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Literacy Development: Evidence Review

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The EEF Guidance Report **Improving Literacy in Secondary Schools** is available at: https://educationendowmentfoundation.org.uk/tools/guidance-reports/improving-secondary-literacy/

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Executive summary

The Department for Education (DfE) recently stated:

> *'Nothing is more important in education than ensuring that every child can read well' (DfE, 2015 p7).*

Yet, the U.K. ranks 22nd in the world for reading achievement at 15 years (OECD, 2016) and 15% of adults lack functional literacy (DfBIS, 2012). Clearly, we need to do more to ensure that all children learn to read and write effectively.

Literacy includes the word-level skills of word reading and spelling and the text-level skills of reading comprehension and writing composition. These skills are involved in virtually all everyday activities. As a result, poor literacy impacts on every aspect of life.

Word reading, spelling, reading comprehension, and writing composition are supported by similar language and cognitive skills as well as affective and environment factors. Learning to be literate builds upon existing knowledge of the language from speech. Becoming literate then enables children to learn more about language. However, literacy is unlikely to be achieved without explicit and prolonged instruction.

This review provides an evidence base for decision-making during literacy education. We identify key skills that must be in place to enable children to reach their optimum potential and highlight where weakness can suggest a need for extra support. We begin by discussing models of literacy development as these models provide a framework within which to present the evidence base for the rest of the review. We then consider the underlying skills in greater depth, beginning first with the proximal factors that underpin word-level and text-level reading and writing. Then we consider distal child-based and wider environmental factors that indirectly impact on literacy development.

Models of literacy development

Models of skilled literacy describe the processes used in reading and writing. Models of literacy development explain how children acquire these processes. Understanding these processes highlights the skills and knowledge that a child needs to have to be able to read and write effectively. To some extent, reading and writing depend on similar skills. We describe an overall model of literacy development that summarises the two domains, each of which has two levels:

- level—word or text; and
- domain—reading or writing.

At the level of individual words, both word reading and spelling depend upon three areas of knowledge and the connections between this knowledge (e.g., letter-sound rules, spoken vocabulary):

- sounds;
- letters; and
- meaning.

At the text level, reading comprehension and writing composition both require:

- good word-level skills;
- understanding of language structure;
- background knowledge (both topic knowledge and understanding of narrative structure); and
- verbal reasoning skills for building a mental model of the events described.

In reading comprehension, the meaning of text is rarely fully complete; it is necessary to make inferences to fill gaps, monitor comprehension, and slow down or re-read as necessary.

Spelling and writing composition are not simply the reverse of word reading and reading composition, production places greater demands on other cognitive processes:

- spelling requires greater specificity and different motor demands to word reading; and
- writing composition has greater demands on planning, goal maintenance, and working memory, even into adulthood.

Evidence for the factors that underpin literacy development

We divide factors that underpin literacy development into two broad categories: proximal factors, or those directly involved in the processes of literacy, and distal factors, or those underlying literacy. Different types of evidence are used to determine the factors that impact on literacy development. For example, some questions about development depend on following a group of children over time, while other questions require comparisons between different groups of children. Some research questions require number-based (quantitative) data, while others require language-based (qualitative) data. In this review we have focused on summarising the most robust evidence—findings that have been replicated across different types of high quality research studies. Where there are limitations in the evidence base or gaps in the literature, these are highlighted. For example, the influence of affective factors is a developing area of research, thus the evidence base is not as robust as the evidence for proximal factors.

Proximal factors that underpin literacy development

Proximal factors include skills used to form links between the spoken and written form of the language, and skills involved in constructing meaning.

Forming links between the spoken and written form of the language depends upon three component skills:

- phonological skills—the ability to recognise and manipulate the sounds that make up spoken words;
- orthographic skills—the written features of words that make up written words; and
- knowledge of common links between spoken and written words (e.g., letter-to-sound rules).

The meaning of text is constructed at many different levels, by both writers and readers. Meaning is constructed within words by the combination of morphemes. Words themselves often have multiple senses or meanings. Meaning is also constructed across words both within and between sentences. A range of skills directly influence a child's ability to construct meaning at each of these levels. These skills include:

- vocabulary depth and breadth;
- knowledge of morphology;
- grammar and syntax;
- discourse level skill such as construction of coherent mental models, comprehension monitoring, and standards for coherence; and
- pragmatics.

Distal child-based influences on literacy

Distal child-based factors impact on literacy development indirectly. In most cases, these factors impact on proximal skills that in turn affect literacy processes. Distal factors are generally less malleable and

the evidence for the mechanisms explaining how these factors influence literacy is less well developed. Here, we focus on the distal child-based factors that are most likely to impact on children within an average classroom.

Children with speech, hearing, visual, or motor difficulties are at greater risk of difficulties learning to read and write. Even relatively mild difficulties can have an additive effect. Children who have multiple difficulties are at greater risk of literacy difficulties.

- Children with persistent speech difficulties may have weaknesses in phonological skills. This can make it difficult to form links from spoken to written language (for example, using letter-to-sound rules) in order to read and spell effectively.
- Children who are deaf or have hearing loss are at risk of weaknesses in phonological skills, vocabulary, and language skills. These skills impact on a child's ability to form links from spoken to written language and constructing meaning during reading and writing.
- Children with visual and motor difficulties are likely to have difficulty with the eye and hand movements necessary for reading and writing.

Broader cognitive skills and processes such as rapid automatized naming, executive function, meta-cognition, and memory impact on the child's ability to read and write. However, these skills are difficult to train, and there is little evidence that training impacts on literacy attainment. It may be more effective to consider strategies to minimise the burden on these skills.

Affective factors such as reading motivation, attitudes towards reading, and perceptions of self are likely to impact on the amount of reading a child engages in. The more children read, the more print exposure they receive, which increases the opportunities to learn through self-teaching. Print exposure gives opportunities to encounter new words and grammatical structures, and to practice literacy skills and strategies.

Distal environmental influences on literacy

The broader environment not only impacts on the amount of reading and writing a child engages in, but also the nature of their experiences and their attitudes and motivations to read and write. There are many environmental factors which indirectly impact on literacy development. In this review, we focus on the role of family background, home literacy environment, language environment, and bilingualism. In many cases, it is neither possible nor desirable to try and change these factors. Even so, understanding the factors that influence a child's engagement with literacy outside the classroom is crucial to understanding how best to support the child within the classroom. While the home environment can influence the risk of a child developing literacy difficulties, high quality literacy education embedded within a rich school literacy environment can go a long way to overcome any challenges.

Environmental factors that likely are important for literacy development include parental attitudes towards literacy, family history of strengths or difficulties with literacy, and socio-economic status. It is often difficult to tease apart the impact of these different factors. These factors feed into the home literacy environment—the amount and nature of literacy-related activities that the child can engage with in the home.

Children with English as an Additional Language vary widely in their reading and writing. When considering the likely impact of bilingualism, the extent to which children can apply their existing knowledge is key. This will be influenced by:

- the amount of spoken and written English a child been exposed to;
- the age at which they began to learn English; and
- the amount of similarity between their first language and English.

Conclusion

To optimise every child's opportunity to reach their full potential, educators should consider the proximal and distal child-based and environmental influences on literacy development. Doing so is particularly important when considering how and why some children fall behind in literacy. Careful consideration of these different influences may help teachers to identify the best next steps to make teaching both effective and efficient.

SECTION 1: What is literacy?

Section summary

This section defines the scope of the review. Literacy includes the word-level skills of word reading and spelling, and the text-level skills of reading comprehension and writing composition. These skills are involved in virtually all everyday activities. As a result, poor literacy impacts on every aspect of life.

Word reading, spelling, reading comprehension, and writing composition are supported by similar language and cognitive skills, affective and environment factors. Learning to be literate builds upon existing knowledge of the language from speech, and then extends this knowledge. However, literacy is unlikely to be achieved without explicit and prolonged instruction.

This review provides an evidence base for decision-making during literacy education. We identify key skills that must be in place to enable children to reach their optimum potential and highlight where weakness can suggest a need for extra support.

'Literacy' describes a wide range of different skills. Here, we operationalise literacy to include the word-level skills of word reading and spelling, and the text-level skills of reading comprehension and writing composition. Each of these branches of literacy are separable from one another. Some children read words fluently but have difficulty comprehending what they have read. Other children make a lot of spelling errors but show excellent reading comprehension. Even so, the branches of literacy do not develop in a vacuum. Literacy skills are not only co-dependent on each other, but their development depends on an eco-system of inter-related language and cognitive skills, as well as affective and environmental factors. Some factors are more influential on particular branches of literacy, at certain points in development, and under certain environmental conditions. Nonetheless, the interdependent nature of the various literacy skills demands a holistic approach that considers the impact of both top-down and bottom-up processes.

Reading and writing seem to come effortlessly to literate adults. This can make it hard to comprehend the complexity of the challenge faced by children as they embark on the task of learning to read and write. Literacy development involves the combined efforts of a wide range of pre-existing abilities, as well as learning new skills. Historically, orthography (the written form of the language) evolved from speech. Speech is the primary communicative form; the orthography is an alternative set of visual symbols arbitrarily 'mapped' onto speech. The goal of any communication system is to share information. Orthography enables humans to communicate across time and space. As we read, we try to understand what message the author intended to send. When we write, we try to share information in a way that ensures that others will understand our intended meaning. For children, the process of learning to be literate involves deciphering how to receive and send these messages.

Most children have good knowledge and experience of language in its spoken form before they begin to read and write. For most children, spoken language develops spontaneously, provided they are exposed to an environment rich in language. On the other hand, literacy is very unlikely to be achieved without explicit and prolonged instruction. Literacy is 'parasitic' on knowledge from speech (Liberman, A., 1968 in Kavanagh, 1968). Literacy is not so naturally achieved: it relies on using and augmenting existing cognitive systems for spoken language. Most theories of literacy acquisition are explicit about the use of existing systems.

1.1 Why does literacy matter?

In modern society, literacy is involved in virtually all everyday activities. As a result, poor literacy impacts on every aspect of life. Literacy education is such a core foundation of society that it is often used as a measure of socio-economic development. Poor literacy is estimated to cost the UK economy £81.3 billion per year (World Literacy Foundation, 2015). Children with poor literacy have difficulty accessing the curriculum and are therefore more likely to have poor educational outcomes (McLaughlin, Speirs, & Shenassa, 2014; Ricketts, Sperring, & Nation, 2014). In the longer term, this limits employment options, increasing rates of unemployment (McLaughlin et al., 2014; OECD, 2013) and even impacts on health (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). The Department for Education (DfE) recently stated:

> *'Nothing is more important in education than ensuring that every child can read well' (DfE, 2015 p7).*

Yet, the UK ranks 22nd in the world for reading achievement at 15 years (OECD, 2016) and 15% of adults lack functional literacy (DfBIS, 2012). Clearly, we need to do more to ensure that all children learn to read and write effectively.

1.2 Purpose of this review

The purpose of this review is to summarise typical literacy development in English writing systems, identifying the key skills that must be in place to enable children to reach their optimum potential. We aim to provide an evidence base for decision-making during literacy education by also highlighting where weaknesses can suggest a need for extra support. What follows is not an exhaustive review of the science of literacy development; rather, we provide a summary of the most influential models of word reading, reading comprehension, spelling, and writing. We highlight commonalties between theories, and focus on contributing factors that have the highest quality evidence for the greatest impact on literacy within typical development. Differences between theories or conflicting evidence are only discussed when this has significant educational implications or relevance. In this review, we do not attempt to generalise across written languages but instead draw heavily on research from English-speaking countries. There is some discussion of the differences in the structure of the English written language system compared to other languages on p83. This has considerable implications for children learning to read and write other written languages (particularly those that are not alphabetic).

1.3 Structure of this review

We begin by discussing models of literacy development (see SECTION 2: Models of literacy development) as these models provide a framework within which to present the evidence base for the rest of the review. Having described this overall model of literacy development, we then discuss the leading component theories in more depth. First, we describe theories of the underlying processes in skilled literate individuals, which helps to highlight the skills that children need to develop. We then go on to provide a description of typical development of reading and writing.

After describing models of literacy development, we consider the underlying skills in greater depth. We present this evidence in line with the Supermodel of Literacy Development, beginning first with the proximal factors that underpin word-level and text-level reading and writing (see p37). Then we consider distal child-based (see p63) and wider environmental factors (see p69) that indirectly impact on literacy development.

SECTION 2: Models of literacy development

Section summary

This section summarises key models of skilled literacy and literacy development. Models of skilled literacy describe the processes used in reading and writing. Models of literacy development explain how children acquire these processes. Understanding these processes highlights the skills and knowledge that a child needs to have to be able to read and write effectively. To some extent, reading and writing depend on similar skills. We describe an overall model of literacy development that summarises the two domains of literacy, each of which has two levels:

- level—word or text; and
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At the level of individual words, both word reading and spelling depend upon three areas of knowledge and the connections between this knowledge (e.g., letter-sound rules, spoken vocabulary):

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In reading comprehension, the meaning of text is rarely fully complete; it is necessary to make inferences to fill gaps, monitor comprehension, and slow down or re-read as necessary.

Spelling and writing composition are not simply the reverse of word reading and reading composition; production places greater demands on other cognitive processes:

- spelling requires greater specificity and different motor demands to word reading; and
- writing composition has greater demands on planning, goal maintenance, and working memory, even into adulthood.

While the details of models of literacy development vary, common to all is the understanding that spoken and written language are inextricably linked. The mental **lexicon** (our internal vocabulary or dictionary) stores representations of the words that we know, and this information is accessed by both speech and literacy systems. Theories usually apply the ***Lexical Quality Hypothesis*** (Perfetti, 2007; Perfetti & Hart, 2002) to describe the nature of the information within the lexicon. According to the lexical quality hypothesis, representations of words vary in detail. High quality representations specify features of the word-form such as the sounds and letters that make up the word. They include semantic information, such as multiple word meanings, links to related words, and synonyms. High quality representations also reflect grammatical information such as part of speech or number marking. All of this information overlaps such that high quality representations can be processed more quickly because there are more opportunities to activate the word. The more activation the word receives, the more quickly and easily

we understand the meaning, or find the correct pronunciation or spelling. In contrast, low quality representations are missing some of this detail. This makes it hard to access the word to retrieve the correct spelling, pronunciation or meaning. As children learn to read and write, they add orthographic (spelling) information to their lexical representations. This information is then used in reading, writing, speaking, and listening.

Most models of literacy development focus on a single area of literacy. Here, we present an overall model of literacy development in both reading and writing. This model illustrates that the skills that underpin literacy are of equal importance and are co-dependent on one another.

2.1 The Supermodel of Literacy Development

We begin with a description of the mechanisms involved in reading and writing, first at the level of individual words and then at the level of text. At the core of the Supermodel of Literacy Development is the principle that the overall aim of reading and writing is communication between an author and a reader. The child's role in this process differs depending on whether they are reading or writing but in both cases the goal is to share meaning.

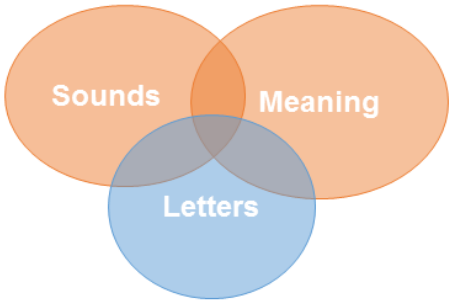

Figure 1: Word-level literacy processes

When a child is learning to link text-to-meaning at the level of the word, literacy depends upon three components of word knowledge: meaning, sound structure in spoken language, and the letters in written language (see Figure 1). We present these components as overlapping to represent both how the information is stored in the lexicon (see Lexical Quality Hypothesis p10) and the multiple bidirectional pathways through which children can get from text-to-meaning and back again (see Dual Route Model p17, Grain Size Theory p18, and Theories of skilled spelling p27). For example, children begin to read and spell with a large number of words in their speech vocabulary. In Figure 1, words in a child's speech vocabulary are represented by the overlap between the components 'sounds' and 'meanings'. The word in the lexicon has representations for both components, and links between the two.

As children learn rules that link letters and sounds, this knowledge forms the overlap between the 'letters' and 'sounds' components of the model (Figure 1)—such as when learning systematic synthetic phonics. At this point, children could access the meaning of a word by translating letters-to-sounds and then access meaning from the speech vocabulary. In all of the overlapping regions of the Supermodel, there can be multiple unit sizes—for example, children can link letters to sounds at the level of single phonemes or larger units (see Grain Size Theory p18).

Through development, representations of words within the lexicon (or vocabulary) become more detailed. Skilled readers and spellers use multiple links from letter-to-sounds-to-meaning but they also form direct associations from text-to-meaning. These direct associations are represented by the overlap between the 'meaning' and 'letters' components (see Figure 1). The goal of word reading and spelling

development is to achieve high quality representations of words with overlapping information about meaning, sounds, and letters—words that exist in the area that overlaps with all three components (see Lexical Quality Hypothesis p10).

Word reading and spelling are word-level components of literacy, but when comprehending and composing connected text many other skills come in to play. These skills are shown in Figure 2. The meaning of connected text includes, but goes beyond, the sum of the individual words and so at this level children need to combine understanding of meaning of particular words with the meaning conveyed by the structure of the text. To do so, they draw upon their prior experience of the world—background knowledge about the topic at hand and narrative knowledge about how written text works (see Reading Systems Framework on p22 and the Model of Skilled Writing on p31). This knowledge is used to make elaborative and literal inferences as meaning is constructed, and is therefore influenced by general verbal reasoning skills.

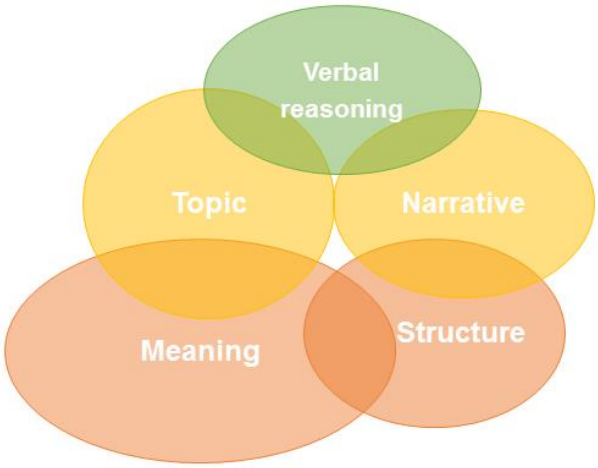

Figure 2: Text-level literacy processes

Hence, in the Supermodel of Literacy Development (see Figure 3) we highlight four types of knowledge that form the key components of literacy: *knowledge about the written language* (letters), *knowledge of language* (sounds, meaning and structure), *background knowledge* about the wider world (topic knowledge and understanding of narrative), and *reasoning skill*. We call these underlying cognitive mechanisms **proximal** to literacy. In the current review, we discuss development of these components in the context of forming links between the spoken and written form of the language (from p38) and language skills and constructing meaning (from p49).

The proximal factors described above are, in turn, influenced by a wide range of other factors, which we describe as **distal** to literacy. These distal factors indirectly influence literacy development. Some distal factors are specific to the child and others result from the wider environment (see Figure 4). Distal child-based factors include broader cognitive skills, amount of reading experience, and affective factors such as motivation. The role of these factors is discussed from p63. Distal environmental factors include socio-economic status and home literacy and language environment; these factors are described from p83.

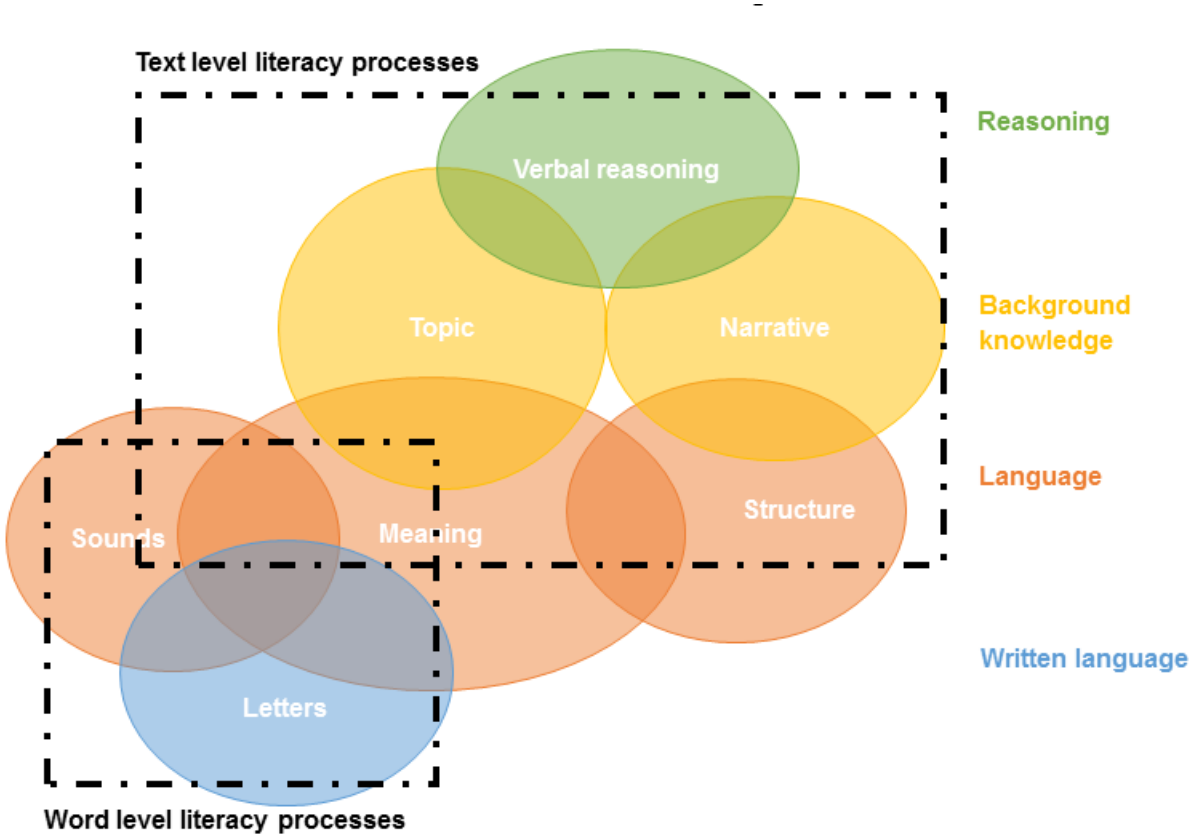

Figure 3: The Supermodel of Literacy Development

The Supermodel of Literacy Development provides a general framework to understand the key components of literacy development. We now discuss more precise models and theories of word reading and reading comprehension, and then spelling and writing composition.

