
Lamb
Feast
Frog

At the end of the list, the participant had to respond with the three smallest items: *woodpecker, caterpillar, frog.*

more intrusion errors, although at final recall the two groups performed similarly. This pattern of performance suggests that poor comprehenders do not differ from good comprehenders in overall memory capacity but that they have more difficulty suppressing irrelevant information that has been activated in memory.

Taken together, these findings suggest that success in both the working memory task and in reading comprehension may be related not only to the ability to select relevant information but also to suppress irrelevant information in memory. Furthermore, performance worsens as memory updating demands increase. The participants in these studies differ somewhat from those that have been used in the research focusing on children, and no information is available concerning the language skills of the participants who differed in reading comprehension ability. It would be important to explore these tasks in children with reading comprehension impairments and to relate problems on the memory updating tasks to the patterns of oral language difficulties that are common in these children. Problems of establishing the causal status of these memory updating effects remain. It could be that problems in memory updating are a cause of comprehension difficulties; alternatively, it might be that language difficulties are primary and that these in turn underlie the difficulties on the memory updating tasks (which always involve manipulating verbal materials).

Language comprehension problems in poor comprehenders

There is good evidence that poor comprehenders have problems on measures of oral language comprehension, just as they have problems in reading comprehension (Catts et al., 2006). Poor comprehenders typically show poorer knowledge of word meanings on standardized tests of vocabulary (e.g., Nation & Snowling, 1998b) and they often obtain lower scores on tests of verbal IQ (Stothard & Hulme, 1995).

Stothard and Hulme (1992) made a direct assessment of poor comprehenders' oral language comprehension skills at the sentence and passage level. In one test, children listened as passages from the Neale Analysis of Reading Comprehension test were read aloud to them and then answered questions about these passages. The poor comprehenders answered fewer comprehension questions than age-matched controls. The groups were also given the Test for the Reception of Grammar (TROG; Bishop, 1983) in which they heard a sentence and had to choose the picture (from a set of four) that corresponded to the sentence. Once again the poor comprehenders performed less well on this test than age-matched control children and performed only as well as younger comprehension-age-matched controls. Similar findings have been reported on tests of grammatical understanding (Catts et al., 2006) and on tests of grammatical sensitivity (Nation & Snowling, 2000).

One area of language processing that has attracted considerable interest in relation to text comprehension is anaphoric reference. Anaphors are linguistic devices that ensure cohesion within or between sentences. For example, in the following discourse: *James signaled to the waitress at the end of the restaurant. The waitress brought the bill*, the anaphor is the repeated word *waitress*. More usually, *waitress* would be replaced by the pronoun *she* or in some circumstances a general term. In each case, it is necessary to link the anaphor with its antecedent for successful comprehension.

According to Ehrlich and colleagues (Ehrlich, Remond, & Tardieu, 1999; Megherbi & Ehrlich, 2005) poor comprehenders have an impairment of discourse-level processing that affects their processing of anaphora, and in particular pronouns. In French the pronoun system is complex and in addition to signaling syntactic function (subject versus object) it also marks gender (for animate and inanimate objects) and number (singular versus plural). Megherbi and Ehrlich (2005) compared good and poor comprehenders in a cross-modal naming task in which children heard two sentences and had to complete the second sentence by selecting an appropriate pronoun from two displayed on a screen. The pronoun was either consistent with the agent of the sentence (Probe A) or inconsistent (Probe B). For example (adapted from p. 727):

> After a long time away, Ellie (A) had dinner with Sebastian (B) in a restaurant.
> [Continuation] She chatted cheerfully with:
> [Probe A] him
> [Probe B] her.

Skilled comprehenders showed a significant consistency effect; they could select the pronoun faster if it was consistent with the agent in the sentence than if it was inconsistent. The magnitude of this consistency effect was reduced for poor comprehenders. However in conditions when the protagonist was closer in position in the sentence to the anaphor (when the continuation was *He chatted cheerfully* in the above example), they showed a larger and now significant consistency effect. In two further conditions, the texts had the same structure but they differed in the verb in the second sentence such that it was biased in meaning toward one or other protagonist. In this situation, the poor comprehenders had significant difficulty, particularly when the selection of the pronoun required them to overcome conflicting information primed by the verb. These findings suggest that poor comprehenders have difficulties in activating appropriate pronouns based on prior contextual information; such online language processing difficulties might plausibly contribute to these children's reading comprehension problems.

To investigate discourse-level processes in production rather than comprehension, Cain and Oakhill (1996) investigated narrative skills in poor comprehenders with a specific focus on story organization processes: 12 skilled and 14 less skilled comprehenders aged 7–8 years took part and they were compared with younger controls (aged 6–7 years) matched for reading comprehension skill. The children were asked to tell stories following different kinds of prompts: a topic title (e.g., Animals), a directed title (e.g., The Birthday Party), or a sequence of pictures, (e.g., pictures of a fishing trip). The narratives were then scored according to the child's grasp of story conventions, story event structure, and the use of connectives.

All three groups could use story conventions to produce narratives incorporating an opening, character setting, scene setting, and ending phase. However, the skilled comprehenders produced more coherent stories (see Box 3.5 for examples of complete, intermediate, and nonstory narratives). The difference in coherence was the consequence of the poor comprehenders using fewer connectives joining propositions in

Box 3.5 Examples of narratives varying in event structure. (From Cain, 2003. Reproduced with permission from the British *Journal of Developmental Psychology*, © The British Psychology Society.)

Nonstory
Topic title prompt: "The Farm."

Child's Response: "One day there was a man who had a big farm and there was lots of animals in it. The End."

Intermediate story
Picture sequence prompt: "The Fishing Trip."

Child's Response: "Once upon a time this little girl and her mum and her dad went fishing on a boat and the dad was fishing in the sea and then he saw some birds eating something and then he caught a fish."

Complete story
Picture sequence prompt: "The Fishing Trip."

Child's Response: "One day a family and their little girl decided to go fishing. They went down to the harbor and asked if they could borrow a boat so they could go fishing. Then the dad went fishing, but no fish came and he started to get a bit miserable. Then the little girl threw some bread into the water for some swans and the fish liked the bread and when the fish came up for the bread one of them went near the hook and then the dad caught a big fish and everyone was happy. The End."

the text, particularly in response to topic titles, and even in relation to the younger control group. Cain and Oakhill suggest that a problem with interclausal connectives may be a cause of their comprehension problems. This is an interesting idea; in order to use causal connectives, a child has to have a good command of the semantic relations between clauses and this ultimately depends on language comprehension.

Finally, two comprehensive studies of language skills in poor comprehenders indicate that oral language difficulties are pervasive and quite severe in this group. In the first of these, Nation, Clarke, Marshall, and Durand (2004) compared a group of poor comprehenders to an age-matched control group of children (who also had equivalent text reading accuracy and nonword reading skills to the poor comprehenders). The children were assessed on a wide range of language measures, including measures of vocabulary knowledge (average effect size $d = 1.74$), morphosyntax (average effect size $d = 1.09$), and broader receptive and expressive language skills (average effect size $d = 1.02$). These results show very clearly that the poor comprehenders have quite marked difficulties on a wide range of language measures compared to normally developing children of the same age and level of reading accuracy skills.

In fact, a large proportion of the poor comprehenders (8/23 or 35%), but none of the control children, satisfied a reasonably conservative criterion to qualify for a diagnosis of specific language impairment (SLI).

Second, in one of the largest studies of this group to date, Catts et al. (2006) compared 57 poor comprehenders with 27 poor decoders and 98 typically developing children of the same age, selected from a population-based study of children with language impairments. Each child completed a battery of language and reading tests in kindergarten, second, fourth, and eighth grade and the classification into reader-groups was undertaken using the eighth grade data. Poor comprehenders had reading comprehension skills below the 25th centile as compared with normal range decoding skills. They were matched to the controls in decoding skill. The poor decoders had word recognition skills below the 25th centile and were matched to the normal readers in terms of reading comprehension. Concurrent data were available for performance on tests of receptive vocabulary, grammatical understanding, discourse comprehension, and phonological skills.

As expected, the poor comprehenders but not the poor decoders showed deficits in vocabulary and grammatical skills (in contrast, their phonological skills were normal). The poor comprehenders also showed significant impairments in discourse processing and listening comprehension. Interestingly, poor comprehenders were comparable to poor decoders and typical readers in making an inference when they remembered the premise on which it was based (e.g., if the premise was adjacent to the point where an inference had to be made). However, they were significantly impaired relative to the other groups when the premise and the inference were at a distance from each other in the text (effect size for the difference between poor comprehenders and controls: $d = 0.64$).

Like Nation et al. (2004), Catts and colleagues reported data regarding the numbers of poor comprehenders who fulfilled diagnostic criteria for language impairment. Since the children were part of a cohort who had been followed because they were considered to be at high risk of language impairment, it was possible to provide accurate figures regarding those who had been given a research diagnosis in kindergarten of specific language impairment (SLI) (see Chapter 4). A relatively low proportion of children from the poor decoder and typical reader groups had a diagnosis of SLI (between 0.3 and 5.8%). However, among poor comprehenders 21.2% were diagnosed as SLI and a further 10.8% had language impairment in the context of low general cognitive ability.

Semantic deficits in poor comprehenders

A number of studies have focused at a detailed level on the nature of the language comprehension difficulties in poor comprehenders and, more specifically, have investigated language processing at the semantic level (e.g., Megherbi & Ehrlich, 2005). It will be recalled from the findings of Nation et al. (1999) described earlier that the poor comprehenders had selective deficits in representing the meaning of abstract words in memory. In addition, Nation and Snowling (1998a) reported that poor comprehenders were slower and more error prone on synonym judgments than control children matched for reading accuracy skill (do these words have similar

meanings: *boat* and *ship*?) and produced fewer exemplars in a semantic fluency task (give me as many forms of transport as you can think of).

To investigate poor comprehenders' sensitivity to the semantic relationships between words, Nation and Snowling (1999) used a semantic priming task in which children heard strings of spoken words and nonwords and, on hearing each item, they had to decide if it was a word or not. Target words were primed by spoken words that were related to them in terms of categorical membership (from the same semantic category) and in terms of frequency of association (how often the prime and target co-occur in language). The poor comprehenders, like the controls, showed semantic priming. However, the poor comprehenders showed reduced sensitivity to semantic relations based on category membership. Although they showed category related priming for strongly associated category members (*cat – dog*) they did not do so when the associated category members were not strongly associated (*train – aeroplane*); the controls, in contrast, showed clear priming effects for both types of items. This finding suggests that for poor comprehenders associative relationships between words are less efficiently stored in semantic memory than for normal readers.

Landi and Perfetti (2007) reported further evidence, from an EEG event-related potential (ERP) study, for a basic weakness in semantic processing in poor comprehenders (see Figure 3.6). In this study a group of university students was divided into more and less skilled comprehenders based on a standardized reading test. The more and less skilled comprehenders did not differ in their speed of reading individual words or nonverbal intelligence. Participants performed three tasks while their ERPs were recorded. In the semantic (words) task they saw pairs of words presented sequentially, and had to decide whether they were related in meaning (e.g., *lemon – pear*) or not (e.g. *bear – truck*). The semantic (pictures) task was the same except the items presented were line drawings either from the same category (related) or from different categories (unrelated). Finally, for the phonological (words) task, participants saw pairs of words and had to decide whether the pairs were homophones (related) or not (unrelated).

The more and less skilled comprehenders showed no difference in their ERPs to the phonological task (as expected, given previous demonstrations that good and poor comprehenders perform normally on single word reading and phonological tasks).

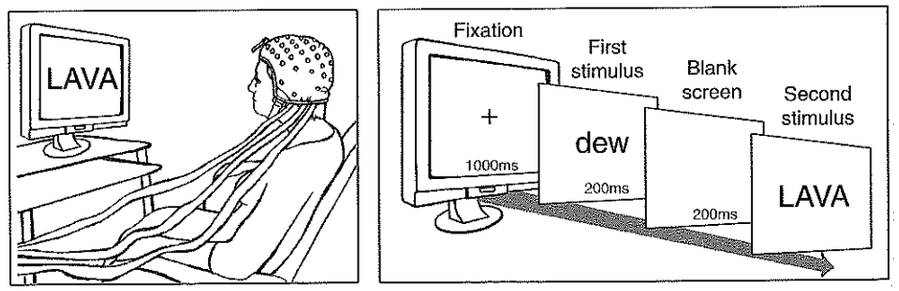


Figure 3.6 Illustration of an ERP experiment conducted by Landi and Perfetti (2007) to investigate semantic processing.

However, on both semantic tasks (pictures and words) the less skilled comprehenders were slower to make their decisions. There were also differences in the strength (amplitude) of ERP components (P200 and N400, occurring roughly 200 ms and 400 ms after stimulus presentation) between the skilled and less skilled comprehenders, particularly in the semantic word task. These differences therefore support the idea that less skilled comprehenders have a basic weakness in accessing information about the meanings of individual words (from either written word forms or pictures).

New word learning in children with comprehension impairment

Given the semantic difficulties observed in poor comprehenders, we would predict that they will have difficulty in establishing new semantic representations, in contrast to children with dyslexia who find it difficult to learn new phonological forms (Aguiar & Brady, 1991).

Nation, Snowling, and Clarke (2007) taught 12 poor comprehenders and 12 normal readers of the same age the names and meanings of four new words. Each new word was a three-syllable nonword with four semantic attributes (three concrete and one abstract attributes in each case): e.g., *a corbealyon is a small, hairy, angry bird*. First, the children were taught the names of the new words and their semantic attributes. After they had learned the associations between the phonological forms and their meanings to criterion, they were asked to define the nonwords and then to retrieve them (the newly acquired phonological forms) in response to the definitions. The following day they again recalled the new phonological forms before completing a task in which they matched the nonwords to pictures of the objects presented with foils.