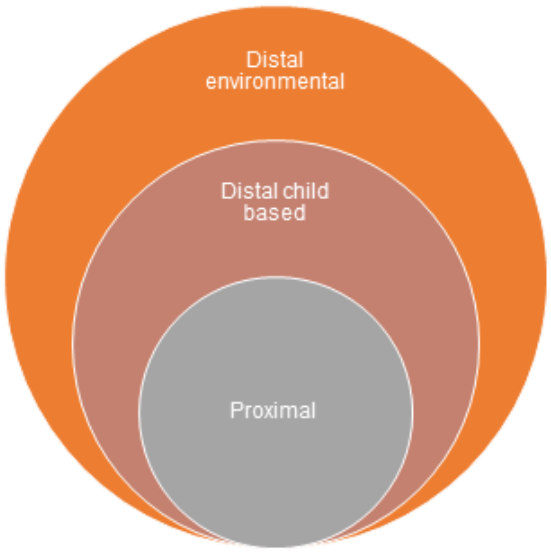

Figure 4: Proximal and distal factors influencing literacy development

2.2 Models of reading

Skilled readers build up meaning not simply based upon the sum of the individual words on a page, but in the combination of words within sentences, across passages and pages. As we read, our interpretation of meaning is constantly influenced by the inferences and assumptions we make, in addition to our pre-existing knowledge. Models of reading development must account not only for how we access the meaning of individual words, but also these comprehension processes. Most research has focused on the processes involved in either word reading or reading comprehension. Few have attempted to explain the combination of these processes. One popular exception is the Simple View of Reading, which provides a useful framework within which to understand the component processes.

2.2.1 The Simple View of Reading

The ***Simple View of Reading*** (see Figure 5) states that reading is the product of two complex, separable, but interlinked dimensions that are referred to as *decoding* and *linguistic comprehension* (Gough & Tunmer, 1986; Hoover & Gough, 1990; Tunmer & Hoover, 1992). A great deal of research supports the separable contributions of these two components (Adlof, Catts, & Little, 2006; Johnston & Kirby, 2006; Kieffer, Petscher, Proctor, & Silverman, 2016; Nation & Snowling, 1997; Tilstra, McMaster, Van den Broek, Kendeou, & Rapp, 2009). Decoding is defined broadly as recognition and understanding of visually presented words (not to be confused with letter-to-sound decoding). Several different terms have been used to describe the process of reading individual words.[1] To avoid any confusion with the mechanisms that underlie this dimension, here we refer to this as ***word reading***. This includes all word-level skills that enable decoding the written word, as well as the rapid activation that occurs in skilled reading (Perfetti, Landi, & Oakhill, 2005).

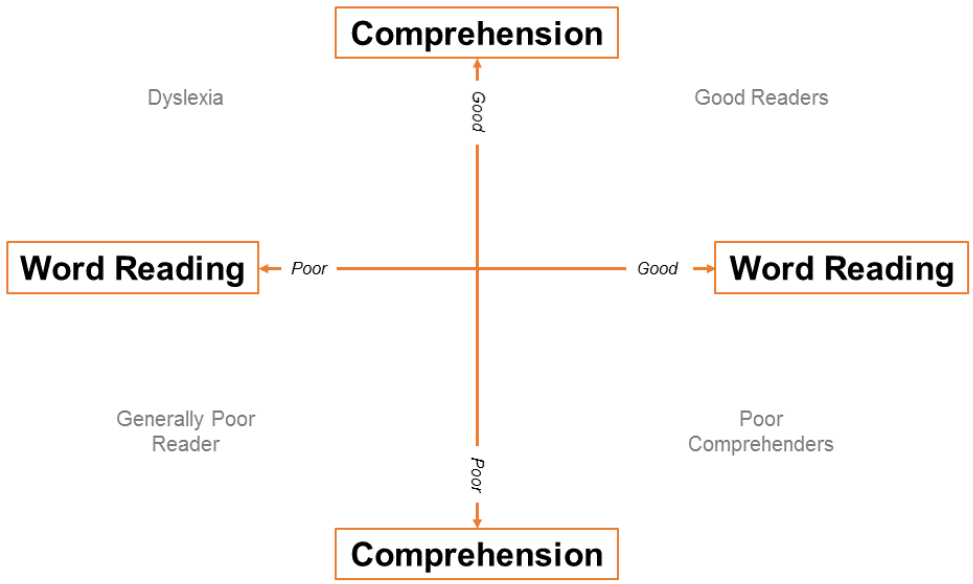

Figure 5: The Simple View of Reading with associated patterns of performance in word reading and language comprehension.

[1] Others have referred to this as decoding (Gough & Tunmer, 1986; Hoover & Gough, 1990), sight word reading (Ehri, 1995, 2005a, 2005b) and visual word recognition (Coltheart, 2006; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Grainger, Lété, Bertand, Dufau, & Ziegler, 2012; Grainger & Ziegler, 2011).

We refer to the second component of the Simple View of Reading as **comprehension**. Hoover and Gough (1990 p131) describe this as *'the ability to take lexical information (i.e., semantic information at the word level) and derive sentence and discourse interpretations'*. As we will describe in further depth later, comprehension processes do not only include language skills but all the skills required to form **mental models** or representations of the underlying message in the text. These include skills such as integration of word meanings and syntax, but also inferences which rely on background (topic and narrative) knowledge (Oakhill & Cain, 2000; Perfetti et al., 2005). We return to define these components of comprehension later (from p21).

Word reading and comprehension have unique underlying processes. Children with good word reading and comprehension read well. However, an individual may have strengths in one dimension but weaknesses in another (see Figure 5). Impairments or inefficiencies in word reading or comprehension both lead to reading difficulties. However, the nature of these difficulties can indicate where the problem lies (Nation & Snowling, 1997; Nation & Snowling, 1998a; Tunmer & Hoover, 1992). A key message for educators is that children will not necessarily show equal performance or progress across the two dimensions. As a result, different types of teaching and assessment are necessary to tap into these different skills (Rose, 2006).

At the beginning of development, word reading processes are so laborious that they necessarily restrict comprehension. Reading comprehension, like other cognitive processes, is necessarily limited by the amount of cognitive resources that are available. If word reading processes demand a lot of cognitive resources, little remains for other processes. For example, if individual words have to be decoded using letter-to-sound rules this places high demands on working memory. As a result, limited working memory capacity remains available for other aspects of processing, such as making inferences using word meanings across the text. Consistent with this, a correlational study of 626 American children from preschool to ten years old showed that word reading was a strong longitudinal predictor of reading comprehension at five to seven years old, but less so by nine to ten years old (Storch & Whitehurst, 2002).

As word reading skills improve, the processes that link writing and language at the word level stop limiting comprehension. At this point, the child's comprehension skills (such as their ability to use their background knowledge and reasoning skills—see Figure 3) become more important and dominant (Perfetti et al., 2005). In line with this, word reading ability contributes little to reading comprehension ability by the beginning of secondary school, at least for children with reasonably good word reading ability. The contribution of other skills increases through adolescence. For example, in a cross-sectional correlational study of 277 American children, word reading explained more variance in reading comprehension skill for nine- to ten-year-olds than 12- to 13-year-olds. Meanwhile the contribution of listening comprehension and vocabulary was larger in the older group (Tilstra et al., 2009). In a correlational study of 2143 Dutch children, word reading was a strong longitudinal predictor of reading comprehension at six years old, but had a small effect by 12 years old (Verhoeven & van Leeuwe, 2008). Vocabulary and listening comprehension had a reciprocal relationship with one another and their combined influence on reading comprehension increased with age. Over the course of development, the aim is for word-level reading skills to become less cognitively demanding—both more automatized and more fluent (LaBerge & Samuels, 1974; Samuels, 1994). Automatized and fluent word reading then free up cognitive resources for reading comprehension (discussed further on p25).

It is important to establish whether a child has difficulties in either or both components of reading. According to Tunmer & Hoover's (1992) conceptualisation of the Simple View of Reading, children with very poor word reading but good oral comprehension are described as **dyslexic**[2] (Nation & Snowling, 1997; Tunmer & Hoover, 1992)—see Figure 5. Around 7% of the population have sufficiently poor word

[2] Defining dyslexia is sometimes controversial, and discussion of this is beyond the scope of this review. See Vellutino et al (2004) for more details.

reading abilities to fall into this category (Peterson & Pennington, 2012). Of course, the dimensions are on a continuum, which means many more children will present with less severe word reading difficulties. Those children will also need additional support (Colenbrander, Ricketts, & Breadmore, 2018). Note, however, that these children do not have difficulty with comprehension—you will be able to see this in spoken activities—spoken language comprehension will be good. Under conditions where these children are able to read the individual words, reading comprehension is good (Nation & Snowling, 1998a). The next step for ameliorating reading difficulties amongst this group of children is to identify which of the processes that underpin word reading are impaired, and how to support those word-level processes. Assessment of these types of reading difficulties must include consideration of both oral and written language skills. Assessment of reading comprehension can be misleading if children have difficulty reading individual words. They might use so much cognitive effort to read the individual words that insufficient resources remain to apply their comprehension processes.

Children with good word reading but poor comprehension are sometimes defined as **poor comprehenders** (Nation & Snowling, 1998b) or **hyperlexic** (Tunmer & Hoover, 1992)—see Figure 5. Anecdotally, these children can be more difficult to spot in the classroom. Children with weaknesses in comprehension appear able to read the words on the page quite fluently, which may disguise their reading difficulties to some extent. However, these children will have poor understanding of what they have read and these comprehension difficulties may also be observable in spoken language activities. There is much variation in the criteria for this group of children, which makes it difficult to establish prevalence rates (see Clarke, Henderson, & Truelove, 2010). In a randomised controlled trial of reading comprehension interventions with 1120 British eight-years-olds, Clarke, Snowling, Truelove, and Hulme (2010) estimated that around 8% of the population fall into this category. These children are likely to benefit most from interventions that target language comprehension more broadly, not necessarily in the domain of reading comprehension specifically (for examples, see p38).

Finally, children with poor word reading and poor language comprehension have a double deficit, and are typically described as **generally poor readers** (Nation & Snowling, 1998a; Tunmer & Hoover, 1992). These children will need support for both word reading and language comprehension.

In the following sections, we describe the processes involved in word reading and comprehension. Then later we describe factors that contribute to these processes and how those skills typically develop.

2.2.2 Word reading

By far, the most intensely researched domain of both development and skilled literacy is word reading. We begin by considering the processes involved in skilled word reading. Then we discuss theories of how these processes develop from laborious single word reading to fluent reading of connected text. However, before going into this theory in depth we need to define terms.

Using our definition, **word reading** can be silent or oral. Either way, the goal is to extract meaning at the level of individual words. Some theories describe the word-level skills of *decoding* or *written word naming* (producing the sounds that make up the word), however this could be achieved without understanding the meaning of the words—as illustrated when we read nonsense words. Other theories refer to *visual word recognition,* however, this can also (arguably) be achieved without fully understanding the meaning of the word: at this point, the letters are simply understood to be a word. Word recognition and naming are likely to be components of oral and silent word reading, rather than synonymous with word reading.

2.2.2.1 Skilled word reading

Most theories suggest that skilled readers use multiple mechanisms simultaneously to get from text to meaning. Common across theories is the idea that one mechanism augments the existing speech system and at least one other links text to meaning more directly (Coltheart, 2006; Grainger et al., 2012;

Harm & Seidenberg, 2004). The *Self-teaching Hypothesis* suggests that we form print-to-meaning associations by initially accessing the lexical representations for a written form by translating it first into a spoken form. Each time we successfully decode a word in this way, it provides opportunities to learn word-specific print-to-meaning associations (Share, 1995). For example, the child who is able to sound out only the <b> and <k> of *'book'* may guess the correct pronunciation of the word, and from this experience then be able to read *'book'* next time they encounter the word. Word reading development, therefore, involves the formation of both direct and indirect links from text to meaning.

The *Dual Route Model* (see Figure 6) suggests that when we attempt to read a new word, an *indirect route* links speech and literacy systems (Coltheart, 2006; Coltheart et al., 2001). The written word is decomposed into smaller units, which are then translated into speech units—for example, using letter-to-sound conversion rules or phonics knowledge. The meaning of the word can then be accessed from speech vocabulary (sometimes described as the *phonological lexicon*). Readers can use this indirect route to decode (or sound out) words that have never been read before. Provided the word is in their lexicon they can not only say the word, but also access meaning.

Once a word has been repeatedly read in this way, direct links emerge from text to meaning. This *direct route* is particularly helpful when the reader encounters irregular spellings, where letter-sound conversion would be inefficient or error prone. It also accounts for the finding that high frequency words are read more quickly because decomposition is not necessary for these words (Coltheart, 2006; Coltheart et al., 2001).

Every time a word is encountered, skilled readers activate both direct and indirect routes to meaning simultaneously (see Figure 6). Some argue that the fastest route wins the race to meaning, while others argue that the two routes combine to have a summative effect on activation of the underlying representation (Coltheart, 2006; Coltheart et al., 2001). The more activation the representation receives, the faster and more accurately the word is read.

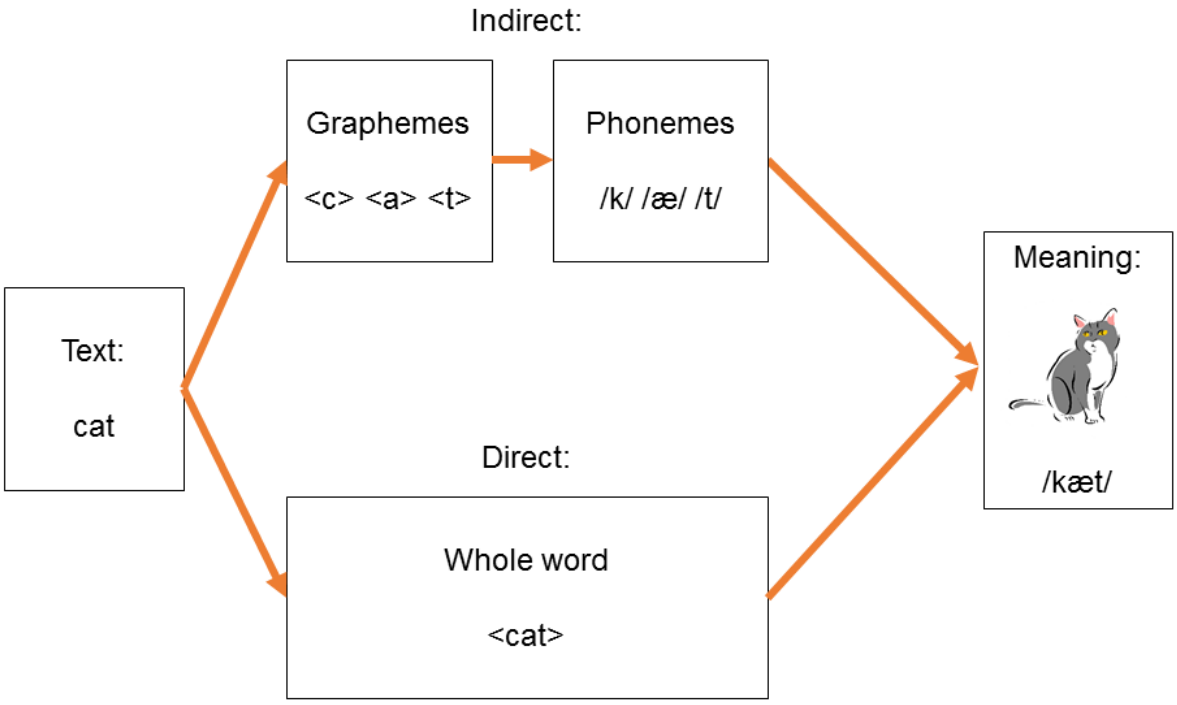

Figure 6: Simplified Dual Route Model of visual word recognition and reading aloud (based on Coltheart, 2006; Coltheart et al., 2001).

While skilled readers must be able to read words in isolation, it is far more typical to read words in connected text. Dual route frameworks assume that reading is a **bottom-up process**—that the reader passively absorbs the meaning from the text. This does not explain how prior knowledge and experience influence word reading, particularly during sentence and passage reading. It is clear that **top-down processes** do impact on reading—the reader is an active participant, their expectations influence the cognitive processes that are applied to interpret the meaning of the written word. Eye-movement studies demonstrate the impact of composing meaning in connected text. Skilled readers build up meaning across the sentence. As a result, the speed with which words are read is influenced by not only the properties of the word, but also the properties of the sentence and greater context. For example, words that are predictable, or commonly follow other words are read more quickly (Frisson, Rayner, & Pickering, 2005). Words that are implausible in the context are read more slowly (Rayner, Warren, Juhasz, & Liversedge, 2004). Therefore, models of word reading must be able to account for the influence of both bottom-up and top-down processes. Most reading is goal-directed behaviour and the reader is an active participant in the process.

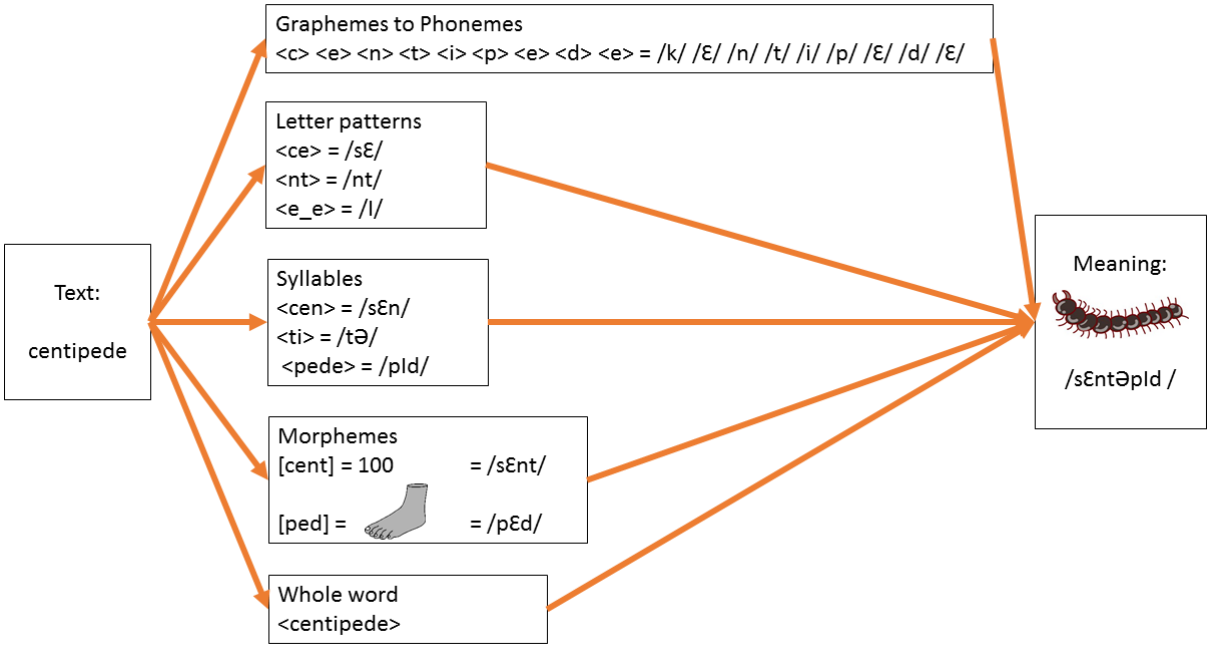

Figure 7: Simplified multiple routes or grain size theory of word reading (based on Grainger et al., 2012).