The poor comprehenders took a similar number of trials to learn the new nonwords as the age-matched controls but they had significantly more difficulty in defining the nonwords whose phonological forms they could retrieve well. There was no group difference in the immediate recall of the nonwords to definitions (arguably a test tapping both phonological and semantic learning) but after the delay of 1 day the poor comprehenders could remember fewer of the semantic attributes of the new words. These findings support the hypothesis that poor comprehenders show normal phonological learning but have difficulty in learning (and consolidating) the semantic attributes of new words.

More generally, poor comprehenders appear to have difficulty in inferring the meanings of new words from context (Cain, Oakhill, & Elbro, 2003; Cain, Oakhill, & Lemmon, 2004), a pattern that also characterizes adults with weak verbal working memory skills (Daneman & Green, 1986). Cain et al. (2003) presented a group of 15 7–8-year-old poor comprehenders with eight short stories, in each of which a novel word was embedded. The children were encouraged to "guess" the meaning of the novel word as soon as it occurred. The word was followed by a defining context either immediately (in the near condition) or after a filler text (in the far condition). After reading the entire text, the children were asked to define the word again and their meanings were scored on a scale of 0–2 (with 2 being recorded when the child had made a full inference regarding the word's meaning).

Children varied in their propensity to provide a correct "guess" for the different words before the defining context and this variation in baseline were taken into account when estimating the ability of the children to define the words in the near and far conditions. The poor comprehenders were worse at giving the meanings of the novel words that had been defined in the passages and they had particular difficulty when the definitions were presented at a distance in the text from the word (resonating with the findings of Catts et al., 2006).

In summary, poor comprehenders have difficulty both in inferring the meanings of new words from context and in remembering the meanings of words they have been directly taught. Such difficulties are likely to contribute to the vocabulary impairments observed in many poor comprehenders and these impairments in vocabulary knowledge are one likely source of the reading comprehension problems seen in these children. Arguably, poor vocabulary knowledge will also affect the ability to make inferences about the relationships between events in a text, particularly when these depend upon an understanding of semantic relations.

Problems in inference skills as a possible cause of reading comprehension impairment

As we have seen, successful reading comprehension requires frequent inferences. The words on a printed page are often not completely explicit and a variety of inferences are used to "go beyond the information given" and fill in the gaps. Different ways of classifying the inferences that are made in reading have been proposed (e.g., Graesser, Singer, & Trabasso, 1994). While there are many different types of inference (see Box 3.6), two types that have been of particular interest in studies of poor comprehenders are cohesive and elaborative inferences. Cohesive inferences are those that are needed to maintain links between different parts of a text (one form of cohesive inference is involved in identifying the referents of pronouns as described earlier). It appears that without adequate use of cohesive inferences comprehension will often fail or be severely limited. Elaborative inferences are those that are made to add information that is not contained in the text. Such inferences may lead to a richer or fuller representation of the text, but often such inferences do not appear to be essential for comprehension. Readers use inferences in reading in complex and flexible ways. It seems that in many contexts readers will not draw all the inferences that they could from a text, but rather they draw the more obvious and more important inferences that are needed to support comprehension. Inferences that are needed to make a text coherent are more likely to be made than inferences that involve elaborations of the information presented. This makes sense in terms of cognitive effort, with readers only making the inferences that are more important for supporting comprehension (Perfetti, Landi, & Oakhill, 2005).

The study by Catts et al. (2006) hinted at the difficulties poor comprehenders have with making inferences. Perhaps not surprisingly, children's ability to make inferences during the process of reading comprehension improves with age. Barnes, Dennis, and Haefele-Kalvaitis (1996) examined developmental differences in inference skills in children between the ages of 6 and 16 years. They controlled for possible

Box 3.6 Examples of different inference types. (Graesser, Singer, & Trabasso, Constructing inferences during narrative text comprehension, *Psychological Review*, 101, pp. 371–395, 1994, published by American Psychological Association and adapted with permission.)

Inference type	*Description*	*Classification (e.g., cohesive)*	*Source (e.g., knowledge-based)*
Anaphora	Forming a link between two terms referring to the same thing: e.g., "The *car* came racing round the corner. Everybody scattered as the *vehicle* crashed into the wall."	Cohesive	Text-based
Pronoun resolution	Linking a pronoun to its previous referent: e.g., "*John* picked up Mary's book. *He* had wanted to read it for ages."	Cohesive	Grammatical knowledge
Case-structure role assignment	Assigning the role of agent, object, recipient, time, or location to a noun phrase: e.g., "The elephant (agent) gave his bananas (object) to the monkey (recipient)."	Cohesive	Grammatical knowledge
Causal antecedent	Provides an explanation for the actions and events in a text: e.g., "The campfire started to burn uncontrollably. Tom grabbed a bucket of water" – inference: Tom grabbed the water to put out the fire.	Local coherence	Knowledge-based
Superordinate goal	The overall goal that motivates the characters in the text. If the following sentence is encountered at the beginning of the story "It was Sam's mum's birthday and Sam wanted to buy her a present," then the superordinate goal, *Sam wanted to buy his mum a present,* would be inferred if the following sentence was encountered at a later point in the story "Sam woke early and went to the shops to find something special."	Global coherence	Knowledge-based

Box 3.6 *(cont'd)*

Inference type	*Description*	*Classification (e.g., cohesive)*	*Source (e.g., knowledge-based)*
Thematic inference	The overall goal or moral of the passage: e.g., never play with fire.	Global coherence	Knowledge-based
Character emotional reaction	The reactions of a character to the actions and events in the text: e.g., "Sam gave his mum a lovely a present" would lead to the inference that his mum was really pleased.	Coherence	Knowledge-based
Causal consequence	The predicted consequences of the actions and events in the text: e.g., "The dragon turned towards the knight and let out a fiery roar" might lead to the inference that the knight was wounded by the dragon.	Elaborative	Knowledge-based
Instantiation of noun category	Elaboration of a specific exemplar from a generic noun, i.e., "fish" becomes "shark" after reading "the fish attacked the swimmer."	Elaborative	Text-based
Instrument inference	Inferring a particular object used by an agent to complete an action, i.e., inferring the knight used a sword from the sentence "the knight lunged at the dragon and pierced his shiny scales."	Elaborative	Knowledge-based
State inference	Static properties of objects, characters, etc., not related to the causal structure of the text: e.g., a dog has a tail.	Elaborative	Knowledge-based
Subordinate goal action	How an agent achieved a goal not relevant to the superordinate goal of the text: e.g., you might infer that Sam took the bus to the shops to buy his mum a present.	Elaborative	Knowledge-based

differences in knowledge between children of different ages by first teaching all the children some novel information that was critical to understanding the passages they were going to read. This "knowledge base" concerned an imaginary planet called Gan and included information such as "Turtles on Gan have ice-skates attached to their feet." After learning the knowledge base to the criterion, the children were given a reading comprehension test about Gan. They found that even the youngest children studied (6–7-year-olds) were able to make inferences required to maintain text cohesion. However, there were clear improvements with age in children's ability to make inferences from the text, even after controlling for possible differences in the children's relevant knowledge. In other words, improvements in inference making with age could not be accounted for by differences in knowledge.

A number of pioneering studies by Oakhill (1982, 1983, 1984) showed that poor comprehenders are poor at making inferences while reading. Oakhill (1983) studied a particular type of inference referred to as instantiation. Instantiation is where a specific meaning for a more general term is inferred from the context. So, for example, having read that *The fish frightened the swimmer* we might infer that this particular fish was a shark. Oakhill found that less skilled comprehenders made fewer instantiations than more skilled comprehenders, suggesting that their determination of the meanings of words was less influenced by the sentence context. Oakhill (1982) also showed that less skilled comprehenders made fewer constructive inferences (inferences that are necessary to integrate two different sources of information) than more skilled comprehenders and that they were less good at drawing inferences that involved integrating what had been read with general knowledge.

Cain and Oakhill (1999) investigated inference generation during reading in poor comprehenders, making a stringent comparison between them and two groups of typical readers, one of the same age (CA controls) and the other comprising younger children who obtained the same comprehension scores on the Neale Analysis of Reading Ability (comprehension-age-matched controls). Two types of inferences were studied: inferences that required the integration of information from two consecutive sentences in a passage (passage based), and inferences that required the integration of information from the passage with general knowledge (general knowledge based). The poor comprehenders were worse at both types of inference than the CA controls, but only worse than the younger comprehension-age-matched controls on the passage-based inferences.

One difficulty with the notion that a deficit in inference making is a cause of reading comprehension impairments is that this is an inherently "high-level" difficulty. It might always be that problems in making inferences are consequences of more basic difficulties (such as poor vocabulary knowledge or limitations of verbal working memory, for example). One possible source of problem in making inferences is knowledge limitation (if you do not know that a common type of dangerous fish is a shark you cannot infer that the fish that frightened a swimmer is likely to be a shark). Cain, Oakhill, Barnes, and Bryant (2001) investigated whether poor comprehenders still show inference problems when background knowledge differences are controlled. The study used the procedure devised by Barnes et al. (1996) (described above) in which, before testing reading comprehension, children were taught a "knowledge base"

concerning the imaginary planet Gan. The comparison was between 13 poor comprehenders and 13 good comprehenders who were the same age and matched on reading accuracy level but differing markedly in the number of comprehension questions they could answer correctly on the Neale Analysis of Reading Ability. It was shown that the poor comprehenders were worse than the good comprehenders in answering comprehension questions that involved making inferences from knowledge they had been taught about Gan, even when only counting those questions for which they had correctly answered the corresponding factual question correctly. This parallels the pattern found for younger compared to older children in the Barnes et al. study, that is, younger children (like poor comprehenders) may learn the information relevant to the planet Gan adequately but may then still fail to make an inference from this knowledge when required to do so on a reading comprehension test.

Thus, the problems that poor comprehenders have in answering inference questions are unlikely to be due to limitations in their relevant knowledge, since both groups of children were equally accurate in answering direct questions about this knowledge base. However, equivalent levels of performance on such questions cannot be taken to mean that this knowledge was represented in memory in the same way in both groups of children. It is quite possible that the newly learned information about the planet Gan was less efficiently organized in memory in the poor comprehenders. In line with this possibility, the poor comprehenders in this study were slower to learn the information that they were taught about Gan and they forgot this information more quickly than the control children. The poor comprehenders were also worse at answering literal comprehension questions (questions that did not require inferences). A reasonable conclusion is that problems with inferences are among the problems experienced by poor comprehenders when reading text but that these problems may well reflect more basic processing limitations (such as problems with the organization and storage of information in semantic memory).

Comprehension monitoring deficits in poor comprehenders

Comprehension monitoring refers to the ability to detect when comprehension of a text has broken down and it is an important source of individual differences in reading comprehension even after the effects of verbal skills and working memory are controlled (Cain, Oakhill, & Bryant, 2004). Ehrlich, Remond, and Tardieu (1999) investigated the role of metacognitive monitoring in the processing of anaphora in expository texts by 10-year-old poor comprehenders using a direct self-evaluation task and an inconsistency detection task. The study made use of a self-paced reading procedure in which segments of sentences within paragraphs were displayed on a computer screen and the children advanced the text to the next screen when they were ready to do so; they were also able to review the text if they wished.

In each text, target anaphors were embedded in sentences preceded by one or two introductory sentences. Sentences containing anaphors were segmented into meaning units: Unit 1 contained the target anaphor; Unit 2 and Unit 3 followed and provided further information about the referent. The rationale was that an increase in reading time on critical clauses would reflect implicit evaluation and revision, and

the number of times each child "looked back" would reflect explicit evaluation. Finally, for each text, comprehension was assessed using multiple-choice questions.

In the self-evaluation task, each child first read the whole text and then re-read it segment by segment, assessing their own comprehension on a six-point scale. For critical segments, the antecedent of the anaphor was always a subject noun in the preceding sentence. Anaphors were denoted by the repetition of a noun or by a pronoun and they differed in their syntactic function, referring to either the subject or the object of the sentence. To illustrate, in the example below the anaphor functions as the subject of the critical segment in italics (Unit 1) and the following two segments convey further information (Unit 2 and Unit 3):

> Discovering sea animals is a constant source of surprise. Shells brought by the waves are plentiful on most shores. After the tide / *these shells (they) can be picked up* / in the puddles left in the holes on the rocks / or even more easily in the sand covered by sea weeds.

The object versions were identical in structure except for the critical segment:

> *After the tide / people can pick up these shells (them)* / in the puddles left in the holes on the rocks...

The texts were similar for the inconsistency detection task except that target anaphors either repeated the same lexical content or changed this content to a different one with the same gender and number cues but a meaning discontinuity in the text. The children's task was to find the word in each case that did not fit with the text.

In the self-evaluation task, the reading times were longer for the poor comprehenders than for the good comprehenders but processing time was similar in the inconsistency detection task. Importantly, the objective of detecting the inconsistency led to a slowing of some 39% for good comprehenders but only 11% for poor comprehenders, suggesting that skilled comprehenders are better able to modulate their reading when texts lacked coherence. The effect of anaphor consistency was significant but there were group differences. Whereas good comprehenders showed a significant increase in reading time with inconsistency in Unit 1 and extending into Unit 2, poor comprehenders only showed a marginal increase in reading time in Unit 1 and not in Unit 2 or Unit 3. In a similar vein, poor comprehenders made fewer "look backs" and these did not seem to be a function of inconsistency. They also detected fewer inconsistencies and when they did they found it difficult to identify the word at stake. Less skilled comprehenders evaluated their own comprehension as poorer than that of good comprehenders, however there was also an indication from their responses to multiple-choice questions that they tended to overestimate their ability. Overall, the data suggest that poor comprehenders are sensitive to a lack of cohesion but they cannot identify why it occurs. It seems that difficulties in anaphor processing are related to deficiencies in metacognitive monitoring but the causal relationships between these two aspects of comprehension are unclear.