More recently, multiple routes or *Grain Size Theory* accounts for the influences of a much broader range of information in word reading, including context (Grainger et al., 2012; Grainger & Ziegler, 2011). This framework acknowledges that words can be simultaneously processed using a range of different sources of information (referred to as codes), each differing in detail or granularity (see Figure 7). The *coarse code* is somewhat similar to the direct route to meaning. Through this, the most visible, constraining features of a word support rapid, bottom-up activation of meaning. Meanwhile, top-down information from sentence or passage context also contributes to rapid word reading. A range of *fine-grained codes* provide indirect routes from text to meaning by decomposing the word into various units, including detailed information about letter order. These codes include the letter or letter combinations (**graphemes**) that correspond to phonemes, which are necessary in order to perform letter-to-sound decoding. Other codes include common letter combinations and small morphemes (such as prefixes and suffixes, described in further detail on p54). The size and nature of the units are determined by what optimally maps onto the existing speech system. Each time a word is successfully decoded using

one of these fine-grained codes, it provides opportunities to learn new information about the word (through Self-Teaching mechanisms, see p17). This model explains how partial information can support lexical access. For example, in Figure 7, the word 'centipede' cannot be decoded in a strict letter-by-letter fashion, but decoding could be supported by information from context-dependent letter information, syllables, or morphemes. The range and quality of the codes accessed during reading reflects Lexical Quality (see p10); highly-specified representations can be accessed faster, more accurately, and more fluently due to the multiple routes linking the written form to the meaning of the word. This theory allows for a rich variety of linguistic units to be used simultaneously to support word reading. It also provides a good account for the many different factors that can simultaneously influence word recognition, such as semantic context, morphological composition, and bigram frequency.

2.2.2.2 Development of word reading

Theories of word reading (and similarly, theories of spelling, see p29) can be broadly categorised as 'constructivist', 'phonological', or 'statistical' learning. *Constructivist* and *phonological theories* are generally stage-based theories, arguing that children move through a series of discrete and consecutive stages defined by the dominant strategy that the child uses to read (Ehri, 1995, 2005a, 2005b; Frith, 1985). In contrast, *statistical-learning* perspectives argue for a greater role for word-specific learning influencing the available routes from text to meaning. Here, we summarise the key points described in constructivist and phonological theories since they enable us to conceptualise the path of typical development. However, development is now more commonly understood as a process of acquiring increasingly detailed and flexible word-specific reading strategies, rather than a series of discrete phases in which the child's underlying processes change. Not all words can be read in the same way, especially in a complex writing system such as English. For example, some words are transparent and easily decodable using letter-to-sound rules (e.g., '*jam*'), others are not (e.g., '*who*'). Thus, it is important to remember that the processes that dominate reading behaviour will depend as much on the words that are read as on the abilities and knowledge that the reader brings to the task.

Children are not born with the ability to recognise that written words differ from other pictures or symbols, and so the first thing they need to do is to learn to recognise text. Constructivist theories are particularly interested in these early stages of development, prior to formal education. At the beginning, children rely on salient visual cues to recognise the small number of words that they can read. At this point children may recognise common signs and labels from the environment, such as popular brands or logos (Masonheimer, Drum, & Ehri, 1984). They may even learn a few words, but they do not do so by focusing on the same features as skilled readers. For example, Gough, Juel, and Griffith (1992) taught children to read four words using flashcards. One flashcard had an incidental thumbprint in addition to the target word. That word was learned most quickly, but less than half of the children could read the word when it was later presented without the accompanying thumbprint. Interestingly, virtually all of the children remembered what the word was when they were shown the thumbprint in isolation. Evidently, children were attending to the thumbprint, not the text. These children are not reading in any meaningful sense—they are using the same processes that they use for picture naming. This stage has been described as *pre-alphabetic* (Ehri, 1995, 2005a, 2005b), *logographic* (Frith, 1985), or *cue reading* (Gough et al., 1992).

Phonological theories suggest that a key milestone in early literacy development is the acquisition of the ***alphabetic principle***—understanding that there is a predictable relationship between letters and sounds (Frith, 1985). Once children grasp this, they have their first mechanism for segmenting and decoding the written word. Ehri's (1995, 2005a, 2005b) stage theory proposes that first, during the *partial alphabetic* stage, children decode only certain, particularly salient, parts of words. Others also agree that these early lexical representations and routes to meaning are not fully specified, and include only partial information about letter-sound knowledge. For example, Stuart & Coltheart (1988) suggested that children first learn to decode the first and last letters in the word. The more complex rules are learnt later, such as the letter-sound rules for vowels. As a result, those associations will not

be included in lexical representations until later. The *full alphabetic* phase is characterised by the ability to form multiple links between all of the graphemes and phonemes of a word (Ehri, 1995, 2005a, 2005b). After this has been achieved, readers begin to notice common letter combinations that occur in different words (such as syllables, onsets, rimes, and small morphemes). Stage theories argue that children finally integrate and consolidate this information during what is described variously as the *consolidated alphabetic* (Ehri, 1995, 2005a, 2005b) or *orthographic* (Frith, 1985) stage.

Most stage theories argue that secure knowledge of the alphabetic principle is a prerequisite to being able to use other routes or codes from text to meaning, such as common letter combinations or morphemes. However, while there is no doubt that acquisition of the alphabetic principle is a key milestone, it is not clear that understanding and application of this principle must be fully developed before children can learn how to use other sources of information about words. Processes could develop in parallel. This has important implications for education. If children need fully developed understanding of the alphabetic principle before they can integrate other processes to read and spell then this must be taught and established to be fully developed before supporting other component literacy skills. If, on the other hand, partial understanding of the alphabetic principle is sufficient, that would support training multiple component literacy skills from a young age.

Statistical learning theories argue that learning is word-specific (e.g., Treiman, 2018; Treiman & Kessler, 2014). Therefore, the word-level features that are most useful will be learned first. Features that occur with both high frequency and high consistency will be learned rapidly because this code, or part of the route, is repeatedly and consistently reinforced through exposure. For example, the letters <ck> co-occur quite a lot, and whenever they do they are always pronounced /k/.[3] So this is an extremely useful rule to know. Vowels, on the other hand, occur a lot, but they also have many different possible pronunciations so it might be more useful to attend to larger units (such as syllables or rimes) to disambiguate these letters (Vousden, Ellefson, Solity, & Chater, 2011). This suggests that learning high frequency letter-sound rules is valuable (this is discussed further on p46). However, rather than explicitly learning about low frequency letter-sound rules, it might be better to learn about other features of words that are more frequent or consistent (such as syllables or inflectional suffixes). This supports the use of systematic synthetic phonics programmes, which focus first on training the most productive letter-to-sound correspondences. In the end, regardless of the order of acquisition for each individual word, the aim is to acquire high quality lexical representations of words containing overlapping information about multiple features (Perfetti, 2007). In this way, accurate, efficient, and fluent word reading can be achieved as there are more routes available from text to meaning.

As children's lexical representations develop in quantity and quality, the behavioural changes that are observed most likely result from a change in the number of strategies used to read, not a change in the type of strategy in use (Jared, Ashby, Agauas, & Levy, 2016). As the words that children encounter in reading become longer and more complex, so they necessarily apply more complex strategies to those words. Decoding long words places a great burden on working memory as the reader holds multiple phonemes in memory. In addition to this, there may be other features that need to be analysed. For example, to read multisyllabic words like *'strawberry'* aloud, one also has to determine the location of syllable boundaries (Perry, Ziegler, & Zorzi, 2013), how to pronounce ambiguous or reduced vowels, and whether to place linguistic stress on the first or second syllable (Ševa, Monaghan, & Arciuli, 2009; Venezky, 1970). Reading becomes more accurate and fluent for known words, because more and more links are made between the letters on the page and meaning in our mental lexicon. This reduces the cognitive burden as lexical representations are accessed more quickly and automatically (see p25 for further discussion). We continue to apply all of the strategies that are available to us, throughout development, although these strategies become more refined and effective for particular words. This

[3] Throughout this review, phonetic transcriptions are enclosed within forward slash marks (//), orthographic transcriptions within angular brackets (<>).

enables us to learn new words, applying some of the same skills we learned early in literacy development. These additional resources enable the skilled reader to decode unknown words faster than novice readers.

So far, we have focused on word reading in the context of isolated words. However, soon after learning to read a few words in isolation children begin their attempts to read connected text. For this, children must integrate comprehension skills.

2.2.3 Reading comprehension

The ultimate goal of reading is comprehension—to be able to understand the message contained within connected text by building a mental representation of the underlying meaning (Perfetti et al., 2005). Reading comprehension involves much more than simply extracting and summing the meaning of the individual words, although this is part of the process. Indeed, comprehension goes beyond summing the meaning of phrases, clauses, or sentences. As explained by Kintsch and Rawson (2005, p121), '*deep understanding always goes beyond the text in non-trivial ways, requiring the construction of meaning, not just passive absorption of information*'. Reading comprehension is situational and involves constructing a coherent representation of the text for a specific purpose (Rapp, Broek, McMaster, Kendeou, & Espin, 2007). The **Situational Model** is a mental model of meaning which combines concepts from the text with background knowledge to form a representation of meaning given the situation described (Kintsch & Rawson, 2005; van Dijk & Kintsch, 1983).

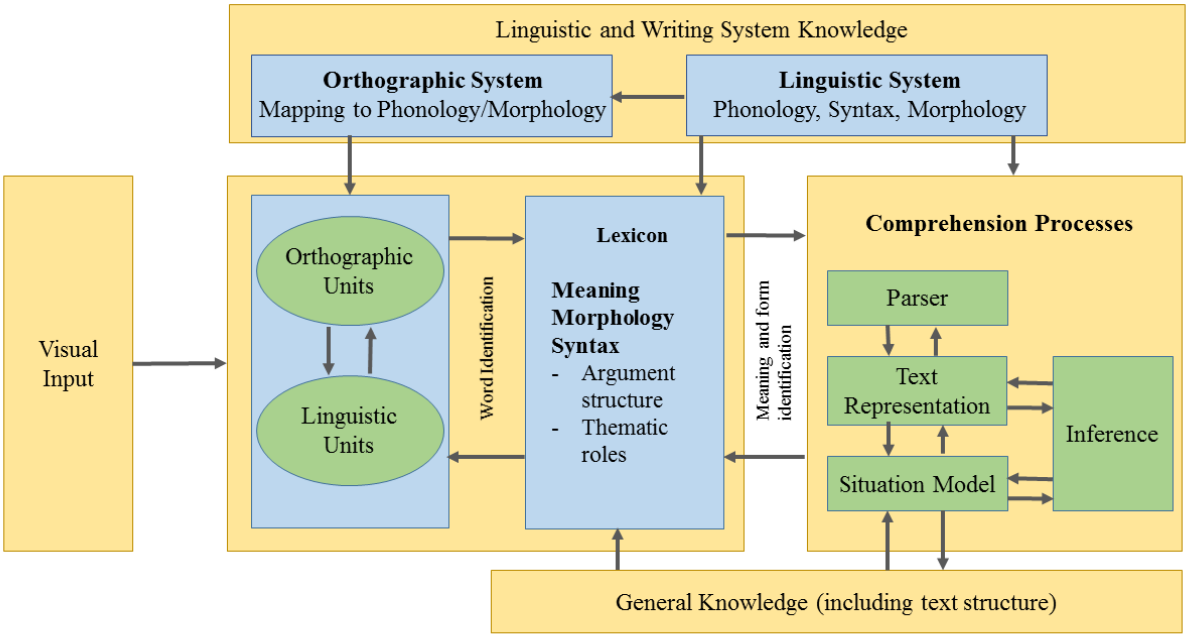

Figure 8: Adapted from The Reading Systems Framework, which was developed from a Blueprint of a Reader (Perfetti, 1999; Stafura & Perfetti, 2017)

Whereas word-reading processes have been described with reference to very precise testable models, models of reading comprehension are better described as global frameworks (see Stafura & Perfetti, 2017). This is because reading comprehension involves the combination of a wide range of processes and sources of knowledge, that likely cannot be explained by a unified cognitive model (Castles, Rastle, & Nation, 2018). Nonetheless, frameworks are helpful in summarising the subcomponents and processes involved in comprehension, and they also highlight the inherent complexity of

comprehension. According to the *Reading Systems Framework* (see Figure 8; Perfetti & Stafura, 2014; Stafura & Perfetti, 2017), reading comprehension involves three types of knowledge: linguistic, orthographic, and general knowledge (these correspond with the language, writing, and background knowledge components of the Supermodel of Literacy presented in Figure 3 on p13). The Reading Systems Framework highlights how reading processes draw upon these types of knowledge in both constrained and interactive ways. The lexical subsystem is the output of word reading and the input for text comprehension processes to act upon. Reading comprehension processes include the parser and inferences which are used to build situational models and text representations (Perfetti, 1999; Stafura & Perfetti, 2017), discussed in further detail below.

2.2.3.1 Mental models in comprehension

A key component of comprehension in the Reading Systems Framework is the construction of mental models—the *situational model* and *text representation*. The reader develops a *situational model* (Perfetti, 1999; Stafura & Perfetti, 2017) as they read. This model is updated dynamically throughout the course of reading as more information is received and both informs, and is informed by, the text representation (see Figure 8 and Figure 9; Zwaan & Madden, 2004). In this way, meaning is derived from multiple input units each of which elaborates and/or fine-tunes the situational model. Word meaning, the meaning of the phrase, the meaning of the clause, the sentence (and so on) all contribute to the situational model. See Figure 9 for the possible situational model for the sentence: *'While Rosa was riding her bike in the park, dark clouds began to gather, and it started to storm.'*

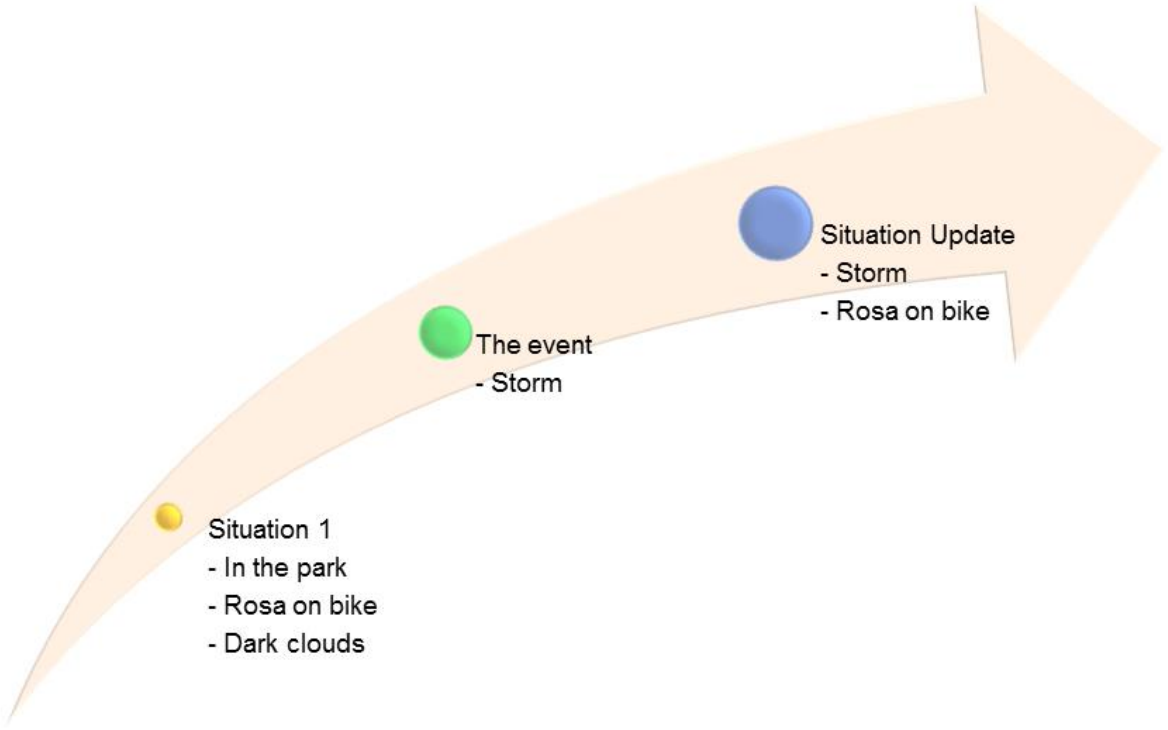

Figure 9: A situation model.

Note. The model illustrates what a reader might understand after reading the sentence 'While Rosa was riding her bike in the park, dark clouds began to gather, and it started to storm.' The general form of the model is SITUATION + EVENT = UPDATED SITUATIONAL MODEL. Adapted from (Stafura & Perfetti, 2017).

The mental model of the text as a whole is referred to as the *text representation*. This goes beyond the meaning of the individual words, or sentences, combining the meaning of all of the messages across the whole text as they have been understood to this point. The text representation has less depth of

meaning than the situational model, but captures the overall gist of the whole text more broadly (Perfetti, 1999). The *parser* influences how the reader integrates information into mental models of text by applying grammatical and thematic knowledge as well as contextual understanding (Perfetti, 1999).

2.2.3.2 Inferences in comprehension

The next component in The Reading Systems Framework is ***Inferences*** (Perfetti, 1999; Stafura & Perfetti, 2017). Much of the time when we read, text is not fully complete and the reader has to make inferences to fill in the gaps. Sometimes this involves directly and literally linking information within the text. For example, from the sentence—

> *'Helen is taller than Libby and Libby is taller than Ava'*

—the reader can infer that Helen is taller than Ava. In the example provided in Figure 8, a **bridging inference** was made to link the *'storm'* mentioned in the second sentence to the *'black clouds'* mentioned in the first sentence. Comprehension that involves inferences that do not go beyond the content of the text is usually referred to as ***literal comprehension***.

Other times, the reader needs to make use of prior knowledge to plausibly fill the gaps in the information provided in the text in order to construct a coherent mental model (Cain & Oakhill, 1999; Kintsch & Rawson, 2005). For example, when you read—

> *'Dom parked the car. He locked the door'*

—you likely infer that Dom locked the car door. To arrive at this understanding, you had to make several inferences. To maintain coherence as you added the second sentence to your situational model, you likely make a bridging inference that *'He'* refers to *'Dom'*. You likely also made **elaborative inferences**, which make use of your prior knowledge. In this case, you integrated your knowledge that cars have doors, and that from your experience you usually lock the car door after parking. Comprehension that necessitates that you go beyond the content of the text is usually referred to as ***inferential comprehension***.

Skilled readers do not make every possible inference as they read. The number and variety of inferences that are made are extremely variable and are dependent on context. In some circumstances readers only make inferences that are necessary for comprehension (McKoon & Ratcliff, 1992). In other cases, readers go beyond the minimum necessary. Readers construct meaning as they read, and while doing so they monitor word recognition and comprehension. Skilled readers notice when comprehension begins to breakdown, and respond by slowing down and re-reading as necessary (Baker, 1984; Garner, 1980; Hacker, 1997). For example, when adults or children encounter ambiguous meanings within a sentence, they are likely to re-read early sections or all of the sentence (Joseph & Liversedge, 2013).

2.2.3.1 Development of reading comprehension

Given the multiple component processes involved in reading comprehension, it should now be clear that the development of accurate and fluent word reading is a necessary, but not sufficient, skill for reading comprehension. Language comprehension is the second component of the Simple View of Reading (see p14). Consistent with this, retrospective longitudinal studies suggest that oral language difficulties precede reading comprehension difficulties. A case control study of 15 British children who had reading comprehension difficulties at eight years old (selected from a larger sample of 242 children) showed that these poor comprehenders had weaknesses in oral language when they were five years old, before learning to read (Nation, Cocksey, Taylor, & Bishop, 2010). Similarly, 57 American 13-year-olds with specific reading comprehension difficulties had lower oral language scores than their typically reading peers when they were five, seven, and nine years old (Catts, Adlof, & Weismer, 2006).

The relationship between language skills and reading comprehension can also be seen within typical development: children with good language skills usually have good reading comprehension (Muter, Hulme, Snowling, & Stevenson, 2004; Oakhill, Cain, & Bryant, 2003). For example, in a longitudinal study of 90 British children, language skills (vocabulary and grammatical knowledge) at age four predicted reading comprehension at age six (Muter et al., 2004 Stevenson, 2004). Similarly, in a longitudinal study of 102 British children, language skills at seven and eight predicted reading comprehension at age eight to nine.

Further support for the relationship between language comprehension and reading comprehension comes from intervention research. Oral language interventions support both language and reading comprehension skills. High quality evidence from randomised controlled trials indicates that interventions that specifically target oral language skills improve reading comprehension (Clarke, Snowling, et al., 2010). A summary of the effectiveness of oral language interventions and key considerations before implementation are summarised in the EEF toolkit.[4] Children with weaknesses in language comprehension benefit more from a balanced approach: interventions that include both word reading and oral language comprehension components are more effective than those that support word reading only (Clarke, Paul, Smith, Snowling, & Hulme, 2017). Reading comprehension is uniquely predicted by multiple components of language comprehension (discussed further from p38).

As is the case with many of the skills that underpin literacy, the relationship between reading comprehension and oral language is reciprocal. Gains in language improve reading comprehension, which then feeds back into improvements in language (Quinn, Wagner, Petscher, & Lopez, 2015). The language skills needed in literacy often go beyond those required in speech in terms of both type and content (Perfetti et al., 2005). In reading, children are exposed to rarer vocabulary and a greater variety of types of language uses (e.g., formal or subject specific language) than in spoken language. As reading comprehension improves, children are able to use context to infer the meaning of new words that they encounter for the first time in text (Perfetti et al., 2005). As reading progresses, they begin to read more texts, which exposes them to a greater number and variety of words, providing more opportunities for vocabulary growth (Nagy, Herman, & Anderson, 1985). This reciprocal relationship causes the gap between children with good and poor reading comprehension to increase with age, known as the *'Matthew Effect'* (Stanovich, 1986). This is supported by the finding that children with poor comprehension show less vocabulary growth over time than those with good reading comprehension (Cain, Oakhill, & Lemmon, 2004; Cain, Oakhill, & Elbro, 2003; Ricketts, Bishop, & Nation, 2008; but cf. p69).

In addition to knowledge of language, background knowledge and reasoning skills are central to language comprehension (see Figure 3)—in particular, the ability to make literal and elaborative inferences to fill the gaps that necessarily occur in language, as well as the ability to monitor and adjust reading to support comprehension processes as and when necessary (Oakhill & Cain, 2012). Less skilled readers might monitor their comprehension less than skilled readers (Baker, 1984; Garner, 1980; Hacker, 1997), or might have a lower standard for coherence (Cain & Oakhill, 1999). These monitoring processes have clear links to other more distal skills that impact on comprehension, such as meta-cognitive skills, executive control, and working memory, which we know continue to develop through childhood (Carretti, Caldarola, Tencati, & Cornoldi, 2014). These distal child-based factors are discussed in more depth later (from p63).

2.2.3 Reading fluency

Most educators consider reading fluency to be a key component of skilled literacy, yet reading fluency is difficult to define and assess. Fluent reading is much more than simply being able to pronounce or

[4] https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/oral-language-interventions/

access the meaning of individual words. Rapid and efficient word reading is a necessary prerequisite to fluency, but at the sentence and text level, additional reading skills come into play. Reading speed increases gradually and incrementally through practice (Samuels, 1979). However, fast reading does not necessarily mean fluent reading, and does not necessarily improve comprehension (Rayner, Schotter, Masson, Potter, & Treiman, 2016). Skilled readers adjust their reading speed flexibly dependent on the text being read, context, and motivation for reading. When motivated to do so, skilled readers slow down when reading complex information. This provides more cognitive resources to integrate background knowledge and reasoning processes that are crucial to understanding complex information (see Figure 3). On the other hand, skilled readers can choose to read more quickly, skimming through sections of irrelevant text. This fast reading is, however, at the expense of depth of comprehension (Rayner et al., 2016). Reading becomes disfluent when the reader is aware that comprehension has broken down. Thus, reading fluency can be considered a consequence of good word reading and reading comprehension skills, rather than a precursor.

Reading fluency is multifaceted and must be distinguished from its components; these are broadly described as accuracy, automaticity, and prosody (Hudson, Lane, Pullen, & Torgesen, 2009; Kuhn, Schwanenflugel, & Meisinger, 2010; Rasinski, Reutzel, Chard, & Linan-Thompson, 2011). The accuracy component depends on the processes of word reading already discussed (see p16). These processes can be considered to be **automatic** once they are achieved at speed, without effort, intention, or conscious awareness (Logan, 1997). For skilled readers, reading processes become so automatic that they are unable to stop themselves from reading text without consciously looking away. This is illustrated by the classic 'stroop effect', where it is harder to name the colour of ink a word is written in when the word names a different colour (for example, the word 'red' written in black ink). Hence, once word reading processes become accurate and automatic they are no longer effortful and more cognitive processes are available for text-level processes. Automaticity of word reading is achieved relatively early in development, and before the child can be considered a fluent reader (Schwanenflugel, Morris, Kuhn, Strauss, & Sieczko, 2008; Stanovich, Cunningham, & West, 1981). The final component of reading fluency is prosody—reading with correct intonation and expression in a manner that sounds like everyday speech (for a more detailed discussion of prosody see p39). We return to the role of reading prosody shortly, but first we consider silent reading fluency.

When reading silently, fluent readers rapidly move their eyes across the text. During reading, we automatically control our eye-movements, deciding where and when to fixate on the text in order to optimise the trade-off between speed, accuracy, and comprehension. Skilled readers adapt their eye-movements and reading speed to suit the depth of processing and amount of cognitive resources required. Both adults and children look for longer and make more fixations when they encounter a low frequency or novel word in a sentence (Inhoff & Rayner, 1986; Joseph, Nation, & Liversedge, 2013). This shows how readers adjust their eye-movements to support word recognition. Fluent silent reading is not, then, where the reader quickly or steadily moves their eyes from left to right across the page; fluent silent reading is flexible. Developmental changes in eye-movement patterns during reading show that silent reading gradually becomes more fluent. For example, the number and duration of fixations, and the number of re-fixations and amount of re-reading, decreases with development (Blythe, 2014; Blythe & Joseph, 2011).

In the classroom, reading fluency is often assessed within the context of oral reading. However, silent and oral fluency are not necessarily the same. Oral reading fluency is the ability to rapidly and accurately read connected text with appropriate intonation and expression (National Reading Panel, 2000b). To achieve oral reading fluency, the reader must simultaneously read and speak. Therefore, the cognitive demands are greater for oral reading than silent reading. Moreover, it cannot be assumed that oral reading necessarily involves comprehension: it is possible to read words accurately without understanding the meaning of individual words, as children do when reading nonsense words. It is therefore possible to accurately read consecutive words in a passage without constructing a mental

model of the meaning (indeed, this is the hallmark of Poor Comprehenders—see p16). This is possibly why several cross-sectional and longitudinal studies have shown that word reading speed (measured using lists of unrelated words) explains only a little additional variance in reading comprehension after accounting for word reading and language comprehension abilities, particularly for older children (Aaron, Joshi, & Williams, 1999; Adlof et al., 2006; Cutting & Scarborough, 2006; Tilstra et al., 2009). For example, a longitudinal study of 604 American children from seven to 13 years old showed that reading speed was indirectly related to later reading comprehension, via its effect on word reading ability (Adlof et al., 2006). Reading speed at age seven (measured by the combination of single word reading speed and connected text reading speed) contributed to word reading ability at that age, which in turn predicted reading comprehension at nine years. For older children, reading speed neither directly nor indirectly contributed to later reading comprehension. Word reading speed only taps into the accuracy and automaticity components of reading fluency; it does not tap into reading prosody.

Word reading fluency is not the same as text-reading fluency (Kim, 2015). Measures of text-reading fluency appear somewhat better predictors of reading comprehension (Florit & Cain, 2011; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Garcia & Cain, 2013; Kim, Wagner, & Lopez, 2012; Kuhn & Stahl, 2003; Language and Reading Research Consortium, 2015b; Roehrig, Petscher, Nettles, Hudson, & Torgesen, 2008). However, measures that only consider reading speed are not as informative as those which consider text reading prosody. Fluent text reading with appropriate intonation and expression almost always requires a good understanding of the meaning of the text. This must include processing of grammar, punctuation, and some preliminary aspects of comprehension, since this information is largely unmarked in writing. As a result, measures that consider oral reading skills, such as text reading prosody, are most closely associated with reading comprehension (Kim, 2015; Veenendaal, Groen, & Verhoeven, 2015; Veenendaal, Groen, & Verhoeven, 2016).

2.3 Models of writing development

Reading is the process of understanding the meaning in text. Conversely, writing is the process of translating thoughts or ideas into text. Skilled writers can produce written words using a variety of output modalities—handwriting onto paper, typing on a keyboard, or using a telephone keypad on handheld or touchscreen devices. Not only do we produce writing using a range of output modalities, the context and motivations for writing also vary, with important implications for the processes involved.

Writing, like reading, can be subdivided into word-level and text-level processes. In some contexts we produce isolated written words. For example, when we ask for someone's address, write an itinerary, or write a shopping list from a recipe. Here, we refer to this as ***spelling***, and go beyond the typical definition to include within this classification various elements of the transcription process (for example, handwriting and typing). More often than not, however, we produce written words within connected text. As we write emails, letters, reports, and stories, we write connected text in response to an internal desire to express and share more complex ideas. This involves the integration of both spelling and text-level compositional processes. We refer to these text-level processes as ***composition*** to distinguish them from spelling processes.[5] Composition involves the mental production of a linguistic message (whether or not it is written down). These two domains of writing rely on different underlying skills. Most of the text that we create in the real world involves the coordination of processes underlying both spelling and composition.

When children are first learning to write, at the beginning of primary school, most of their effort will be expended on word-level transcription processes—spelling and handwriting (or perhaps typing; Berninger & Swanson, 1994). If children write sentences at all they will likely be short, using far simpler linguistic structures than the child is capable of in speech, and littered with spelling and punctuation

[5] Berninger and Swanson (1994) refer to these as transcription and text generation respectively.

errors. As individuals become more expert at writing, transcription skills will play a relatively smaller role in the overall writing process. Instead, composition processes play a larger role in the quantity and quality of written output (Berninger, 1999; Berninger & Swanson, 1994). Even so, if transcription is made difficult for any reason (for example, by asking adults to write in capital letters or using their non-preferred hand), the overall quality of the writing tends to decrease (Bourdin & Fayol, 1994). Similarly, individuals who have spelling difficulties allocate more attention to address these difficulties, limiting the quality of the content of their writing (Sumner, Connelly, & Barnett, 2012). This demonstrates the interdependence of these processes and is analogous to interaction between word- and text-level processes in reading. Moreover, it implies two things: first, that it is important to ensure that word-level skills (handwriting, typing, and spelling) are as automatic as possible for writers, and second, that students with difficulties in transcription (such as those with dyspraxia or dyslexia, or those using unfamiliar equipment) may not be able to demonstrate their true knowledge of a topic in their written work unless their transcription difficulties are supported.

2.3.1 Spelling

At the level of individual words, cognitive and motor processes combine to produce handwritten or typed spellings. Many of the underlying cognitive skills are the same, but spelling is not a straightforward reverse of the processes of word reading. Spelling requires more precision than reading. Word reading can be achieved using incomplete representations, as long as the information that is available is 'good enough' to activate the correct word in the lexicon (to differentiate from other words). Those same incomplete representations would not be 'good enough' for spelling and would result in errors. Often, weaknesses in underlying skills are more visible in spelling, so some children have greater difficulty spelling than reading. The spelling process, at least for mature spellers, likely involves a feedback loop via reading. To spell effectively one must monitor what has been produced so far—simultaneously reading and spelling. There are also processes that are unique to spelling. For example, spelling involves more complex fine motor processes. Fingers, hands, and eyes must all be moved in order to handwrite or type. The cognitive demands of this motor involvement impacts on the spelling process.

Theories of skilled spelling highlight three stages of the spelling process: input identification and central and peripheral orthographic processes (Bonin, Méot, Lagarrigue, & Roux, 2015; Olive, 2014, see Figure 10). The first stage, *input identification,* is when we select which word we intend to write. These processes differ depending on the nature of the input (dictation, copying, conceptualisation). The key similarity is that these processes translate the prompt to spell into activation of the word within the lexicon (see Figure 10). For example, in a spelling-to-dictation test, the input identification stage makes use of spoken word recognition processes. A spoken word prompts auditory analysis of the component sounds, leading to auditory word recognition. From this point, *central orthographic processes* take over. These processes are the same regardless of the nature of the initial prompt. Central orthographic processes convert the lexical representation of the word into the graphemic (letter-based) representations of the word, which will be held in working memory until produced. These processes have been the focus of most models of skilled spelling and, in particular, spelling development. Finally, *peripheral orthographic processes* are those involved in sensorimotor planning and execution of the physical production of the spelling. These include **allographic** processes which determine the form of the letters—upper or lower case, printed or cursive. Next, activation of graphemic motor patterns plan the execution of fine motor processes. In handwriting, this includes information about the order, size and direction of strokes that make up the letter. Finally, neuromuscular execution cause fine motor hand/finger movements that produce pen movements or key stroke responses (Ellis, 1982).

Central orthographic processes are very similar to those described in models of word reading, and it is likely that the same processes and pathways are co-opted. Most conceptualisations of this part of the spelling process include two pathways, reminiscent of Dual Route Models of word reading (Bonin et al., 2015; Kandel, Peereman, Grosjacques, & Fayol, 2011; Sheriston, Critten, & Jones, 2016; Tainturier & Rapp, 2001). One pathway supports direct conversion—the word is activated within the lexicon and the

whole word is held in working memory during the writing process. The indirect pathway supports sublexical conversion using units that are smaller than a word. This pathway enables us to hold smaller units (such as sound-to-letter rules or syllables) in working memory during spelling. Again, drawing analogies from reading, the use of multiple sources of information (graphemes, syllables, morphemes) simultaneously fits just as easily within this part of the model (Breadmore & Deacon, 2019). Certainly, skilled readers use multiple sources of information simultaneously during spelling, and the nature of the task influences the extent to which they rely on the different routes to meaning (Bonin et al., 2015).

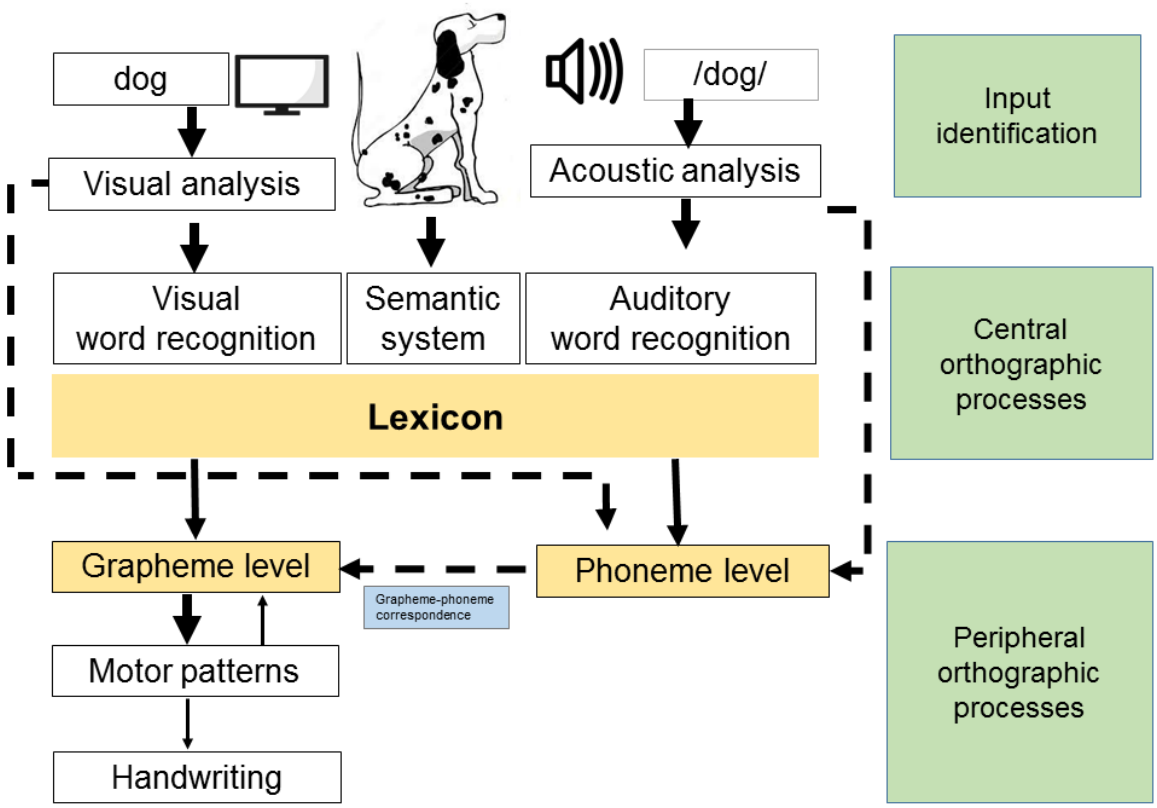

Figure 10: Framework for understanding the processes that underpin spelling from input identification, through central and peripheral orthographic processes (based on Bonin et al., 2015).

2.3.2 Development of spelling

Research and theory into the development of word-level writing processes have focused heavily on central orthographic processes, with very little research dedicated to the development of peripheral orthographic processes involved in the sensorimotor execution of these processes. Complex cognitive processes like spelling are often assumed to occur in serial—stepping through each process consecutively. However, theories of skilled writing increasingly argue for parallel and cascaded processing. These theories argue that central and peripheral systems operate simultaneously, and interact and affect one another (e.g., Olive, 2014). This is important, because this helps us to understand how difficulties in transcription processes (such as disfluent handwriting or typing) can impact on spelling accuracy and vice versa (poor spellers can be slow writers).

2.3.2.1 Development of peripheral orthographic processes

Disfluent handwriting processes can have a negative impact on spelling accuracy. Even so, poor handwriting does not necessarily result in poor spelling. Fluent handwriting frees up resources for other processes such as spelling and composition (Connelly, Dockrell, Walter, & Critten, 2012; Maggio, Lété,

Chenu, Jisa, & Fayol, 2012; Santangelo & Graham, 2016). The accurate, clear, and fluent formation of letters and words is necessary for effective written communication. Handwriting is a complex process and yet for skilled adults has become automatized and largely unconscious. The acquisition of fluent handwriting depends on visual perception, proprioception (knowledge of where one's body parts are), visual motor integration, and fine motor control. Children who have difficulties with visuo-motor and coordination skills are likely to have difficulties in early handwriting (Rosenblum & Livneh-Zirinski, 2008). However, the converse is not true: not all children with handwriting difficulties have difficulties in visuo-motor skills. As many as 10–30% of school-age children have handwriting difficulties (Feder & Majnemer, 2007).

The use of typing in place of handwriting has increased exponentially in recent years and for today's schoolchildren it is likely that most of their writing experience in adulthood will be using a keyboard of one form or another. There are several reasons to think that word processors may be a useful tool for school-age writers. Word processors allow students to revise their work easily, produce legible texts, and can also allow the use of automatic grammar and spelling checkers. A meta-analysis of experimental studies (Morphy & Graham, 2012) indicates that using a word processor can significantly improve the quality and length of written compositions in school-age children who have weaker writing skills. It also has a large effect on motivation to write, with children preferring to write using a word processor (Morphy & Graham, 2012). However, it is important that children writing on a word processor receive tuition in typing. Children who use a word processor but have not been taught typing produce poorer quality writing than by hand (Connelly, Gee, & Walsh, 2007; Mangen & Balsvik, 2016).

2.3.2.2 Development of central orthographic processes

Similar to models about the development of word reading, theories of central orthographic processes in spelling development can be broadly categorised as constructivist, phonological, and statistical-learning perspectives (for a more thorough review see Deacon & Sparks, 2015; Pollo, Treiman, & Kessler, 2007). The key differences between these theories is when, why, and how children will begin to process various different sources of information.

Constructivist theories are concerned with the development of writing more broadly rather than spelling conventions per se. These theories focus on the earliest phases of writing acquisition until development of the alphabetic principle (e.g., Ferreiro & Teberosky, 1982). Constructivists argue that literate society exposes children to a huge amount of text from birth, even before formal education begins. Such exposure leads children to form hypotheses about the function of writing prior to formal instruction. Spelling development involves the refinement of these hypotheses. During a *presyllabic* phase, children do not understand that writing should represent sounds but, nonetheless, do expect text to contain several different letters (Ferreiro & Teberosky, 1982). Presyllabic children also expect semantic properties of words to be represented. For example, young children tend to use more letters to represent objects that are larger (in size or quantity) than objects that are smaller (Stella & Biancardi, 1990, described in Pollo et al., 2007). Later, children develop their first hypothesis about print representing sound when they begin to produce *syllabic* spellings, using one letter to represent each syllable within a word. Finally, children realise that most words contain more letters than syllables, forcing them to adopt the Alphabetic Principle and enter the *alphabetic* stage. Alphabetic children make phonologically plausible misspellings. Constructivist theories do not make explicit predictions for what happens after acquisition of the alphabetic principle, yet we know that mature spellers fluently integrate multiple sources of information when spelling, so this cannot be the end of spelling development.

Phonological theories initially focus on children's acquisition of the alphabetic principle, followed by consolidation of other orthographic processes. Ehri's (1991, 1992, 1998) *prealphabetic* phase and Gentry's (1982) *precommunicative* stage both propose that children initially produce nonphonological spellings formed of random strings of letters. Later, during the *partial alphabetic* or *semiphonetic* stage, children begin their attempts to represent the sounds of words. This knowledge is still incomplete,

evidenced by spelling errors[6] that indicate use of a letter-name strategy, and representation of consonants but not vowels (for example producing <*cr> for *'car'*). During the *full alphabetic* or *phonetic* phase, children have a very good understanding of the alphabetic principle and represent all phonemes in their spellings. Here children's misspellings are phonologically plausible. For example, <*chrac> is a phonologically plausible spelling of *'truck'* because the co-articulation of the phonemes /t/ and /r/ affricates the /t/ to produce /ch/. As children learn the conventions of spelling they enter a *transitional* phase (Gentry, 1982) before finally the *consolidated alphabetic* or *correct* stage at which point all other processes (such as morphology and grammar) are integrated. These theories clearly align closely to stage-based theories of word reading—in some cases, quite specifically. For example, both Ehri and Frith describe reading and spelling as developing out of step with one another and argue that it is the dissonance between reading and spelling knowledge that causes the child to change strategy (Ehri, 1991, 1992, 1998; Frith, 1985). For example, prealphabetic or logographic reading may persist after children transition to making use of the alphabetic principle in spelling. The transition occurs in spelling sooner because logographic spelling is so ineffective. However, having learned the alphabetic principle through spelling, children eventually apply this to reading as well. Phonetic spelling might then persist for longer than in reading—because partial orthographic knowledge is sometimes enough for successful reading but lacks the precision necessary for accurate spelling (Frith, 1985).

More recently, researchers have argued that stage theories provide an incomplete representation of spelling development. For example, Varnhagen, McCallum, and Burstow (1997) argue that there is no substantial evidence that children produce qualitatively different spellings at different points in development, or that a single strategy dominates their approach to spelling at any given time. Rittle-Johnson and Siegler (1999) examined whether the *Overlapping Waves Model*—an approach developed as an alternative to stage theory in arithmetical understanding—could account for spelling strategies. They found that most children used a range of spelling strategies (for example, retrieval, sounding out, and use of a spelling rule) during a single spelling task, rather than relying mostly on a single strategy.