In summary, we still do not have a good understanding of what underpins comprehension monitoring, though a reader's attitude is likely to play a role (Cataldo & Cornoldi, 1998). Indeed, engagement with reading is central to the development of a personal standard of coherence for comprehension (van den Broek, Young, Tzeng, & Linderholm, 1999). Put simply, it is critical for a child to have the objective of understanding what they read and to be motivated enough to "look back" with the purpose of self-correction when something does not make sense. A lack of such motivation may characterize poor comprehenders who do not enjoy reading because they have struggled for many years to understand what they read.

Longitudinal Studies of Children with Reading Comprehension Impairment

It is notable that most of the studies we have described in this chapter are cross-sectional and deal with concurrent relationships. We know of only a handful of longitudinal studies of children with reading comprehension impairment.

An issue that arises when considering the longer term outcome of children with reading comprehension impairment is the stability of the poor comprehender profile. Cain and Oakhill (2006) followed a group of poor comprehenders and a group of normal controls from the ages of 8 years. At follow-up when the children were 11, the majority of poor comprehenders remained poor on a measure of reading comprehension (the Neale Analysis of Reading Ability), and their outcome was predicted by general cognitive ability.

Similar results were obtained from two unpublished studies by K. Nation (personal communication). The first of these was a 6-year follow-up of the poor comprehenders studied by Stothard and Hulme (1992). Of the 28 children in the original sample, 23 were available for reassessment at 13 years of age: 13/14 poor comprehenders and 10/14 CA controls. The level of reading comprehension in the poor comprehender group remained very poor, with the group mean being more than 3 SD below that of the control group. The second study was a follow-up of 18 poor comprehenders originally described by Nation and Snowling (1998a,b) supplemented by a further five children in each group not previously reported. As a group, children identified as poor comprehenders at age 8.5 years continued to show reading comprehension deficits some 4.5 years later. All of the poor comprehenders achieved reading comprehension scores below the mean of the control group at Time 2, and only 4 of the 18 children scored within 1.5 SD of the control mean. Almost half of the sample achieved reading comprehension scores that were in excess of 2 SD below the average level of the control readers.

Catts et al. (2006) investigated the stability of the poor comprehender profile by starting at a later age with a group of poor comprehenders identified in 8th grade and conducting retrospective analyses of their profiles at earlier stages in development. Although it was generally the case that the poor comprehenders had shown oral language difficulties through time, an unexpected finding was that they also showed deficits in phonological awareness in kindergarten when compared with CA controls. There was also a change in their reading status over time, as shown in Box 3.7.

Is it possible that poor comprehenders develop more widespread reading difficulties as they get older? It has already been noted that there is a tendency for poor comprehenders to have difficulty in reading exception words, particularly if they are of low frequency. Furthermore, it would be surprising if comprehension deficits, particularly problems making inferences, did not constrain the growth of a reading vocabulary.

Some evidence that poor comprehenders suffer a decline in reading accuracy over time comes from a study of the reading skills of children with specific language impairment (Bishop & Adams, 1990; Stothard, Snowling, Bishop, Chipchase & Kaplan, 1998). At the age of 8 years, these children (who had experienced preschool language delay) had significantly better reading accuracy than comprehension (the poor comprehender profile). However, a follow-up some 7 years later found them to have more general reading difficulties affecting word recognition, nonword reading, and reading comprehension. It seems likely that these children, who had underlying language weaknesses, had failed to keep pace with their peers because of comprehension difficulties, perhaps coupled with poor motivation to read that resulted in very little reading practice. Moreover the decline was most significant for those with nonverbal IQ below 100.

In summary, there may be more than one developmental pathway to reading comprehension impairments. Furthermore, the nature of cognitive impairments of poor

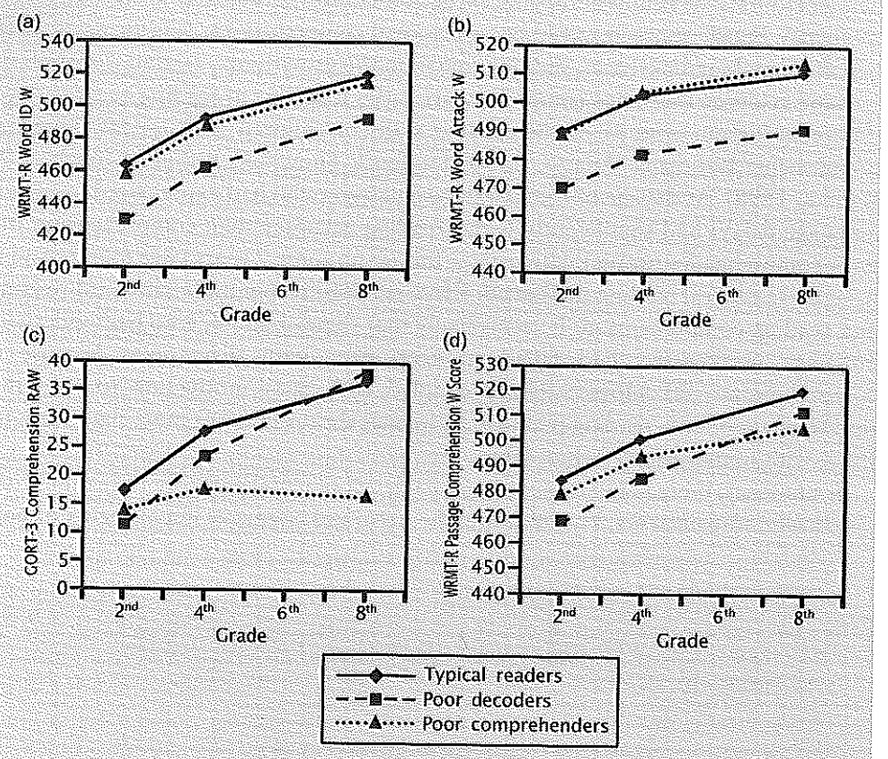
Box 3.7 Growth in reading in poor comprehenders and poor decoders

The four graphs shown below illustrate the pattern of growth on different tests of reading skill for poor comprehenders, poor decoders (equivalent to children with dyslexia), and typical readers in the longitudinal study of Catts, Adlof, and Ellis Weismer (2006). The top two panels show: (a) growth in word recognition (WRMT-R Word ID) and (b) decoding (WRMT-R Word Attack) for the four groups. It is clear that the poor comprehenders and typically developing readers show identical starting points and equivalent growth on these measures between Grades 2 and 8, while the poor decoders show a consistent impairment on these measures across the range of ages studied.

The bottom two panels show growth in reading comprehension as assessed by: (c) the GORT comprehension test and (d) the Woodcock-Reading Mastery Passage comprehension test. On the GORT, the poor comprehenders show severe deficits in reading comprehension that are evident from Grade 4 onwards. In contrast, they actually scored better than the poor decoders on the Woodcock-Reading Mastery Passage comprehension test, which places a heavy emphasis on decoding accuracy (although their performance begins to dip between Grades 4 and 8).

The differing patterns in the top and lower graphs underline the fact that different tests of reading comprehension may pose differing demands.