Like constructivists, *statistical-learning theories* highlight the importance of the nature of text the child is exposed to as they develop. The frequency with which different sources of information occur within the text drives the extent to which the child uses that information. Young children are adept at implicit learning of statistic regularities—noticing that events or objects co-occur with greater frequency than chance (Zacks & Hasher, 2002). Statistical-learning theories of spelling (Deacon & Leung, 2012; Pollo, Kessler, & Treiman, 2009; Treiman & Kessler, 2006) argue that this single mechanism drives development, resulting in the use of a variety of sources of information simultaneously throughout literacy acquisition. In this context, development is entirely dependent on exposure to the regularities within the language. These theories predict that the sources of information will not only vary between individuals but also between words. This variation will match the variation in the language that the individual has been exposed to. This variation will change during spelling development and across different languages. For example, young children disproportionately use letters from their own name in invented spellings. This happens because very young children have greater exposure to their own name than any other written word. This changes as children are exposed to a wider range of text, and get a better understanding of the frequencies of different letters in general text. Hence, children's preference towards letters in their own name disappears quickly as children learn to read and spell (Treiman, Sotak, & Bowman, 2001).

2.3.2 Composition

Composition is the process of translating ideas into written language. In order to do this, an individual must be able to formulate their thoughts in language and use their knowledge of writing structures to present this accurately. It can be tempting to think of composition as simply the mirror image of reading

[6] Throughout this review, misspellings, misreadings, and grammatical errors are preceded by an asterisk (*).

comprehension. Both tasks rely on the same underlying processes and there are clear similarities in the distinction and interaction between word- and text-level processes. However, reading and writing are different, particularly in relation to the complexity of the task demands (Berninger, Abbott, Abbott, Graham, & Richards, 2002; Shanahan, 2016). Notably, while the processes involved in reading can become largely automatic, writing places far greater demands on other cognitive processes such as planning, goal maintenance, and working memory, even into adulthood (see Figure 12).

A classic early study highlights the distinction between writing and reading. Juel, Griffith, and Gough (1986) showed that the predictors of word-level abilities (spelling and word reading) were similar and showed similar patterns of change over time. However, the predictors of text-level abilities (writing and reading comprehension) were more divergent. Reading comprehension was predicted by a combination of word reading and language comprehension, in line with the Simple View of Reading (Gough & Tunmer, 1986). Second grade writing was predicted by spelling, oral storytelling skills, listening comprehension, and an overall IQ measure. A recent paper by Kim, Petscher, Wanzek, and Al Otaiba (2018) also showed that early reading comprehension predicted later writing composition rather than the reverse.

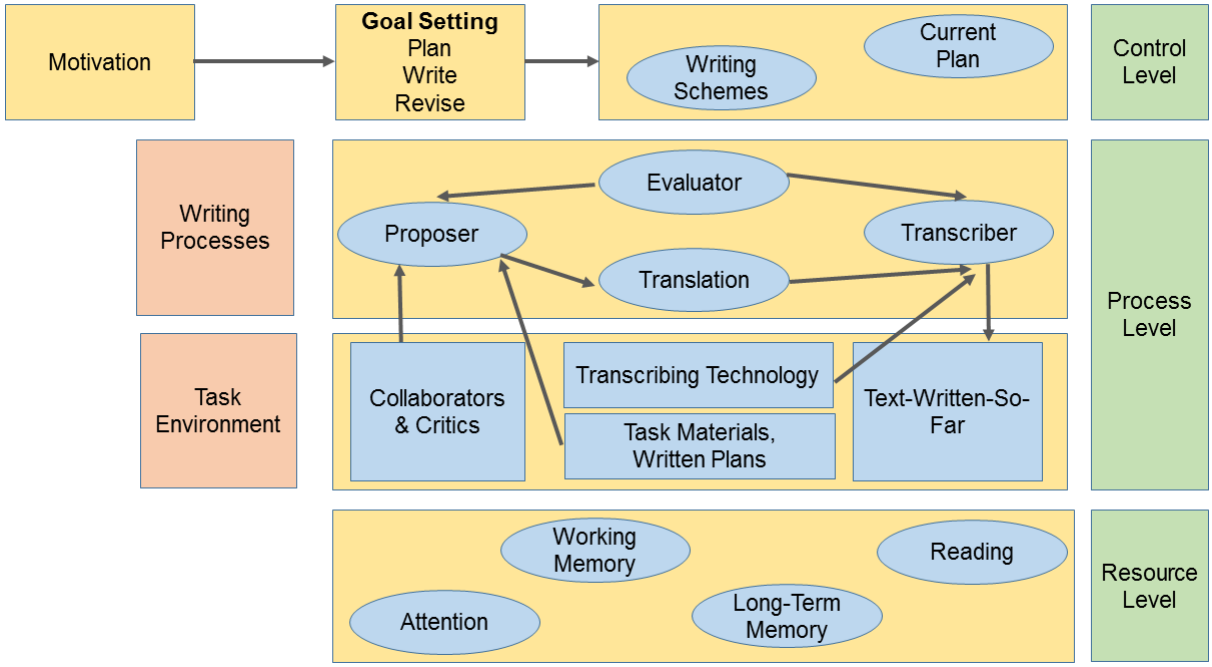

Figure 11: Model of skilled writing proposed by Hayes (2012)

Hayes (2012) describes a *Model of Skilled Writing*, shown in Figure 11. This is a revised and updated version of his initial model proposed in Flower and Hayes (1980). In this model, Hayes separates three levels of factors: the control level, the process level, and the resource level. The *control level* deals with the processes needed to decide to write and to decide on the content of the writing. This involves motivation, goal setting, planning, and the use of existing ***writing schemas*** (that is, pre-determined overarching structures for pieces of writing such as fairy tales, reports, or letters). The lower level, the *resource level*, describes the cognitive resources needed to write connected text—attention, long term memory, working memory, and reading skills. The *process level* involves the task environment, including the task materials (use of pens, pencils or keyboard), the text written so far, and collaborators and critics and the writing processes themselves. These writing processes are broken down into proposing ideas, translating into appropriate language, transcribing the text, and evaluating the work produced.

It is clear from this model that writing is a complex task with many different factors and skills required. The quality and quantity of writing produced depends upon an individual's motivation to write, their planning skills, background topic knowledge, knowledge of the appropriate writing schemas, as well as their transcription skills, the transcription materials available, working memory, and ability to review and monitor their own writing. The ways in which these different factors interact is not fully articulated in this model, and many of these interactions may be quite complex. For example, an individual's motivation to write may be influenced by their knowledge of the topic, or their ability to plan may be limited by the task situation. It is perhaps unsurprising that children find writing difficult and develop their writing skills relatively slowly in comparison to their text reading skills.

2.3.2.1 Development of composition

Berninger, Fuller, and Whitaker (1996) propose several modifications of the Flower and Hayes (1980) model to allow it to accurately describe writing development. The first modification was to separate text generation into two elements: *idea generation* and *transcription processes*. Early in development, writing content is largely limited by transcription processes (e.g., spelling, typing and handwriting). As these become more fluent, idea generation processes begin to play a larger role in the quality and quantity of written output produced. However, particularly for young children, it may be difficult to translate an idea into an appropriate linguistic form for writing.

Another modification concerns the processes of planning, editing, and revising text. These processes are key to skilled adult composition, but they develop at a relatively late stage, after more basic writing skills have developed. Berninger et al. (1996) argue that children are unlikely to show spontaneous pre-planning, editing, or revision of their work until late primary school at the earliest, and these skills need to be explicitly encouraged in many cases. Recent meta-analyses have shown that explicit instruction in these areas tends to have a large effect on writing outcomes (Graham, McKeown, Kiuhara, & Harris, 2012; Graham & Perrin, 2007). Pre-planning is the earliest of these skills to emerge, followed by online ('in the moment') revision of text, but this can only develop once transcription skills are relatively automatic. These modifications led Berninger, Vaughan, et al. (2002) to propose a ***Simple View of Writing*** (sometimes known as the *'Not so Simple' View of Writing*, because it is more complex than the Simple View of Reading!) in which there are three types of skills all limited by working memory capacities: transcription, text generation, and self-regulation (see Figure 12).

McCutchen (2000, 2011) contrasts the protocols, or self-talk, produced during the process of creating written text for expert, beginning, and intermediate writers. The expert writer produced a great deal of self-talk in ratio to the written text produced, and demonstrated consideration of the reader, long-term knowledge, and sentence structure during the composition process. The novice writer showed self-talk that was much more akin to a spoken version of the written text produced (for example, one child stated *'my mom makes me swim back and forth ten times'* while writing *'my mom makes me swim back and forth over and over'*). Intermediate writers showed signs of sentence-by-sentence writing—for example, writing sentences that are individually grammatically correct, without realising that the sentences do not follow the expected chronological structure when telling a story. For example, a story might go along the lines of: '*Here is Pat and his brother. They went to the zoo and saw a penguin. His brother is called James*', where the third sentence would more logically go ahead of the second sentence. More able intermediate writers were able to consider overall structure of the piece of writing while also preparing individual sentences. McCutchen suggests that early writing is often a direct or close translation of spoken language. As an individual becomes more skilled in writing, they become able to employ monitoring of macro-structure and the needs of the audience while writing. Kellogg (2008) argues that writing should be considered a skill that, like playing a musical instrument, involves both precise visuo-motor skills and artistic production. Becoming an expert musician takes around ten years of sustained practice, and similarly, becoming a skilled writer takes over a decade of development. In the case of professional writers, this may be more like two decades. Kellogg argues that writing progresses from the early stages of telling what one knows, with minimal reviewing and consideration of the reader, to

the intermediate stage of planning and reviewing text from the author's point of view only, with the final stage of crafting text for the readers' benefit being reached only in the most skilled writers. He views working memory capacity as being key to this development: intermediate writers can only hold in mind reader representations of the text intermittently and therefore cannot mentally review text consistently.

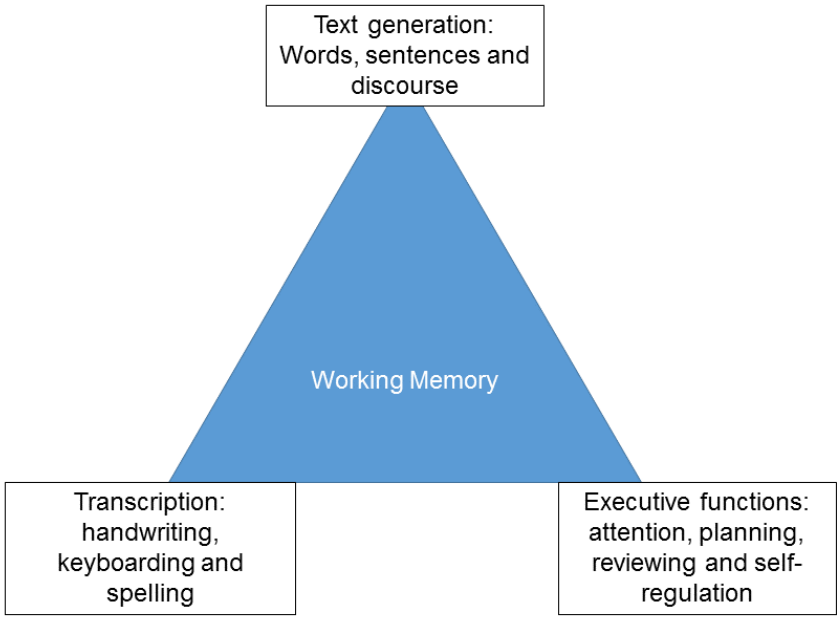

Figure 12: The Simple View of Writing (based on Berninger et al, 2002)

2.4 Summary of models of literacy development

The overall aim of literacy is to enable communication between author and reader. At the level of the word, models of reading and spelling highlight the importance of well specified lexical representations of words, which depends upon knowledge of the letters in written language, sounds of spoken language, and meaning (see Figure 1). Literacy development depends crucially on the acquisition of knowledge of these three components (letters, sounds, and meaning) and the links or pathways between components. The development of text-level literacy (reading comprehension and writing composition) requires a secure foundation in word-level skills in addition to a broader range of skills including greater understanding of language structure, narrative and background knowledge, and verbal reasoning skills (see Figure 3). We can broadly summarise the proximal skills that underpin literacy development as those involved in the task of forming links between the spoken and written forms of the language (see Section 4.1, p38) and those involved in the task of constructing meaning (see Section 4.2, p49).

Having described the dominant theories of word reading, spelling, reading comprehension, and writing composition, we turn now to the factors that underpin successful literacy development. In each case, we describe the typical developmental trajectory of acquisition of the skill along with a discussion of the mechanisms underlying the impact on each domain of literacy. This includes a summary of the nature and quality of the evidence. Before presenting this evidence, in Section 3 we provide some background information on the nature of research evidence. We do so with the goal of supporting the reader to evaluate the quality and security of the evidence that we present.

SECTION 3: Evidence for the factors that underpin literacy development

Section summary

This section summarises the different types of evidence that are used to determine the factors that impact on literacy development. For example, some types of questions about development depend on following a group of children over time, while other questions involve comparisons between groups. Some research questions require number-based (quantitative) data, while others require language-based (qualitative) data. The strengths and weaknesses of these approaches are described here.

There is a wide range of different types of research study used to gain information about how literacy develops. Each of these has its own advantages and disadvantages and is suited to answering slightly different types of research questions. The greater the range and consistency of evidence, the more confidence we should have about that factor underpinning literacy. The strongest evidence is supported by consistent findings across multiple approaches.

A key first step in research design is to consider your research question and hypothesis. A research question is a question you wish to answer using research. A hypothesis is a statement that you can test using research. If it can be tested, it can be falsified (shown to be incorrect). Note that it is very difficult to show that a hypothesis is definitely correct, only that it has not been disproved by existing evidence. It is therefore important to think about what kind of evidence would disprove a hypothesis as well as searching for evidence that supports your hypothesis.[7]

Briefly, most questions in educational psychology are about **causal relationships—**what underlying skills and components can cause changes in literacy outcomes? However, these are also often the most difficult questions to answer, as we explain below.

Many studies in education research use a **case-study** or **case-series** approach. This is a detailed report of a single individual or situation (for example, in one classroom, or in one school), or a set of individuals or situations. Case studies will often use **qualitative analysis** (language-based information rather than numerical information) or **mixed methods** (using both language-based and number-based information). This is a useful approach to help us understand multiple aspects of a situation, particularly when the phenomena to understand are quite complex and difficult to reduce to numbers, for example, when referring to an individual's beliefs or attitudes. However, this focus on a single situation means that it is difficult to generalise beyond this particular case. It is impossible to be sure which aspects of the case are causally related to the outcome, and which simply co-occur.

In order to provide some generalisation across cases, some qualitative studies use techniques such as interviews (semi-structured or unstructured) or focus group discussions. These allow qualitative analysis, but can also give some indication of which beliefs or themes are most common and which themes tend to be associated with one another. As with case studies, these approaches are particularly useful for understanding complex phenomena that are difficult to assign numbers to, such as beliefs or attitudes.

[7] Further information on developing appropriate research questions is available in the EEF DIY evaluation guide: https://educationendowmentfoundation.org.uk/tools/diy-guide/getting-started/

In many studies of literacy development, the focus is on **quantitative approaches**. These are more systematic approaches which attempt to quantify the role of different factors on literacy outcomes. The aim of quantitative research is often to provide information which can be generalised across different contexts.

Perhaps the simplest form of quantitative research is a **correlational study**, used to assess the **association** between two or more continuous variables. For example, to understand the relationship between calories consumed and weight, we might measure daily calories consumed and weight in many different individuals, and perform a correlation analysis to examine whether those individuals who consume more calories tend to be heavier. Correlational designs can be used in a variety of different educational contexts to establish whether there is a significant association between the variables. For example, we could examine whether children who do more homework tend to have better academic outcomes. This approach to research design is straightforward to carry out and sensitive to a wide range of measures. However, it has some key limitations. The first of these is that there is no indication of the direction of the association. In the example, we may hypothesise that doing more homework causes children to have a better understanding of their academic work. However, the same association would be shown if the cause went in the opposite direction—perhaps individuals with better academic outcomes do more homework because they were given extension activities to do at home. Just as important, correlations are subject to the **third variable problem**: it may be that a third, unmeasured variable actually causes the association. Continuing the example, perhaps both children who do more homework and children who do better in school have parents who ensure they work hard at both home and at school. Perhaps the parents, not the homework itself, improve academic outcomes. While it is possible to measure some possible **confounding variables**, it is impossible to be sure that you have accounted for all the different possible third variables that could moderate the association. Therefore, correlational studies cannot show causation.

One approach that is often taken to clarify the nature of the association in developmental studies is a **longitudinal study**, in which measures are taken at multiple time points. This allows us to work out the direction of the association by examining change over time, and to consider the order of change. With the homework example above, we would measure homework completed and academic grades at time 1, and then homework and academic grades at some later point (time 2). If homework at time 1 predicts academic grades at time 2 after taking account of academic grades at time 1, we would be confident that the direction of the association was not that academic grades caused greater homework. This type of analysis also deals with the third variable problem to a large extent—the time 1 measure accounts for the effects of other influences on that variable. However, it can be highly conservative: the largest predictor of academic grades at time 2 is always likely to be academic grades at time 1 because this measure (by definition) accounts for all of the previous influences on academic grades.

Many studies of children who are struggling to learn to read utilise **between-group comparisons**: children with dyslexia, language difficulties, or another type of disorder are compared to ‘typically’ developing children. If the children with difficulties show lower scores on another task, we can assume this impairment is associated with literacy difficulties. This approach can be useful for understanding what cognitive skills are impaired in different types of literacy difficulty, and it is useful for statistical reasons to enable us to examine skills that do not follow a **normal distribution**. For example, when we examine the effects of differences in visual or auditory acuity, most children show good skills and only a relatively small group show difficulties. However, when we look at evidence from between-group comparisons it is not necessarily the case that any difficulties shown are causally related to the literacy difficulty. It may be that they co-occur more often than expected by chance, but do not cause the difficulties.

The strongest test of whether a particular skill causes literacy difficulties is an **intervention study**. In an intervention study, the researcher acts to change an underlying skill and examines whether changing that underlying skill has a significant effect on the outcome skill (in this case reading or writing).

Intervention studies are very good tests of causal hypotheses, and can have direct implications for teaching, but they are not infallible. For example, some skills may not be amenable to training (IQ is a good example of this) but certainly still play an important role in outcome.

The simplest intervention study is a single group **pre-test post-test design** where all children take part in training and we examine whether they show growth in the target outcome. A limitation with this is that with children we would typically expect to see improvement over time whether or not the children take part in an intervention, and it is difficult to know how much improvement would be expected. Furthermore, we might expect improvements just because the children are completing the same tests multiple times (**practice effects**). For these reasons, many intervention studies have a parallel 'control' group who do not receive the intervention, to assess how much change would be expected without the intervention. However, this does not fully control for other possible effects. It may be that the children in the intervention condition improve simply because they are receiving extra attention (known as **Hawthorne Effects**). An improvement is to have a **treated control group**, who are receiving a different kind of intervention, to ensure both groups get the same levels of attention. A further limitation is that it can be tempting to assign children to a particular intervention condition on the basis of need, or on the basis of convenience. To ensure the two groups are similar, best practice is to randomly allocate children to one of the different intervention conditions (a **randomised controlled trial**). This methodology originates from medical research and is the gold standard for assessing the effectiveness of an intervention, minimising the risk of selection bias. However, even randomised controlled trials have their limitations: once an intervention has been shown to be effective, it can be difficult to know how or why the intervention is effective, which is why this should be supplemented with other types of evidence.[8]

Of course, there are hundreds of different research studies about different aspects of literacy, many of which draw different conclusions, and it can be hard to know which studies to trust, or how to generalise across many different studies. **Review papers** summarise findings across many studies on the same topic to allow us draw stronger conclusions. **Systematic reviews** have a clearly defined protocol to ensure that they are less biased in finding research studies that answer a particular research question. They are a synthesis of multiple research studies on a single topic. Systematic reviews can draw stronger conclusions than any single individual study as they draw across a larger sample and as such have much greater **statistical power**. They can also be useful in examining moderating factors in effects—they can see whether effects are stronger in, for example, a particular age group of children or educational system in comparison to others. Systematic reviews sometimes, but not always, contain **meta-analysis**. This is a statistical technique to combine quantitative results across different studies asking the same research question. Meta-analyses are particularly useful to examine intervention effects, but can also be used to examine other types of study. They normally do this by combining individual effect sizes from each study to arrive at a single overall **effect size** for a given research question. Effect sizes denote the magnitude of a given effect, regardless of whether or not it is statistically significant.

In the following report, we have relied on, and cited, the highest quality research in a given area, with a particular emphasis on recent systematic reviews and meta-analyses where these are available.

[8] A good overview of some of these issues is provided in: https://v1.educationendowmentfoundation.org.uk/uploads/pdf/Randomised_trials_in_education-revised250713.pdf

SECTION 4: Proximal factors that underpin literacy development

Section summary

This section summarises the proximal factors that impact on literacy development because they directly underpin the processes that are used during reading and writing.

Proximal factors include skills that are used to form links between the spoken and written form of the language, and skills involved in constructing meaning.

Forming links between the spoken and written form of the language depends upon three components skills:

- phonological skills—the ability to recognise and manipulate the sounds that make up spoken words;
- orthographic skills—the written features of words that make up written words; and
- knowledge of common links between spoken and written words (e.g., letter-to-sound rules).