Box 3.7 *(cont'd)*



Growth in components of reading from Grade 2 to 8. (Reprinted with permission from Language deficits in poor comprehenders: A case for the simple view, by H. W. Catts, S. M. Adlof, and S. E. Weismer. *Journal of Speech, Language and Hearing Research*, 49(2), 288–289. Copyright 2006 by American Speech-Language-Hearing Association. All rights reserved.)

comprehenders may change with age in complex ways. Longitudinal studies are badly needed to investigate the causes as well as the consequences of reading comprehension impairments.

Summary of Core Cognitive Deficits and Likely Causes of Reading Comprehension Impairment

Children with reading comprehension impairment have difficulties that appear as marked on measures of spoken language comprehension as on measures of reading

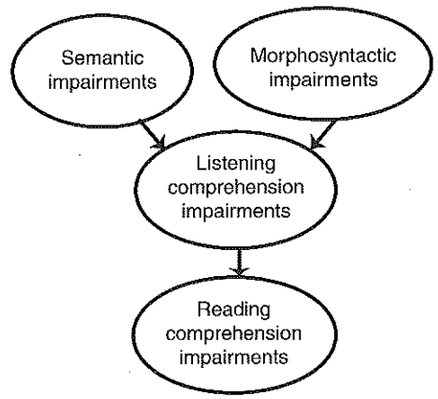


Figure 3.7 Path diagram showing listening comprehension impairments as a mediator of reading comprehension impairments.

comprehension. The studies we have reviewed indicate that these children have basic difficulties in the domains of semantics (understanding word meanings) and grammar (dealing with word formation and understanding how syntactic forms convey meaning). In fact, the language difficulties of a sizable proportion of these children are so severe that they would qualify for a diagnosis of specific language impairment (although the majority of children identified in research studies have never received such a diagnosis). In contrast, these children's phonological skills appear normal in relation to their age. When reading, these children also show problems with higher-level inference skills and have problems linking ideas from different parts of the text and relating what they have read to their general knowledge. It is likely that similar difficulties would be in evidence on tests of spoken language comprehension, though such studies have not been done.

A parsimonious theory of the cognitive bases of reading comprehension impairment in children is shown in Figure 3.7. In this theory there are two partially independent causes of reading comprehension impairment: problems with semantics and problems with morphosyntax. These are impairments of the oral language system, and such problems lead directly to problems with understanding spoken language (listening comprehension impairments). In this theory, the children's problems with reading comprehension are entirely the product of problems with listening comprehension, just as proposed by the Simple View of Reading model.

This theory is certainly a simple and a testable one, but it is probably too simple. The theory shown in Figure 3.8 is a slight elaboration of the theory. Here we postulate an impairment (or set of impairments) in processes specific to reading comprehension. A likely candidate for such an impairment would be a deficit in comprehension monitoring, but there could be others (such as motivational problems to do with a lack of interest in reading, caused by a history of failing to understand what has been read). This alternative theory sees reading comprehension

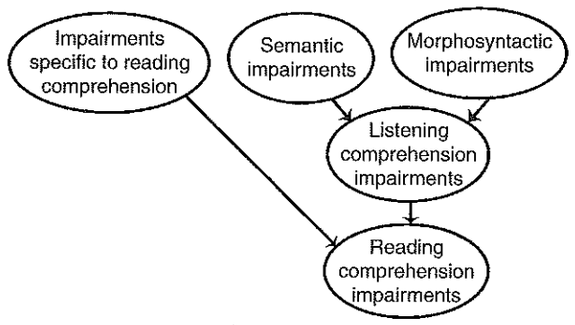


Figure 3.8 Path diagram showing separable causes of reading comprehension impairments.

impairment as being heavily dependent on underlying weaknesses in oral language skills, but with an additional contribution from processes specific to reading.

Speculatively, we would suggest that the first theory might be close to the state of affairs seen in young children with reading comprehension impairment, while the second theory might be closer to the truth for older children with reading comprehension impairment. Given a basic impairment in oral language skills that prevents the development of adequate listening and reading comprehension skills, it is likely that failing to comprehend what is read will have knock-on effects and prevent the child developing strategies (such as comprehension monitoring) that are important for skilled reading comprehension.

Etiology of Reading Comprehension Impairment

Reading comprehension impairment arguably is a less specific or circumscribed disorder than dyslexia and has also been much less studied. For both of these reasons less is known about the possible biological bases of reading comprehension impairment. To our knowledge neither behavioral genetic nor brain imaging studies have been conducted with children selected to show the poor comprehender profile. However, there are some relevant studies that we will outline below.

Genetics of reading comprehension

It seems probable, given its association with language impairment, that genetic influences on reading comprehension impairment will be substantial. One indirect way of assessing this is to consider the role of genetic factors in the development of verbal ability (verbal IQ). We know that reading comprehension impairment is associated with low verbal ability and it is plausible that the deficits in language skills picked up by tests of verbal ability (particularly tests of vocabulary knowledge) are causes of reading comprehension problems. It is well established that verbal ability shows a substantial heritability: in the region of .5 to .6 (for a review, see Plomin, DeFries,

McClearn, & Rutter, 1997). It is likely, therefore, that the verbal deficits that underlie reading comprehension impairment will show significant genetic influence.

A behavior–genetic analysis of reading comprehension was reported by Keenan, Betjemann, Wadsworth, DeFries, and Olson (2006) using a sample of twins from the Colorado study. The sample consisted of 74 MZ, 60 same-sex DZ and 62 opposite-sex DZ twins with a mean age of 11 (ranging from 8 to 17 years) in which at least one member of each pair had reading difficulties. Each child was tested on an extensive test battery. In brief, the measures used for the analysis comprised composite scores of word recognition, listening comprehension, reading comprehension, and IQ. The first aim of this study was to estimate the heritability of individual differences in reading comprehension (see Chapter 1). However, a second aim was to assess the extent to which genetic influences on reading comprehension were shared with genetic influences on word recognition and on listening comprehension.

The analysis used a technique known as Cholesky decomposition, which is a statistical procedure equivalent to hierarchical regression that can be used to estimate how much genetic (or environmental) variance in one trait is shared with genetic (or environmental) variance in another trait. The first analysis was conducted using measures of word recognition, listening comprehension, and reading comprehension. Each of these traits was found to be significantly influenced by genetic factors, with reported heritability estimates of .61 for word recognition, .51 for listening comprehension, and .61 for reading comprehension. Just two independent genetic factors accounted for all of the genetic influence on reading comprehension (see Figure 3.9). The first factor (A1) significantly accounted for individual differences in all three composites: word recognition, listening comprehension, and reading comprehension. After the influence of this factor was taken into account, a second genetic factor (A2) accounted for additional variance in listening and reading comprehension. The third genetic factor tested in the model accounted for no variance

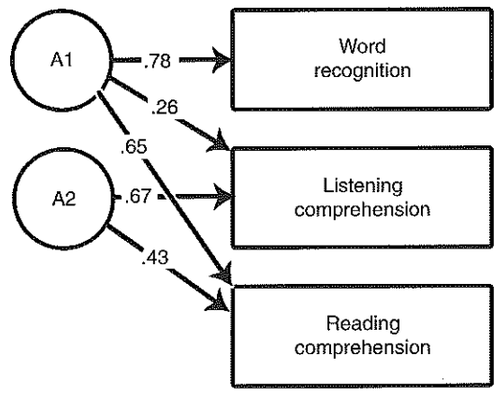


Figure 3.9 Diagram illustrating multiple genetic influences on reading comprehension. (Reprinted with permission of UKLA from Keenan, J., Betjemann, R., Wadsworth, S., de Fries, J., and Olson, R. Genetic and environmental influence on reading and listening comprehension. In *Journal of Research in Reading*, 29(1), 2006.)

in reading comprehension after the influences of the earlier two factors were taken into account. In sum, genetic influences on word recognition and listening comprehension together fully account for individual differences in reading comprehension, a finding that is entirely in keeping with the predictions of the simple view of reading. Moreover, there was one shared environmental influence on all three measures, suggesting that aspects of the home or school environment probably contribute to individual differences in reading and language skills.

As predicted then, there is substantial genetic influence on individual differences in reading comprehension. However, to what extent might this be related to variations in general cognitive ability? To investigate this issue, Keenan and colleagues reported a second analysis of their data, this time first examining genetic influences on IQ and then investigating the extent to which these were shared with other genetic influences on individual differences in reading comprehension. The heritability of IQ in this sample was .68 and the genetic influences on IQ also accounted for variance in word recognition, listening comprehension, and reading comprehension. After the effects of the genetic influences on IQ were taken into account, a second genetic factor accounted for variance in word recognition and reading comprehension but, interestingly, not in listening comprehension. A third genetic factor accounted for variance in both listening and reading comprehension. Together, these findings imply that there is a significant amount of IQ-independent genetic influence on listening comprehension. The authors suggest that this may be due to skills such as comprehension monitoring or inference generation that are not typically tapped by IQ tests but influence reading comprehension.

A limitation of this study was its relatively small sample size for a twin study and the wide age range of children tested. It would be interesting to know if the pattern of genetic and environmental influences on reading comprehension differs with age. It may well do if, as suggested earlier, poor reading comprehension takes its toll on the development of efficient metacognitive strategies, such as comprehension monitoring, over time.

Neural correlates of poor comprehension

Just as for genetic research, there is a paucity of evidence on the neurobiology of poor comprehension. Leonard, Eckert, Given, Berninger, and Eden (2006) examined the neuroanatomical correlates of reading and language in children with or without reading comprehension impairment. Although none of the participants in this study showed a specific "poor comprehender" profile, Leonard et al. (2006) were able to show that those with decoding impairments without comprehension deficits (a profile similar to dyslexia) differed from those with comprehension impairments in terms of brain anatomy. This study built on previous work from the same group suggesting that a composite measure of brain structure in a number of critical regions, the anatomical risk index (ARI), differentiates children with language impairments from typically developing children and children with dyslexia (see Chapter 4). A novel aspect of the study was the attempt to relate this quantitative index of neuroanatomy to behavioral measures of reading and language.

Structural MRI scans were available from 22 children aged 11–16 years who had been tested on a battery of tests comprising measures of phonological skills, rapid automatized naming (RAN), reading and reading comprehension, and receptive and expressive language. The anatomical risk index was calculated for each child from measures of the asymmetry of the planum temporale, combined plana and cerebellar anterior lobe, cerebral volume, and surface area of the first and second Heschl's gyrus (Leonard et al., 2002). Values of the anatomical risk index ranged from negative to positive, with zero representing normal (or low) risk. Two anatomical subtypes were created by splitting the risk distribution at zero.

For present purposes, the important finding was that there was a significant correlation between both reading comprehension and receptive language and the anatomical risk index, with a preponderance of children with negative indices having poor comprehension. Thus, they tended to have smaller cerebral volume and specifically smaller surface area of Heschl's gyri than normal and relatively less leftward asymmetry of the planum temporale, plana, and cerebellar anterior lobe. However, the same children also tended to have multiple deficits in reading and language, so it is not possible to assess the extent to which the risk index was related to comprehension per se. In contrast, children with a more "dyslexic" profile, who had less pervasive difficulties and were free of comprehension problems, tended to have positive risk indices.

A limitation of this study was its small heterogeneous sample and the absence of IQ measures for some of the participants. The findings are therefore badly in need of replication. However, the study suggests that the patterns of brain anatomy associated with reading comprehension deficits probably differ from those associated with dyslexia. This is to be expected, given the growing body of evidence that poor comprehenders have quite widespread language processing difficulties whereas those with dyslexia have more circumscribed difficulties affecting phonological processing. In summary, given its strong relationship with language impairment, it is likely that poor reading comprehension is the product of genetic risk factors associated with differences in the development of brain mechanisms responsible for oral language. However, reading comprehension depends on the use of higher-level comprehension strategies that are fine-tuned over time. The role of environmental influences in producing the poor comprehender profile should not therefore be underplayed. There is, to our knowledge, no research to date that addresses these issues.

Interventions for Reading Comprehension Impairment

Evidence concerning interventions for reading comprehension impairment is limited. A meta-analysis of reading comprehension interventions designed for typically developing children reported that the eight most effective methods for improving text comprehension were: comprehension monitoring, cooperative learning, graphic/semantic organizers for learning new vocabulary, story structure training, question answering, question generation, summarization, and multiple strategy teaching (National Reading Panel, 2000). The "metacognitive" strategies that need to be in

place for proficient text comprehension were considered to be the ability to predict, question, clarify, summarize, and imagine. To varying extents, metacognitive strategies draw upon linguistic and cognitive resources and they can be used to help children to build coherent mental models of the texts they read. One method that has been advocated as a way of fostering good comprehension strategies is reciprocal teaching (Brown & Palinscar, 1985). In reciprocal teaching, children are first shown how to apply the strategies by their teacher, who models the process. Children then read a piece of text, paragraph by paragraph, and they learn to practise the strategies of:

- generating questions;
- summarizing;
- attempting to clarify word meanings or confusing text;
- predicting what will happen in the next paragraph.

The teacher supports the student while they practise, giving feedback and additional modeling as necessary. Gradually it is intended that the guided practice becomes a dialogue in which groups of students work together with a text, asking questions of one another, commenting on answers, summarizing, and improving the summary. In a similar vein, activities can include helping one another to infer the meaning of a word or to reason about story events.

Only a few studies so far have specifically investigated the effectiveness of interventions for children selected as poor comprehenders. Yuill and Oakhill (1988) developed an intervention to target inferencing skills. Inference training was compared with comprehension training (based on shared reading and the answering of comprehension questions) and rapid decoding training. Skilled and less skilled comprehenders aged 7 years each received seven sessions of training in one of the three intervention conditions. Reading comprehension ability was measured using the NARA II (Neale, 1997) and it was found that although less skilled comprehenders benefited significantly more from inference training and comprehension training than decoding training, there was no significant difference between the effectiveness of inference training and comprehension training. In the inference training condition gains in individual scores on the NARA were striking, with participants on average showing improvements in comprehension age of 17 months.