The meaning of a message is constructed at many different levels, both by the author and by the reader. Meaning is constructed within words by the combination of morphemes. Words themselves may have multiple senses or meanings. Meaning is also constructed across words within and between sentences. A range of skills directly influence a child's ability to construct meaning at each of these levels. These skills include:

- vocabulary depth and breadth;
- knowledge of morphology;
- grammar and syntax;
- discourse-level skill—such as construction of coherent mental models, comprehension monitoring, and standards for coherence; and
- pragmatics.

Here we consider factors relating to a child's underlying aptitudes that are well established as influencing literacy outcomes. First, we discuss the skills that underpin children's ability to forge links between their known spoken language and the new written language that they are learning. Then we discuss the impact of language skills on children's ability to construct meaning through literacy.

Many of the skills that underpin literacy are related to knowledge of language or linguistic structures. For most children, knowledge of language initially develops from experience hearing and producing speech, and is later applied to literacy. Early language development is described in Law et al. (2017). Here, we focus on the aspects of language that have a key role in literacy development. In many cases, we describe a child's knowledge about a specific linguistic structure that supports literacy acquisition as an *awareness*. For example, we will soon discuss *phonological awareness*. There are two components to the knowledge necessary in order for a child to demonstrate awareness:

1. **epilinguistic** or ***implicit awareness***—the child must have sufficient knowledge about the language structure to be able to employ it in their everyday use of the language; and
2. **meta-linguistic** or ***explicit awareness***—the child must have the ability to reflect on the language structure, and the way in which it can be manipulated.

When we measure these skills, we should remember that we typically demand that the child shows both levels of awareness. For example, phoneme awareness—the ability to segment and blend phonemes—is a key foundational skill for word reading and spelling. To demonstrate awareness, a child must not only be able to blend phonemes together when producing words in speech, but they have to be able to manipulate phonemes when explicitly asked to do so—for example, when asked, *'say BOAT without the /b/'*. These two components of awareness do not develop simultaneously—it is possible to have emergent underlying abilities without the explicit ability to reflect upon your knowledge. Such a discrepancy is often referred to as implicit or unconscious knowledge. Having both the skill and the explicit capacity for reflection is often referred to as meta-linguistic or conscious knowledge. More research is necessary to determine whether implicit awareness is sufficient for literacy acquisition (Fletcher-Flinn & Thompson, 2000).

4.1 Forming links between the spoken and written form of the language

There are many different ways to consider the structure of the language. In the following section, we focus on knowledge relating to the sounds of spoken language and the letters of written language. Figure 13 summarises the most frequently used terms to describe the sound structure of language along these lines, ordered by the size of the unit of analysis. Later we will also discuss multi-word units in the context of constructing meaning (see Table 4 p50). First, we describe typical development of awareness of these different structures within the context of developing the ability to form links between units of sound (**phonology**) and text (**orthography**).

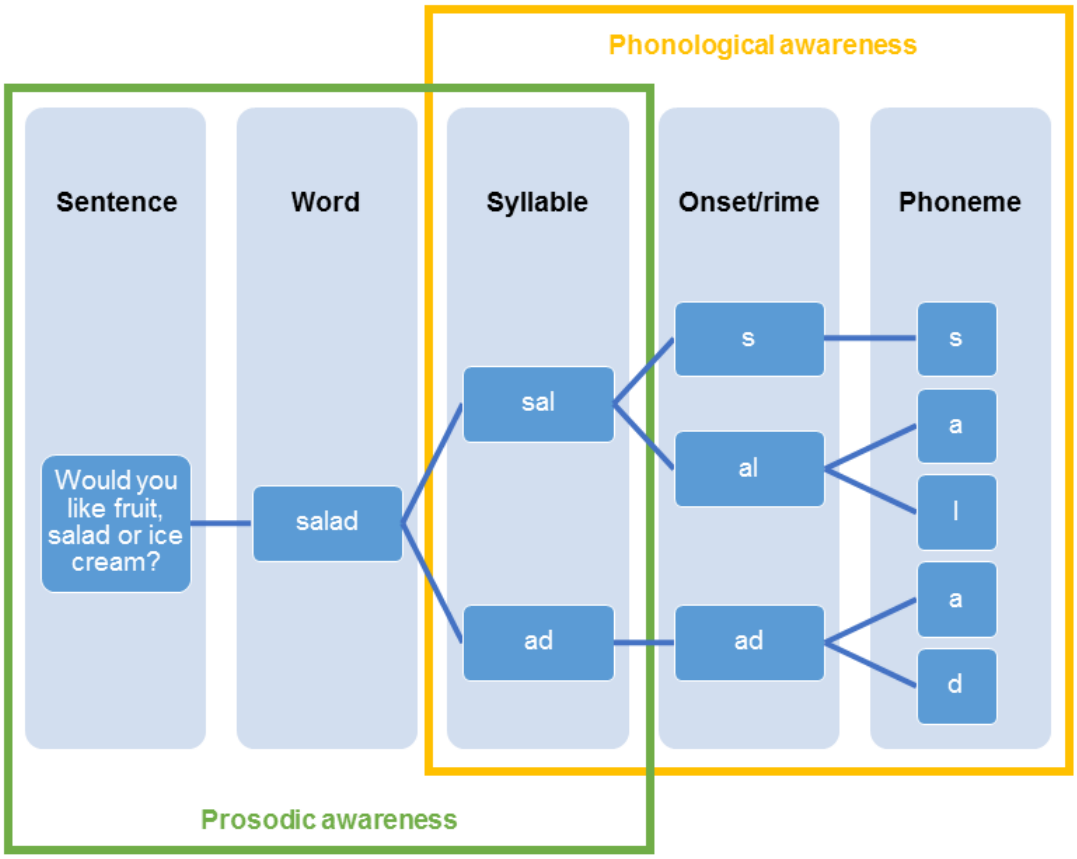

Figure 13: Phonological awareness, prosodic awareness, and units of sound.

4.1.1 Phonological skills

Phonological skills include any ability that involves access to the sounds of spoken language. As such, they are oral language skills. Phonological skills can exist independently of literacy, although there remains a debate about whether children develop some aspects, particularly fine grained **phoneme awareness**, before the initial stages of beginning to read (Castles & Coltheart, 2004; Hulme, Snowling, Caravolas, & Carroll, 2005). Here, we discuss two of the most salient phonological skills associated with literacy development: phonological awareness (Melby-Lervåg, Lyster, & Hulme, 2012) and prosodic awareness (Kim & Petscher, 2016).

We use **phonological awareness** to refer to knowledge about sound units that are smaller than a word (**sub-lexical**, see Table 1)—for example, to count **syllables**, notice **rimes**, or segment and blend **phonemes** (see Table 2). This is sometimes referred to as segmental awareness.

Table 1: Segmenting spoken words (based on Stuart & Stainthorp, 2016)

Segment	Definition
Phoneme	The smallest unit of speech sound in a word that changes meaning. For example, the word *'bed'* is composed of 3 phonemes: /b//ɛ//d/. If we change the first phoneme /b/ to /r/, then the word has a different meaning. There are approximately 44 phonemes in the English language (Kilpatrick, 2015).
Onset	The onset is any consonant phoneme(s) that occur at the start of a syllable. It consists of everything until the vowel. For example, the /b/ of *'beat'*. Not all English syllables contain an onset. For example, *'eat'* is a syllable that begins with a vowel.
Rime	The rime is an obligatory unit of English syllables. It consists minimally of the vowel phoneme, and may also include any consonants that follow the vowel. For example, the /iːt/ (*'eat'*) of *'beat'*
Syllable	A syllable is formed of one obligatory vowel phoneme combined with optional consonant phonemes that precede and/or follow the vowel. For example, /band/ is composed of a vowel phoneme /a/, preceded by the consonant phoneme /b/ and followed by the consonant phonemes /n//d/.

Prosodic awareness (also known as suprasegmental phonological awareness) refers to larger sound units—the rhythmic components of spoken language including stress, timing, and intonation (Harrison, Wood, Holliman, & Vousden, 2018). In English, syllables within sentences tend to have alternating stress. **Stress** refers to the emphasis or loudness of the syllable. Stress can also carry meaning. For example, the two different meanings of the word *'record'* (the noun meaning item containing information, or the verb meaning to note something down) are distinguishable by stress patterns (RECord or reCORD).[9] **Timing** refers to how speech speeds up or slows down across the sentence, which is also used to convey meaning. For example, consider the difference between:

'Would you like fruit, salad or ice cream?'; and

'Would you like fruit salad or ice cream?'

Finally, **intonation** refers to changes in pitch, which also carries meaning in spoken language. For example, rising intonation can indicate a question: compare the intonation of *'Anna is going to the park'* with *'Anna is going to the park?'*. It is clear, therefore, that a good understanding of how prosody conveys meaning is needed for fluent reading aloud.

[9] Throughout this review, strong or stressed syllables are marked in upper case.

Awareness of these two aspects of the sounds of spoken language exert independent and interactive influences on literacy which we describe in detail below.

4.1.1.1 Development of phonological awareness

Phonological awareness typically begins as an initial awareness of large segments such as syllables and rimes during the preschool years, and develops into an awareness of smaller segments (phonemes) once children start to learn to read (Carroll, Snowling, Hulme, & Stevenson, 2003; Ziegler & Goswami, 2005). Consonant clusters (two or more consecutive consonants) are particularly hard for children to segment and this skill develops later (Bruck & Treiman, 1990). It should be noted that the development of phonological awareness depends on the language or languages which the child is speaking and learning to read (Duncan et al., 2013). The above progression is typical of alphabetic languages, with some variation. For example, English does not have as many consonant clusters as Czech, so the ability to segment consonant clusters is generally more advanced in Czech children (Hulme, Caravolas, Malkova, & Brigstocke, 2005). See p87 for further description of the effects of the written language.

Others describe the development of phonological awareness as a transition from implicit awareness through to the emergence of explicit awareness. It is argued that children's initial implicit awareness enables them to recognise global similarities between words, but without the ability to explain how the words are similar. For example, recognising that *'fun'* is the odd one out from *'hat' 'fun'* and *'cat'*, or recognising that *'sun'* and *'sand'* are similar might initially involve children understanding which sounds are the same. However, this does not necessarily mean that the same child is also able to segment the section of the word that sounds the same—they might not be able to say that *'sun'* and *'sand'* start with a /s/. Later, children gain explicit awareness. At this point, children begin to have a conscious awareness of individual units and are able to explain precisely how different words sound different, and, in some cases, manipulate the sounds (Gombert, 1992).

Crucial to the development of an awareness of phonemes is the act of learning how to read and write (Cunningham & Carroll, 2011b; Morais, Cary, Algeria, & Bertelson, 1979). This is because syllables and rimes are 'natural' units of language which children are attuned to.[10] Phonemes are harder to perceive and need to be made explicit (Goswami & Bryant, 1990). Because graphemes (individual letters or letter combinations) tend to map onto individual phonemes, the process of learning to read and write forces one to notice phonemes (Carroll & Snowling, 2004). Once children start learning how to read, they develop an awareness of phonemes relatively rapidly, usually achieving this skill by the end of the first year of school (Cunningham & Carroll, 2011a; Wimmer, Landerl, Linortner, & Hummer, 1991). Indeed, phoneme awareness in young children tends to be binary in nature, being more of a have/have not skill (i.e., a bimodal distribution) rather than a normally distributed variable (most scores cluster in a u-shaped curve around the mean; Seidlová Málková & Caravolas, 2016).

4.1.1.2 Development of prosodic sensitivity and awareness

Prosodic sensitivity refers to an implicit awareness of the rhythmic elements of speech. Explicit awareness of these elements is referred to as **prosodic awareness**. These are features of speech that often cross over the boundaries of the phonological segments described above and extend over multiple words. These features are known as prosody or supra-segmental units. In English, the main components of prosody are *stress*, *timing*, and *intonation*.

Prosodic sensitivity begins to develop from before birth as stress patterns of speech can be detected in the womb. Similar to segmental phonology, prosodic development typically begins with an implicit

[10] There are some exceptions to this across languages. For example, Japanese has 'mora', not conventional syllables

awareness of all rhythmic elements, extending to an explicit awareness as development progresses (Holliman et al., 2014). Children are born with an innate tendency to attend to the rhythmic features of language, which is used to bootstrap their way into segmenting speech into conventional phonological units (Cutler & Mehler, 1993). By this rationale, prosody stimulates the development of segmental phonological awareness. For example, vowels are the loudest (have the highest amplitude) of all of the phonemes. This peak in amplitude forms the rhythmic 'beat' of the syllable in speech. The development of sensitivity to the beat corresponds with when children correctly produce the vowel sound in that syllable (Goswami, 2011). Therefore, this beat sensitivity cues rime and phoneme awareness (Wood & Terrell, 1998). Beat sensitivity also allows one to become aware of the stress that is often placed on the onset/vowel sounds, thus underlying development of this aspect of prosody.

4.1.1.3 Assessing phonological skills

When assessing phonological awareness it is important to consider two things: the unit of language and the level of awareness one is attempting to tap. Careful consideration should be given to the appropriateness of the task for different age groups. Phonological skills develop through childhood, but performance on some tasks usually reaches a ceiling before adolescence. Tasks vary in their auxiliary task demands—that is, additional skills that are required to complete the task, which can undermine the results. In particular, tests of explicit phonological awareness have high working memory and meta-linguistic demands. Table 2 summarises the types of tasks and questions that are used to assess different phonological awareness skills, as published in well-regarded standardised assessments.

Table 2: Tasks used to measure phonological skills

Task	Example	Skill and level of awareness required	Standardised age range
Matching	Which of these picture words starts with the /s/ sound like 'sock'; 'sun' or 'bear'?	Phonological awareness (phoneme) Implicit	4–6 years (Wagner, Torgesen, Rashotte, & Pearson, 2013)
Blending	What word do these sounds make? Real words: can-dy /kæn//di/, s-u-n /s//ʌ//n/ Nonwords: mo-tab /məʊ//tæb/, v-o-p /v//ɒ//p/	Phonological awareness (syllable/ phoneme) Explicit	4–adulthood
Segmentation	Say each sound that you hear in the order that you heard it: Real words: c-ar /k//ɑː/ g-r-ee-n /g//r//iː//n/ Nonwords: i-p /ɪ//p/ p-a-s-p /p//ɑː//s//p/	Phonological awareness (phoneme) Explicit	Real words: 5–6 years (Gibbs & Bodman, 2014) Nonwords: 7–adulthood (Wagner et al., 2013)
Deletion	Say 'toothbrush' without the 'brush' Say 'cup' without the /k/	Phonological awareness (syllable/phoneme) Explicit, manipulation	4–adulthood (Wagner et al., 2013)
Spoonerism	Swap over the first sound from each word: 'lazy dog' gives 'daisy log'	Phoneme awareness Explicit, manipulation – combines isolation and substitution	6–adulthood (Frederickson, Frith, & Reason, 1997)

Note. Phonological awareness tasks listed in approximate order of difficulty. Age range provided with reference to recommendations in published standardised assessments.

Children who already know at least some letters (and certainly more experienced readers) will use their orthographic knowledge to help them to solve phonological awareness tasks even though these are orally presented tasks. For example, individuals may visualise the spelling of the word to make the task easier (Castles, Holmes, Neath, & Kinoshita, 2003). This means that, even in the absence of any orthographic stimuli, it can become a test of orthographic knowledge rather than phonological awareness per se (Castles & Coltheart, 2004). For this reason, it is better to measure phonological awareness using nonwords rather than real words, because this makes it much harder to make use of orthographic knowledge. Timed tasks can also minimise reliance on orthography (Kilpatrick, 2015). Nevertheless, most assessments rely on real-word stimuli.

In Table 3, we summarise some of the key tasks used in the literature to measure different components of prosodic awareness.

Table 3: Tasks used to measure prosodic awareness/sensitivity

Task	Example	Skill and level of awareness required	Approximate suitable age range
DEEdee	Does Humpty Dumpty sounds like DEEdee DEEdee or deeDEE DEEdee	Stress Explicit	7 years to adulthood (Kitzen, 2001)
Mispronunciation task	Show me the soFA (stress reversal) (individual is shown a set of pictures to choose from).	Stress Implicit	3 to 6 years (Wood, 2006)
Compound noun task	Point to the picture of what was just said: 'paint, brush' (picture of a tin of paint and a brush) or 'paintbrush' (picture of a paintbrush).	Timing Implicit	5 years to adulthood (Kitzen, 2001)
Intonation contour sensitivity test	Is this an example of someone asking or telling?: 'raining outside' compared to 'raining outside?' (with rising intonation at the end).	Intonation Implicit	5 to 8 years (Harrison et al., 2018)

Note. Also see Kim and Petscher (2016) for a battery of prosodic sensitivity tests designed for six- to seven-year-olds. References are to experimental research studies that developed the measure as there are not currently any published tests of prosodic awareness.

4.1.1.3 Phonological skills, word reading, and spelling

A large body of research over the last 35 years has highlighted phonological awareness as the strongest correlate of word reading ability (Hulme & Snowling, 2013). Its influence on literacy is universal, applicable across different educational practices and languages (Caravolas, Lervåg, Defior, Seidlová Málková, & Hulme, 2013).

The reason for the importance of phonological awareness lies in how we are taught to read and spell words. If a written word is unfamiliar, as most are at the start of reading acquisition, we read using **phonological decoding** (see Section 4.1.3 Phonics on p47). When children (and adults) encounter an unknown word, they will segment it into its composite graphemes. They can then access the corresponding phonemes and blend the phonemes together to generate the pronunciation of the word (see Dual Route Model p17). Similarly, in spelling, if a child does not have an established orthographic representation of a word (as is the case for most words at the start of literacy acquisition), then they must decode the spelling of the word using sound-to-letter correspondences. Gradually, as children become more familiar with a word, the orthographic representation consolidates and children no longer need to decompose the word into phonemes in order to read or write it (Caravolas, Hulme, & Snowling, 2001). Decoding necessarily involves an awareness of phonemes and the ability to blend them together.

In both word reading and spelling, decoding can be achieved using other, larger units as well (such as syllables, rimes, or morphemes). This can also lead to successful word reading, so long as the reader is aware of the necessary correspondences (see Grain Size Theory p18). Regardless of the unit of analysis, this phonological recoding is the key to creating long-term orthographic representations through 'self-teaching' (Share, 1995). Nonetheless, phoneme awareness specifically remains the aspect of phonological awareness that is most strongly associated with word reading—above rime and syllable awareness (Melby-Lervag, Lyster, & Hulme, 2012)—perhaps because there is a relatively small number of phoneme-grapheme correspondences whereas in forming rime or syllable units, those rules can combine in many different ways.

Phonological awareness has been identified as a correlate of word reading and spelling ability throughout childhood and adolescence (Melby-Lervag et al., 2012) and also in adulthood (Wagner, Torgesen, & Rashotte, 1999). Deficits in phonological awareness have been associated with reading impairment, with it being one of the principle deficits identified in dyslexia (Carroll, Solity, & Shapiro, 2016; Pennington et al., 2012; White et al., 2006). However, there is debate about whether poor phonological skills are a cause of reading impairment or whether they are simply a consequence of poor reading (Huettig, Lachmann, Reis, & Petersson, 2018). Once children have developed explicit phoneme segmentation and blending skills necessary for decoding, phonological awareness is generally no longer a limiting factor (Wagner et al., 1997). Therefore, associations after this point are more likely to be due to reading/spelling influencing phonological awareness rather than phonological awareness influencing literacy. However, there is evidence that phonological awareness continues to have an effect on literacy beyond this point via its influence on the quality of phonological representations: according the Lexical Quality Hypothesis (see p10), the better the phonological representation of a word, the faster the word is accessed. As a result, phonological processing continues to effect word-reading processes for skilled readers (Breadmore & Carroll, 2018; Daneman & Reingold, 1993).

Longitudinal studies have consistently shown that the association between phonological awareness and spelling is even stronger than that between phonological awareness and word reading (Furnes & Samuelsson, 2011). The need for specificity in spelling, as well as the need to hold the word in memory during the transcription process, may mean that children have to rely on decomposition of words into smaller phonological segments for longer. In contrast, in reading, other processes such as recognition of larger orthographic units (syllables, words) can be relied upon at an earlier stage (Bourassa & Treiman, 2000).

While phonological awareness has a direct effect on word reading and spelling, prosodic awareness is an indirect predictor in the early stages of literacy acquisition. For example, the ability to perceive lexical stress as measured by a mispronunciation task (for example, '*Which is correct: BAker or baKER?*') predicted word reading and spelling accuracy in five- to seven-year-olds (Holliman et al., 2014). However, in both cases the link was indirect, acting via rime awareness. Kim and Petscher (2016) similarly found that prosodic sensitivity in six- to seven-year-olds was not directly related to word reading. Instead, the relationship between prosody and word reading was completely mediated by phonological and morphological awareness. It was argued that prosodic awareness helped children to build well-specified phonological (and morphological) representations, and it is these skills in turn which support word reading and spelling. However, there is evidence from intervention research of a direct link between prosodic awareness and word reading. Harrison et al. (2018) delivered speech rhythm training (focusing on stress, intonation, and timing) to a group of 73 four- to five-year-olds. The intervention group showed significant improvement in their word reading performance compared to children in the control group, implying a potential causal link from prosodic awareness to early literacy development.