Oakhill and Patel (1991) focused on mental imagery training as a potential method for improving the reading comprehension skills of poor comprehenders. Twenty two poor comprehenders and 22 good comprehenders, taught in small groups were instructed using representational and transformational drawings, to picture stories in their minds. They were then encouraged to use their mental images to answer comprehension questions. Oakhill and Patel (1991) found that poor comprehenders benefited more from imagery training than good comprehenders and suggested that "the ability to use imagery strategies may give poor comprehenders a way of helping to circumvent their memory limitations ..."(p. 114). Benefits of mental imagery training for story comprehension were also reported for a small group of children with SLI by Joffe, Cain, and Maric (2007). However, in this study, as in that of

Oakhill and Patel, there was no untreated control group of children with reading or language difficulties, which makes the changes produced by the training difficult to interpret (they may partly be due to simple practice or retesting effects). Nevertheless it seems that the effectiveness of mental imagery strategies as a method of improving reading comprehension skills is worthy of further study.

Johnson-Glenberg (2000) examined whether poor comprehenders would benefit more from a visual training program or a verbal training program. The verbally based reciprocal teaching (RT) program (Brown & Palinscar, 1985) was compared to a visually based visualizing/verbalizing program (Bell, 1986). Fifty-nine poor comprehenders assigned to either one of the training programs or a control group participated in small group teaching over 16 weeks. Both training programs were similarly effective in improving poor comprehenders' reading, language, and memory skills associated with reading comprehension ability. Johnson-Glenberg (2000) suggested that a combination of the two strategies might be particularly powerful.

These studies have taught specific components of reading comprehension and have generated some promising improvements in the reading skills of poor comprehenders. To our knowledge, however, none of these approaches have been evaluated using randomized controlled designs in realistic educational settings.

Summary and Conclusions

Reading comprehension impairment contrasts sharply with the pattern of reading difficulty seen in children with dyslexia. Many children with reading comprehension impairment read with normal speed and accuracy but have great difficulty understanding what they have read; in contrast children with dyslexia struggle to read accurately but may be good at getting the gist from a passage they have great difficulty in decoding. We need to emphasize that these contrasting patterns are extremes, and there are many children with poor reading skills who have both sorts of difficulty (these children have sometimes been termed "garden variety" poor readers; Stanovich, 1994).

The contrasting patterns shown by children with reading comprehension impairment and dyslexia are important practically and theoretically. Theoretically, as we have seen, these two disorders provide evidence that different parts of the language system (phonology, semantics, and grammar) develop somewhat independently. These different language subsystems in turn provide the foundations for different aspects of reading. Word recognition skills in reading depend critically upon phonological skills, while comprehension of text that has been decoded depends upon semantic and morphosyntactic (grammatical) skills.

So far we know less about the cognitive characteristics of children with reading comprehension impairment than we do for children with dyslexia. The best evidence to date indicates that poor comprehenders have difficulties with nonphonological language skills and listening comprehension. At a more detailed level there is evidence that these children have semantic processing difficulties and problems with aspects of grammar, as depicted within the Morton and Frith (1995) framework shown in

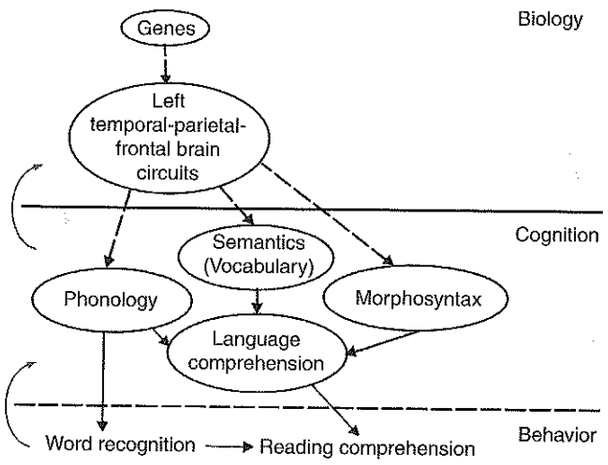


Figure 3.10 Path model showing possible sources of reading comprehension deficits.

Figure 3.10. Together, these basic deficits can be expected to affect the growth of vocabulary knowledge and the ability to make inferences while reading (processes that are essential to text integration) that are part and parcel of the poor comprehender profile. In turn, persistent problems with comprehension may affect the development of metacognitive strategies, such as the "lookback" strategy and compromise comprehension monitoring. Such semantic and grammatical problems may also relate to differences in the way that verbal information is encoded and stored in memory. In this sense we agree with Perfetti, Marron, and Foltz (1996, p. 159) that problems of reading comprehension can be seen as consequences of more basic language comprehension impairments: "the operation of basic processes that identify words, activate their meanings, configure phrases, assemble meanings and so forth." It seems likely that problems with comprehension monitoring may develop as a consequence of reading comprehension difficulties and there is some evidence that intervention programs can effectively foster the development of such strategies.

In conclusion, we started this chapter with the Simple View of Reading model and within this model poor comprehenders are children with good decoding but poor listening comprehension skills. Such children's difficulties can also be related to the triangle model. When viewed in terms of this model, poor comprehenders have set up the phonological pathway proficiently but have impairments in the semantic pathway, possibly as a consequence of deficient semantic representations. But as we have seen, the problems of poor comprehenders extend well beyond single word reading. As yet, the causal connections between different language skills and the different components of reading comprehension are not well understood and we badly need more longitudinal studies to understand the processes that are operating.

4

Specific Language Impairment

Problems in understanding or producing language are among the most frustrating and isolating handicaps that a child can experience. The term specific language impairment (SLI) is used to refer to children whose oral language skills are much worse than expected given their nonverbal ability (NVIQ) and where other known causes (e.g., deafness) cannot explain the disorder. Recent evidence suggests that SLI is a neurobiological disorder, the development of which depends heavily upon genetic risk factors. However, there is considerable heterogeneity among children with SLI in the pattern of language difficulties that they show; as we shall see, some children with SLI have speech difficulties while others do not, some have difficulties with the social use of language, and others may be effective communicators despite difficulties with expressive language skills.

Definition and Prevalence

The term *Communication Disorders* is used in DSM-IV (American Psychiatric Association, 1994) to describe children who are referred to clinically as SLI whose scores obtained on individually administered measures of language development are below expectation given "nonverbal intellectual capacity." The term can also be applied if a child has suffered an accompanying sensory deficit, learning difficulties, or environmental deprivation, provided that the language difficulties are in excess of those usually associated with these other problems. DSM-IV goes on to distinguish several types of communicative disorder, including expressive disorder (primarily affecting language production), mixed expressive–receptive disorder (affecting language comprehension and production), and phonological disorder (affecting the use of speech sounds to signal meaning). (DSM-IV also has the diagnostic categories of Stuttering and Communication Disorder Not Otherwise Specified. These categories are not relevant to the discussion of SLI as they refer to difficulties with, for example, fluency or voice that impede communication but are not associated with a disorder of language development.)