Beyond the age of seven, as the words that children encounter become longer and more complex, prosody becomes a necessity for multisyllabic word reading and acts as a direct predictor of word

reading (Heggie & Wade-Woolley, 2017). This is because words of more than one syllable necessarily involve a stress pattern where not every syllable will be stressed. Therefore, it is possible to read multisyllabic words without making phonemic errors, but still making stress-assignment errors which cause an incorrect pronunciation of the word. Indeed, Holliman, Mundy, Wade-Woolley, Wood, and Bird (2017) found that prosody was the strongest predictor of multisyllabic word reading, above and beyond phonological awareness. They argue that once phoneme-level skills are mastered, prosodic awareness becomes the limiting factor when reading complex words.

4.1.1.4 Phonological skills and reading comprehension and composition

Phonological awareness is related indirectly to reading comprehension via its effect on word reading (consistent with the Simple View of Reading, see p14). However, there is also research which suggests that it has an additional, direct effect on comprehension. For example, in a cross-sectional study, Engen and Høien (2002) found that phonological awareness independently predicted reading comprehension beyond word reading in a group of 1300 Norwegian children aged seven to eight years. They suggested that the link was caused by the close relationship between phonological and **meta-cognitive awareness**. Meta-cognitive awareness is the form of conscious control and monitoring of one's cognitive processes that is necessary to achieve good comprehension (Byrne, Fielding-Barnsley, Ashley, & Larsen, 1997). Other potential causal factors were indirect: the role of short-term memory in phonological tasks—important for integrating information above the single word level (Stothard & Hulme, 1995)—and the role of phonological skills in stimulating vocabulary growth by allowing a stream of speech within a 'scene' to be segmented into meaning-relevant chunks (Chiat, 2001). The ability to integrate information and to understand the meaning of words are essential to reading comprehension.

Earlier we described how detection and understanding (receptive awareness) of prosodic structure impacts on word-level reading and spelling. Here, we describe how expressive use of prosody (oral expression) plays an important role at the text level to help reading fluency and comprehension. Meaningful oral expression is essential to fluent reading (see Section 2.2.3 Reading fluency, p24) and this in turn helps us to understand what we are reading (Rasinski, 2006). In a longitudinal study of 92 American children from seven to nine years old, Miller and Schwanenflugel (2008) showed that fewer inappropriate pauses during oral reading predicted adult-like rises and falls in intonation, which in turn predicted oral reading fluency (over and above word reading skills). All three skills were associated with reading comprehension. In addition, Lochrin, Arciuli, and Sharma (2015) examined the ability of seven- to 12-year-olds to produce appropriate syntactic intonation (correct use of pauses within phrases). Syntactic intonation predicted reading comprehension. The authors suggested the relationship operated via enhanced oral language skills—the ability to produce appropriate syntactic boundaries improved semantic processing, which lead to better linguistic comprehension of text (Koriat, Kreiner, & Greenberg, 2002).

Very little research has examined the role of phonological or prosodic awareness in writing. It has been argued that phonological skills are related indirectly to writing fluency via their effect on spelling (McCutchen, Teske, & Bankston, 2008). However, models of writing development do not cite a direct role for phonological skills in composition (De La Paz & McCutchen, 2011).

4.1.2 Orthographic skills

Orthographic skills describe any skill that involves recognition or manipulation of the written form of language. Thus, **orthographic awareness** is the ability to form, store, and access representations of the orthography, or visual form, of words (Deacon, Benere, & Castles, 2012). Orthographic skill encompasses unconscious/implicit recognition of spelling strings as well as the explicit ability to spell them (Treiman, 1992a). These skills can exist independently from phonological awareness, although, as we will discuss later, the linkage between phonology and orthography is essential to the development of literacy. Orthographic skills can be measured in a number of ways. Tasks often involve making

orthographic choices about nonwords—selecting a preferred spelling from a selection of nonwords. For example, word-like-ness tasks such as: *'Which word is spelt more like a real word—ppoun or pounn?'* (Kilpatrick, 2015).

The process via which orthographic representations are formed or added to the lexical representation of a word is called **orthographic learning**. Orthographic learning occurs via repeated exposure to a word in written form (Share, 1995). For example, a classic task involves children reading text where a nonsense word (e.g. <yait>) is encountered several times, together with a meaning (for example, *'the coldest city in the world'*). Afterwards, there are several ways to see whether the orthographic representation of the word was learned. For example, you can use a pseudohomophone orthographic choice task—*'What is the coldest city in the world: Yait, Yate, or Yaet?'*—or ask for the spelling without ever presenting the pronunciation of the word—'*Spell the coldest city in the world'*. The orthographic representation of the word has been learned if its spelling is recognised and produced accurately and quickly. Orthographic learning can occur relatively quickly, with some learning happening after just one exposure (Kyte & Johnson, 2006). However, the evidence is that learning increases with the number of exposures, and that good learning requires at least four exposures (Nation, Angell, & Castles, 2007).

Share's original conception of orthographic learning argued that it occurred via phonological recoding: a word is first 'decoded' at the phonological level before an orthographic representation is established (Share, 1995). However, research from the last ten years shows that orthographic learning does not have to be mediated by phonological skills; it occurs after silent reading, as well as reading aloud (de Jong, Bitter, van Setten, & Marinus, 2009), and children do not have to be able to successfully decode words in order for them to be learnt orthographically, although it does help (Wang, Nickels, Nation, & Castles, 2013a). It has also been shown that orthographic learning has a lasting effect several weeks after exposure (Nation, Angell, et al., 2007). Finally, such learning occurs more effectively when words are presented in a meaningful context compared to in isolation (Ouellette & Fraser, 2009; Ricketts, Davies, Masterson, Stuart, & Duff, 2016). Recent research suggests that this type of orthographic learning is, however, only part of the journey. The interactive and consolidating processes that take place between representations of newly learned words and existing words (lexical engagement) occurs more slowly (Tamura, Castles, & Nation, 2017).

4.1.2.1 The development of orthographic skills

Development of orthographic awareness begins by understanding that written words differ from pictures. This typically occurs by the age of three to four as a result of being exposed to a literacy-rich environment—for example, seeing writing on signs or cereal boxes. Children of this age may attempt to 'write' with a crayon or pencil, and these marks will differ from their drawings (Lavine, 1977; Treiman, 2017). Trivette, Hamby, Dunst, and Gorman (2013) conducted a meta-analysis of 49 experimental studies that examined the emergent writing skills of one- to five-year-olds (1647 children from U.S., U.K., Israel, Canada, Hong Kong, Sweden, Norway, and France). From this, they formulated a means of categorising different types of mark-making, scribbling, drawing, and writing across 13 levels of prewriting and emergent writing. Trivette et al. (2013) concluded that the development of emergent writing skills occurs in a highly predictable sequence: children initially make random marks on the page, then they make more controlled marks, strokes, and straight lines. Next they produce geometric shapes (circles, squares, ovals, etc) before finally beginning to produce conventional symbolic letters at around the age of four. Others have also argued that by the age of five, children begin to make marks that resemble individual letter forms, although these may not be the right letters (Tolchinsky-Landsmann & Levin, 1985). Still, children at this stage are not aware that the function of the writing system is to represent the sounds in words. Interestingly, they instead tend to believe that written forms reflect their meanings—often quite literally. For example, young children may believe that the words for big animals, such as bears, should have more letters than smaller animals such as caterpillars (Ferreiro & Teberosky, 1982). Gradually, as children's understanding of the connection between writing and speech increases they realise that all of the words in an utterance are reflected in writing and that the physical

properties of words do not reflect their meaning. At this point, children tend to begin to think that print reflects speech at the syllable level (for example, *'should be'* written *'*c b'*; Ferreiro & Teberosky, 1982). Through more exposure to print, children come to realise that the number of letters does not correspond to the number of syllables in a word and that they must think of speech at a finer-grained level. This usually coincides with the onset of formal schooling and instruction in the alphabetic principle (Treiman & Cassar, 1997).

It should be noted here that if children are learning to read in a non-alphabetic script (such as Chinese where characters denote meaning), or a script that does not map onto phonemes (such as Japanese where graphemes map to mora, a type of syllable), then their orthographic awareness does not need to progress as far as the fine-grained level. In fact, it will correspond with an earlier, more intuitive sense of the meaning of print (Hanley, 2007). This is discussed further in Section 6.3: Language environment and bilingualism.

With time, children focus more and more on the letters within words and how they are arranged. They learn about **statistical regularities** (or orthotactics) in spellings. This means that they gain an understanding that certain letter strings are common, and others are rare or never seen at all. They also learn to understand the effects of position. For example, <ck> can appear in the middle and end of words, but never at the start. Similarly, doublets such as <ee> or <ll> appear in the middle or end of words, but rarely at the beginning (Bourassa & Treiman, 2000). This awareness can appear as early as kindergarten (Treiman, 1992a). Over time, as children's experience with print grows, they develop an awareness of multiple statistical regularities.

4.1.2.2 Orthographic skills, word reading, and spelling

As described previously (see p14 and 27), most theories of word reading and spelling point towards an 'end-goal' of automatic and efficient lexical access using word-specific orthographic representations. This word-specific orthographic knowledge should directly predict reading or spelling of familiar words. In turn, effective word reading helps to build new orthographic representations through orthographic learning.

When describing the link between orthographic skills and literacy, Conrad, Harris, and Williams (2013) distinguish between two dimensions: *word-specific orthographic knowledge* and *general orthographic knowledge*. Pseudohomophone orthographic choice tasks measure word-specific knowledge. Word-specific knowledge supports high quality lexical representations of individual words, representations which might contain overlapping orthographic information of different sized units (such as graphemes or words). According to the Lexical Quality Hypothesis (see p10), the better quality the representation, the more rapidly the word will be accessed. Word-like-ness tasks measure decontextualized or generalised knowledge of the statistical regularities of the language more broadly. This suggests that orthographic skills both predict literacy at a word specific level, but are also predicted by literacy at the level of general knowledge about the language—a reciprocal relationship.

Despite these theoretical reasons for a bidirectional link, the research evidence suggests that the relationship is unidirectional. Orthographic knowledge appears to be a product of reading development rather than a causative factor (Conrad & Deacon, 2016), namely, the amount of reading experience a child has predicts their orthographic knowledge, not vice versa. For example, Deacon et al. (2012) measured orthographic skills (word-like-ness and orthographic choice) and word reading ability in a group of first graders, then repeated the assessments in second and third grade. They found that reading in first grade predicted orthographic skills in third grade, but orthographic skills did not predict third grade reading. Conrad and Deacon (2016) found similar results in second and third grade children. Consistent with this direction of association, it has been found that as reading experience increases, children develop more pattern-specific knowledge (noticing common orthographic patterns that are not phonically regular, and mapping their correct pronunciations to long term memory).

One reason for the lack of evidence of a unique relationship from orthographic skill to reading may be the circularity inherent in the measures that are used to test the two constructs. The tasks used to measure orthographic skill tap the quality of underlying orthographic representations. As such, they index prior success in orthographic learning, which is a product of reading experience (see the Self-teaching Hypothesis, see p17). Therefore, when you predict word reading from prior orthographic skill while partialing out prior reading skill, you actually also remove the variance in orthographic skill that you wanted to examine. For example, if reading at age seven is predicted by only orthographic knowledge at age six, then there would be a unique association. However, orthographic knowledge at age six overlaps strongly with reading at age six such that if early reading (the autoregressor) is accounted for, then the independent effect of orthographic knowledge would become insignificant (see Nation & Castles, 2017 for a review).

Theoretically, the reasons for a link between orthographic skills and spelling are the same as those for the link with reading, namely, theories of spelling development cite direct access to high quality orthographic representations as the means by which automatic and efficient spelling is achieved (e.g. Treiman, 1992b). The difference is that with spelling, an orthographic representation is accessed first and 'copied' in written form to correctly spell a word, while with reading, the written word is matched with an orthographic representation in memory. In fact, spelling is arguably a stronger indicator of orthographic knowledge as each grapheme must be correctly represented, while with reading, a match can be made based on incomplete information (Ricketts et al., 2016).

Consistent with theoretical predictions, Ouellette and Fraser (2009) found that general orthographic knowledge contributed unique variance to invented spellings, over and above the contribution of phonological awareness skills in kindergartners. In another study, orthographic processing predicted spelling skill in both French and English-speaking first graders (Chung, Chen, & Deacon, 2017).

4.1.2.3 Orthographic skills, reading comprehension, and composition

The Simple View of Reading predicts that the effects of orthographic skills on word reading will result in an indirect link to reading comprehension. In particular, orthographic knowledge is a key component of lexical quality (Perfetti, 2007). Obviously comprehension involves word reading within the context of a whole text, but the foundation of this is understanding the meaning of each individual word. Therefore, high lexical quality is associated with good reading comprehension (Perfetti & Stafura, 2014). Similarly in writing, the effects of orthographic skills on spelling will result in an indirect link to composition by freeing capacity for higher order compositional skills. To our knowledge there is no evidence of a direct link from orthographic skills to composition.

4.1.3 Phonics

4.1.3.1 Phonics, word reading, and spelling

Being literate in an alphabetic orthography is dependent on an understanding of the alphabetic principle (the knowledge that letters symbolise sounds; Byrne, 1998). In other words, literacy is dependent on being able to link orthography to phonology. The most effective and efficient way for children to begin learning how to read and spell is for them to be explicitly taught how to connect letters and sounds—linking orthography and phonology at the grapheme-phoneme level. The process of learning these correspondences is known as phonics, and has been incorporated into the national curriculum as the mandated form of initial literacy instruction in the U.K. since the Rose review in 2006 (Rose, 2006). Phonics equips the beginning reader with the ability to 'decode' regular words that they have not yet learned the orthographic form of by identifying the graphemes in the word (for example, <c><a><t>), then blending together the corresponding phonemes (/k//ae//t/ → *'cat'*). Likewise in spelling, being able to effectively link orthography and phonology enables spelling through phoneme-grapheme conversion.

Children can segment a word into its phonemes, for example /d//ɒ//g/, and write a grapheme for each phoneme to produce the written word *'dog'*.

Letter knowledge and phoneme awareness are both critical and must be in place before a child can learn how to read (Byrne, 1998). These two skills, plus their interaction, uniquely predict early reading ability; that is, for phonics to be effective, children need to be able to:

1. manipulate phonemes (phonological awareness);
2. manipulate letters (orthographic awareness); and
3. link letters and sounds (phonic knowledge).

In support of this, phoneme awareness and letter knowledge are two of the strongest predictors of early reading ability (Hulme & Snowling, 2013). Similarly, phoneme segmentation and letter-sound knowledge are the precursor skills of early phonological spelling ability (Caravolas et al., 2001). Interventions that combine reading with phonological activities are much more successful in producing gains in reading and spelling than interventions that focus only on phonological awareness (Bus & van IJzendoorn, 1999; Ehri et al., 2001). This is illustrated in a study by Hulme, Bowyer-Crane, Carroll, Duff, and Snowling (2012) with 152 five- to six-year-olds. Here, the authors found that an intervention that combined phonics with reading practice predicted improvements in literacy via (mediated by) improvements in letter knowledge and phoneme awareness.

Phonics is, however, only one component in the development towards fluent reading. No phonics programme aims to explicitly teach every possible grapheme-phoneme correspondence. Even if there were such a programme, this would not provide children with the knowledge of rimes, syllables, and morphemes which is also necessary. Instead, synthetic phonics programmes focus on the most frequent grapheme-phoneme correspondences, making them a great way for getting children 'off the ground' with reading (McGeown, 2015; Rose, 2006; Torgerson, Brooks, Gascoine, & Higgins, 2018). Decoding at this level becomes an increasingly laborious process the longer the word is, and does not work for all words. As the lexicon expands, children go on to link orthography to phonology at many different levels (such as syllables and morphemes).

Once children are confident with phonics and have begun to acquire the alphabetic principle, they can develop their orthographic representations independently by Self-Teaching (Share, 1995), as described on p17. Self-teaching acts as follows: in the early stages of literacy acquisition, children's spoken vocabulary is much more developed than their reading vocabulary. It is therefore likely that the pronunciations of the words they attempt to read are already stored in the lexicon, with links from spoken form to meaning. What is missing is the orthographic information. Phonics knowledge enables children to decode enough new words to guess at the pronunciation of a word that they know. Every time a word is successfully decoded in this way, orthographic learning takes place increasing the lexical quality of the representation. Self-teaching can work for irregular words as well through set for variability—reading an irregular word as if it was regular (e.g. stomach and stow-match), then searching the mental lexicon for a familiar spoken word that is similar in pronunciation and fits the context (Tunmer & Chapman, 2012).

4.1.3.2 Phonics, reading comprehension, and composition

Being able to link phonology and orthography leads to better comprehension of text via improved word reading accuracy (see the Simple View of Reading; Gough and Tunmer, 1986). However, there may also be other mechanisms. For example, Connelly, Johnston, and Thompson (2001) compared two matched groups of beginning readers; one group received a phonics intervention, and the other a book experience intervention. Despite equivalent word reading accuracy at the start, the phonics group showed better reading comprehension post intervention. This was attributed to the phonics group spending more time trying to identify unfamiliar words via decoding and using contextual information to

support these attempts (resulting in more contextually appropriate errors). The attention on context resulted in more rehearsal of the meaning of the text, and hence better reading comprehension.

With regard to writing composition, there is evidence that phonics instruction that includes specific spelling practice has a beneficial effect on the amount of text written (story length) compared to phonics instruction that does not include spelling practice (Roberts & Meiring, 2006). This is probably because improved spelling ability leads to greater automaticity in writing, which allows improvements both in text quality and quantity (see p32 Development of composition, for discussion of this).

4.1.4 Summary: forming links between the spoken and written language

Children's knowledge about the sounds of spoken language, the letters of written language, and the way the two different ways of representing the language are associated is a key component of literacy. These skills are quite fundamental to word-level literacy development (word reading and spelling). As a result, knowledge of sounds, letters, and the links between the two are also closely related to text-level literacy. For the most part, this is because children who have difficulties or inefficiencies at the word level expend such a large amount of cognitive effort decoding the individual words that limited resources remain to apply to reading comprehension or writing composition. However, while understanding of sounds, letters, and meaning is fundamental, it is not sufficient for literacy. After all, the goal of literacy is to communicate meaning. In the next section we describe how children's language skills and ability to construct meaning underpin literacy development.

4.2 Language skills and constructing meaning

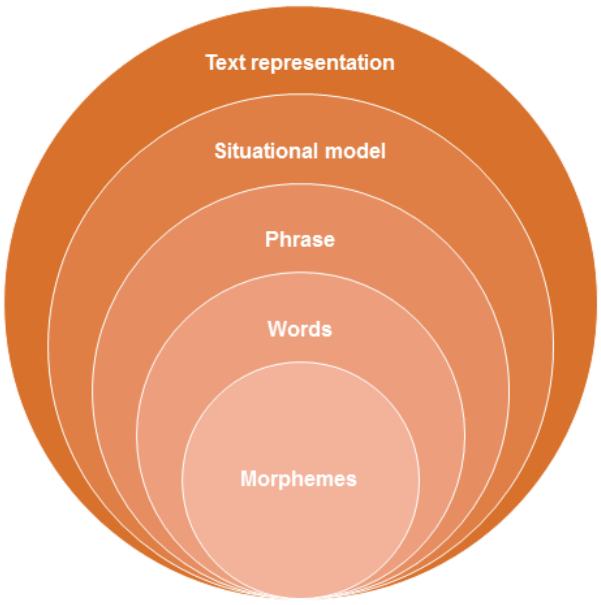

Figure 14: Levels of constructing meaning.

Interpreting the meaning of a message involves much more than a simple summation of the meaning of the words on the page. As shown in Figure 14, meaning is constructed across different levels. Within words, meaning is constructed by the combination of **morphemes** (see Table 4 below for a description of different units of meaning). Across words, meaning is constructed within and between sentences to form a situational model (see p15 for further discussion of mental models of both the situation and the text representation). The depth of our understanding of the multiple meanings conveyed by individual

words, as well as the semantic, thematic, and grammatical links between words, enables us to construct a mental model of meaning across a sentence and the passage.

In the following sections we define and describe the typical developmental trajectory of vocabulary and morphological and syntactic awareness. Then we discuss how background knowledge and inferencing skills further influence a child's ability to construct meaning. There is debate about the extent to which these language components are truly independent of one another, and this may vary with age. Factor analysis of a large-scale study of 529 three- to four-year-olds indicated that vocabulary and syntactic skills could be considered a single factor—that general language ability drives young children's performance in both areas (Anthony, Davis, Williams, & Anthony, 2014). This was also confirmed by a study of four- to eight-year-olds (Language and Reading Research Consortium, 2015a). However, there were some indications that vocabulary, discourse, and grammar were separable skills for the oldest children. Notably, Foorman, Koon, Petscher, Mitchell, and Truckenmiller (2015) found a two-level structure to language for older children (nine- to 16-year-olds): while vocabulary and grammar were separable, a common language factor drawing across both areas was the factor most closely associated with reading comprehension. In any case, the key message for educators is that language is multidimensional. While the areas are correlated, children can exhibit difficulties in one area of language and not others.

Table 4: Units of meaning

Segment	Definition	Example
Morpheme	The smallest meaningful unit. In some cases a word is a morpheme, in others a word is made up of more than one morpheme (see p54 for more information).	'*Cat*' is a one-morpheme word, which is a noun referring to a four-legged feline animal. '*Cats*' contains two morphemes [cat][-s], the plural suffix '*s*' tells us there is more than one cat.
Word	A unit of at least one morpheme that conveys an independent meaning. In the written (but not spoken) form, words have spaces either side.	
Idiom	Multiple words that combine to convey independent meaning.	*'Water under the bridge.'*

Research often distinguishes between vocabulary and other language structures such as morphology and syntax (Kieffer et al., 2016; Perfetti et al., 2005). Vocabulary refers to word meaning. Morphology is meaning at the sub-word level. Syntax refers to meaning generated from the order of morphemes or words (see Table 4). These language skills have important implications for all aspects of literacy. Figure 14 illustrates the relationship between each language structure and word- and text-level literacy. The following sections discuss these relationships in detail.

4.2.1 Vocabulary

We can think of **vocabulary** as our mental dictionary—a list of all the words that we know. But what does it mean to know a word? While knowing the sounds or letters in a word contributes to word knowledge, most people would only consider a word to be in a child's vocabulary once they understand the meaning of the word. Even this is not straightforward to assess though, since most words have multiple distinct meanings (polysemy) and many more subtle senses or shades of meaning dependent upon the context in which the word is used. For example, the word 'board' can be a noun or a verb. Even as a noun, there are multiple distinct meanings of 'board'—a thin piece of wood, a group of people who make decisions, or board and lodging. Each of these distinct meanings can take on subtly different meanings in different contexts—wooden boards on the floor, vertical boards to pin notices on, a surface to cut on, a thick piece of card, and so on. All of these ways of knowing the word are important.

Receptive vocabulary refers to the ability to understand meaning when one encounters the word. A large receptive vocabulary supports understanding of the meaning of a message but does not necessarily mean that we use those words in our own utterances. In contrast, **expressive vocabulary** is the ability to produce and use words correctly, with an understanding of the meaning. Typically, receptive word knowledge precedes expressive knowledge, and children generally find receptive vocabulary tasks easier than expressive tasks[11] (Chafe & Tannen, 1987; Hiebert & Kamil, 2005; Lehr, Osborn, & Hiebert, 2004).

When we consider the role of vocabulary in literacy development, it is important to consider both the breadth and depth of vocabulary (Anderson & Freebody, 1981; Coyne, McCoach, Loftus, Zipoli, & Kapp, 2009; Nagy & Herman, 1987; Tannenbaum, Torgesen, & Wagner, 2006). **Breadth of vocabulary** is the number of different words a child knows. **Depth of word knowledge** is the amount they know about each word, including the interconnectedness of that knowledge. Breadth and depth of vocabulary have implications for different aspects of literacy (Cain & Oakhill, 2014; Dixon, LeFevre, & Twilley, 1988; Ouellette & Beers, 2010; Tannenbaum et al., 2006). For most students, breadth and depth of vocabulary are closely related (Binder, Cote, Lee, Bessette, & Vu, 2017).

A number of factors affect vocabulary development in the early years (see Law et al., 2017 for a review). The amount and quality of language exposure is particularly important—the more caregivers engage in conversation with children, the more words they learn. Once children overcome the initial hurdles of language learning and acquire their first few words, vocabulary breadth develops extremely rapidly. Estimates of the number of words in printed English, or in vocabulary, vary wildly (dependant on the definition of what makes a distinct word form—for example are ‘jump’, ‘jumps’, ‘jumping’ and ‘jumped’ distinct words?). Some estimate that by the time children begin school the average child has a vocabulary of 10,000 words. Through early childhood, they gain as many as 3000 words per year (Anglin, 1993a; Nagy & Anderson, 1984; Nagy & Herman, 1987). Most words are not explicitly taught, but are acquired through incidental learning during repeated exposure (Nagy & Anderson, 1984). At the beginning, this learning mainly occurs as children hear other people using new words in their speech. As the child grows, so does their vocabulary and as a result exposure to new words slows. We never stop learning new words, but as we get older we are more likely to encounter new words in text rather than in speech. You might be aware of this yourself—there may even be some technical words that you have learned over the course of reading this review but have never heard anyone say.

Depth of word learning is usually incremental. Initially, we might recognise having heard (or seen) a word but do not know what it means. At this point there might be a partial phonological (or orthographic) representation of the word but we would not say the word was in our vocabulary. As we begin to learn the word meaning we also gain understanding of the types of contexts in which the word can be used and understand how to place it in a sentence. To begin with we have limited understanding of the word and might only apply it in very specific contexts, for a very specific meaning. Over time, you learn how to use the word more widely, develop a deep understanding of multiple nuanced meanings of the word in different contexts and forge links between semantically related and synonymous words (Nagy & Scott, 2000). To support development of this type of deep and context-free vocabulary knowledge children need multiple exposures to words, in various contexts.

There is wide variation in the breadth and depth of children’s vocabularies at the start of school. Children who begin with more limited vocabularies have difficulty overcoming this. These weaknesses impact on every aspect of education as children struggle to understand the language used in classroom conversation as well as the text that they read (Christian, Morrison, Frazier, & Massetti, 2000). Vocabulary weaknesses usually persist throughout and beyond a child’s school life (Catts et al., 2006;

[11] This might be due to task related differences: receptive vocabulary is usually measured in picture-pointing tasks whereas the task demands of expressive vocabulary measures are usually much more complex since they usually require an explicit definition of word meaning.

Cunningham & Stanovich, 1997; Stanovich, 1986). Increasing the opportunities for incidental word learning can support vocabulary development (Farkas & Beron, 2004; Nagy et al., 1985). This can be achieved very effectively through classroom discussions (Beck, Kucan, & McKeown, 2002) and during book reading (see Wasik, Hindman, & Snell, 2016 for a meta-analysis of empirical intervention studies).

A great deal of research has examined how instruction can help overcome what has become known as the '*vocabulary gap*'. In addition to optimising opportunities for incidental learning, explicit vocabulary instruction can support word learning (Beck, Perfetti, & McKeown, 1982; Biemiller & Boote, 2006; Ford-Connors & Paratore, 2015; Marulis & Neuman, 2010; McKeown, Beck, Omanson, & Perfetti, 1983; Perfetti & Hart, 2002). *Explicit instructional* methods focus on a closed set of words. Teaching dictionary definitions of words is not sufficient. To gain deep word knowledge, children need multiple exposures in varied contexts. Explicit instructional interventions can be effective, but it is not feasible to explicitly teach all the words that children need to learn. Consequently, it is important to carefully consider and prioritise words chosen for explicit instruction.

Beck and colleagues' *Three-Tiers Framework* provides a useful perspective to identify and prioritise words for explicit teaching (Beck et al., 2002; Beck, McKeown, & Omanson, 1987). *Tier One* words (such as *dog, man, swim, look*) occur in spoken language with such high frequency that children are likely to learn them incidentally through conversations, without instruction. *Tier Two* words (such as *contradict, precede, proficient*) are less frequent in conversation, but have a meaning that can be used across multiple domains and because of this these words are of high utility. Although these words are relatively rare in spoken language, they occur frequently in written text. Children might not get enough exposure to these words from spoken language to learn the meaning, and might benefit from explicit instruction. *Tier Three* is comprised of infrequent and domain specific words (such as *piano, dentist*). Academic topic and subject vocabulary (such as *photosynthesis, genome*) are Tier Three words.

Instead of explicit instruction of a closed set of words, another approach is to teach children the strategies that might help them to find the meaning of unknown words in the future. For example, training children to conduct morphological or contextual analysis. These interventions might have longer term utility. Children who are taught word learning strategies do improve their ability to learn the meaning of new words by applying the strategies (Baumann, Edwards, Boland, Olejnik, & Kame'enui, 2003; Kieffer & Lesaux, 2012b).

The most effective way to support vocabulary development is likely to include aspects of all of these methods—explicit instruction for certain words, teaching children to use strategies for word learning, and providing a wealth of different contexts to enable children to practice these strategies and to support incidental word learning.

4.2.1.1 Vocabulary, word reading, and spelling

There are several reasons why vocabulary should have a role in children's word reading and spelling ability. Firstly, children who begin to read already knowing a lot of words from speech just have to learn the mappings from these known words to the written form. For each word in their lexicon there is an existing representation that includes the meaning of the word, phonological structure, and the links to other words. To learn to read and spell each of these words, they just need to add the orthographic features. For words that are in the child's vocabulary, partial letter-sound decoding attempts might be enough to roughly approximate a word known from speech. Children who have a wider selection of words to choose from are more likely to approximate the right word. In contrast, if a word is not known to them, then a brand new lexical representation must be created and all of this information needs to be learned (see Figure 1 on p11).

Once children grasp the alphabetic principle, then they can use letter-sound rules to decode regular words and produce plausible pronunciations or spellings without knowing the meaning of the word.

Even so, reading and spelling unknown irregular words will remain problematic because letter-sound rules cannot be used. Consistent with this, several experimental studies suggest that children learn to read words with irregular letter-to-sound correspondences more rapidly if they already know the meaning of the word. For example, Wang et al. (2013b) conducted a training study with 45 Australian six- to nine-years-olds. There were two training phases using repeated exposures over 15 days. In the first phase, children learned novel word pronunciations and associated meanings. In the second phase the children were exposed to contextually rich written stories which contained the written form of the novel word. At the end of the training phases, word reading was better for irregular novel words if children had been successful when learning the meaning, prior to exposure to the spelling. Similar findings have been observed with British nine- to ten-year-old children—both poor comprehenders and typically developing (Ricketts et al., 2008) and also adults (Taylor, Plunkett, & Nation, 2011).

Depth of knowledge about words is also important for word reading and spelling, perhaps more so than breadth of vocabulary (Ouellette, 2006b; Tannenbaum et al., 2006). According to the Lexical Quality Hypothesis, the more you know about the word the easier it is to access the word during reading and spelling (Perfetti, 2007). Linked to this, the *lexical restructuring hypothesis* suggests that as children learn words they restructure their representations to include increasingly fine-grained detail about the phonological structure and meaning of words. This is necessary in order to distinguish between words in their increasingly large vocabulary (Metsala & Walley, 1998; Walley, Metsala, & Garlock, 2003). Accordingly, children with a broad vocabulary also have more detailed representations of the words that are in their vocabulary.

4.2.1.2 Vocabulary, reading comprehension, and composition

Vocabulary impacts on reading comprehension through a number of different direct and indirect mechanisms. The most common explanation is the *instrumental effect* of vocabulary; understanding the meaning of each individual word in the passage is an essential component to comprehension of the passage as a whole (Anderson & Freebody, 1981). Linked to this, depth of vocabulary knowledge improves speed of access to the lexicon (Mezynski, 1983). In line with the Simple View of Reading, more efficient word processing increases capacity for reading comprehension processes (Gough & Tunmer, 1986; Hoover & Gough, 1990). However, it is not just these word-level processes that are important: vocabulary remains a strong predictor of reading comprehension after controlling for word reading skill (Muter et al., 2004; Ouellette, 2006b). Indeed, breadth and depth of vocabulary are independent predictors of reading comprehension after controlling for both decoding and listening comprehension (Braze, Tabor, Shankweiler, & Mencl, 2007; Ouellette, 2006a; Sénéchal, 2006; Tannenbaum et al., 2006). This means that there is more to this association than the simple ability to read individual words.

Another possibility is that vocabulary is a proxy measure of a third variable. The *aptitude hypothesis* (Anderson & Freebody, 1981) suggests that both vocabulary and reading comprehension relate to verbal aptitude. Meanwhile, the *knowledge hypothesis* (Anderson & Freebody, 1981) suggests that by knowing a word, you know something about related concepts. It is this conceptual knowledge that is essential to reading comprehension since most passages communicate concepts. The effect of **background or topic knowledge** goes beyond the effect of vocabulary. The more we know about a subject, the more likely we are to have the necessary breadth and depth of vocabulary to process information on that topic efficiently. When we have extensive topic knowledge, the vocabulary related to that topic is likely to be well represented and interconnected within the lexicon. As described in models of reading comprehension (see p21), text is rarely fully complete; the extent of our background topic knowledge affects the ease with which we can make the inferences necessary to fill these gaps. Recht and Leslie (1988) showed that both good and poor readers' comprehension is better when they are highly familiar with the topic than unfamiliar with it (in this case the topic was baseball).

The relationship between vocabulary and reading comprehension is likely to be reciprocal. Larger vocabulary knowledge makes it easier to understand the meaning of a sentence or passage. At the same time though, good reading comprehension ability makes it easier to infer the meaning of unknown words (Nagy, 2005; Stanovich, 1986). From middle childhood onwards, many words will first be encountered in text (Wagner & Meros, 2010). Moreover, children who have good reading comprehension skills will see the purpose of reading, and so are more likely to choose to read (see p71 for further discussion of the impact of affective factors such as motivation). This further provides them with more opportunities to learn new words. Not only this, but as the other skills that relate to reading comprehension develop (e.g., inference making), these same skills support acquisition of new vocabulary in both spoken and written language (Cain, 2007; Nagy & Scott, 2000; Nation, Snowling, & Clarke, 2007).

Numerous studies have shown that the size of a child's vocabulary is one of the best predictors of their reading comprehension ability (McKeown et al., 1983; National Reading Panel, 2000a; Ouellette, 2006b; Ricketts, Nation, & Bishop, 2007). This is true both for primary-aged children (Ouellette & Beers, 2010; Verhoeven & van Leeuwe, 2008) and those of secondary age (van Gelderen, Schoonen, Stoel, de Glopper, & Hulstijn, 2007). There is also strong evidence from meta-analyses and systematic reviews that vocabulary interventions improve reading comprehension (Elleman, Lindo, Morphy, & Compton, 2009; Stahl & Fairbanks, 1986; Wright & Cervetti, 2017). For example, a systematic review of 36 peer-reviewed studies published from 1965–2015 showed that teaching word meanings nearly always supports comprehension of text that contains those words (Wright & Cervetti, 2017). The form of vocabulary instruction is important. Instruction that ensures that children actively process the word is more effective than definition or dictionary methods. However, there was limited evidence that vocabulary interventions focused on teaching a closed set of words generalised beyond the specific words that were taught. Similarly, teaching only one or two strategies to figure out the meaning of unknown words had limited effect on comprehension. The most effective interventions taught children to monitor their understanding and use multiple approaches to find the meaning of unknown words.

Much less research has examined the role of vocabulary in writing composition. Certainly, fluent, high quality writing depends upon the ability to select appropriate words and therefore vocabulary should have a direct effect. Having an impoverished vocabulary provides the writer with fewer word choices, and lower lexical diversity (the number of different words used in writing) correlates with quality of compositions (Olinghouse & Leaird, 2009). Writers who use a smaller set of words in their writing have lower quality compositions than those that use a broad set of words in their writing. However, lexical diversity in writing does not necessarily correlate with vocabulary as well as one might expect, and is in fact more closely related to spelling ability than oral vocabulary (Sumner, Connelly, & Barnett, 2016). For example, children with dyslexia have been shown to limit the set of words that they use in their writing, and it has been argued that they do so in order to avoid writing words that they cannot spell, not because they have vocabulary limitations (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008).

4.2.2 Morphology

Most words are made up of smaller, meaningful units. **Morphemes** are the smallest meaningful unit within a word. For example, *'fairness'* contains two meaningful units—the adjective root [fair] and the suffix [-ness]. The **root** carries the main semantic meaning of the word, and can be free or bound. **Free morphemes** can stand alone or form a word. **Compound words** contain two free morphemes placed together to form a new word. Compound words share some meaning from the component morphemes, but the word meaning goes beyond this. For example, the word *'strawberry'* contains the morphemes

[straw][12] and [berry]. Strawberries are berries, but they don't have much to do with straw: some people use straw to protect the plants, but this isn't part of the meaning of the word for most people.

Morpheme combination both within and between words is governed by syntactic rules. Within words, **bound morphemes** need to be accompanied by other morphemes; they can't occur alone. They have to be combined with other morphemes to form a word. For example, when [-s] is added after a noun it makes a plural, but [-s] on its own is not a word and is meaningless. **Affixes** are a type of bound morpheme; they consistently have the same effect on the root but are meaningless on their own. Affixes that precede the root are **prefixes** (e.g., [un-]) and those which go after are **suffixes** (e.g., [-ness]). The way in which different types of morphemes are combined has predictable changes to the meaning and/or grammatical status of the word. For example, adding the suffix [-ed] to a verb always changes to past-tense, influencing meaning by indicating that the event occurred in the past. Syntactic rules also govern morpheme combinations between words, for example, grammatical number markers on the subject noun and verb must match—*'*the cats eats the mouse'* is ungrammatical and ambiguous.

English is a morphophonemic orthography. This means that the written form of the language has consistencies that relate to meaning in addition to the sound structure of the spoken language (Venezky, 1970). Because of this, reading and writing necessarily involves some understanding of morphology. In many cases where letter-sound rules appear unusual or could be ambiguous, knowledge of the component morphemes would disambiguate the spelling. This is because morphemes are represented consistently between words, sometimes even at the expense of letter-sound regularity. For example, *'sign'* contains a silent <g> for consistency with the related words *'signature'* and *'signal'*. Knowing about these meaningful orthographic regularities is crucial to distinguishing between some words. As another example, knowing about the past tense suffix enables us to distinguish between the homophones *'missed'* and *'mist'*. This is crucial in order to understand the meaning of the word correctly as well as to produce the correct spelling. Knowing about the morphological structure therefore provides a way to decode spellings, providing an additional or alternative source of information to letter-sound correspondence.

Morphological awareness refers to the explicit ability to manipulate morphemes (Carlisle, 1995). For morphological awareness to influence literacy, this requires:

1. understanding of the meaningful relationships between words; and
2. segmental understanding of the letter units that represent morphemes.

Knowing how to link meaning to text is what is important for literacy. Combining this with knowledge about how to link the sounds to letters (phoneme-grapheme correspondence) provides direct and indirect routes for reading and spelling (see Dual Route Model p17). You can use morphology productively to understand the meaning of words that you have never encountered before. In this way, understanding the morphological structure of the language can increase your vocabulary. You can also construct new words that have a high likelihood of being understood by others. Indeed many recent additions to the Oxford English Dictionary are complex derivations of existing words—'*deglobalisation'* and '*e-publishing'*, for example (see https://public.oed.com/updates/new-words-list-january-2018/). Unsurprisingly then, there is a close relationship between morphological awareness and vocabulary (Anglin, 1993b; McBride-Chang, Wagner, Muse, Chow, & Shu, 2005; Nagy & Anderson, 1984).

Morphemes vary in transparency. Transparent morphemes have consistent spellings, pronunciations, and meanings across words. Opaque morphemes vary across these three dimensions between words. Transparency is not all or nothing. For example, the morpheme [heal] is pronounced in the same way

[12] Throughout this review morphemes are presented within square brackets ([]).

in *'healing'* but the pronunciation changes in '*health*'. Before children start school they are usually able to combine the most transparent and productive morphemes to create new words in speech (Berko, 1958; Carlisle, 2003). Morpheme combinations that have opaque phonological or semantic relationships are more of a challenge and are developed later (Carlisle, 1995).

Inflections are affixes that only carry grammatical information, such as the suffixes that mark number, tense, or possession (Bybee, 1988; Tong, Deacon, Kirby, Cain, & Parrila, 2011). **Derivations** are affixes that alter the meaning of the word, and sometimes also the **part-of-speech** (Tyler & Nagy, 1989). For example, [un-][fair] reverses meaning. [un-][fair][-ly] changes the word to an adverb, and the action (rather than the object) becomes unfair.

It has been argued that children's morphological awareness or knowledge of inflectional morphemes precedes their knowledge of derivational morphology and is present from a young age (Carlisle, 1995). However, this may be because inflectional morphemes occur more often and are usually more consistent than derivations. For example, plurals are used very frequently and the transformations are extremely regular. In spelling, most plural nouns are formed by adding the suffix [-s] to the singular noun.[13] There are very few true exceptions (e.g., *'man–men'*). Consistent with Statistic Learning Theory (see p20), the most useful morphemes to know will be those that are most productive—morphemes which consistently have the same meaning, spelling, and pronunciation across words. Knowledge about extremely low frequency and opaque morphemes is probably not much more useful than knowing about the individual words since this information isn't likely to be generalised to newly encountered words.

Measuring the morphological awareness of young children is not straightforward. Other skills can easily confound performance. Nevertheless, this is often achieved using an oral production task. The assessor provides the child with a morphologically simple word and asks them to complete a sentence, generating a morphologically complex related word. For example, '*here is one horse, now there are two, there are two* ____'. These tasks have substantial meta-linguistic, vocabulary, phonological, and working-memory demands—all skills that we know are still developing during childhood. So, when a child performs poorly on these tasks it is important to rule out other reasons for the poor performance and to consider whether the child seems to display the same difficulties in their everyday spoken language. Measurement difficulties aside, there is good evidence that morphological skills continue to develop through childhood (Carlisle, 1988).

4.2.2.1 Morphology, word reading, and spelling

Even as adults, we are often unaware of the morphological relationships between words. Even so, we implicitly process this information when reading. Words that share morphemes share a certain degree of phonological, orthographic, and meaningful overlap. For example, the words *'govern'* and *'government'* have a certain degree of shared meaning from the root morpheme (to conduct policy with authority). The spelling of the root morpheme fully overlaps (<*govern*>). The pronunciation of the root partially overlaps, although a change in stress affects pronunciation of the final vowel and consonant (/ˈgʌv(ə)n/, / ˈgʌvəm(ə)nt/). Kirby and Bowers (2017) describe morphology as a '*binding agent*' that pulls together orthographic, phonological, and semantic information forming more integrated and better quality lexical representations which are therefore easier to access. Even if we can't explicitly segment and reflect upon the meaning of the morphemes within a word, we process these words more quickly and easily.

Knowledge about the morphological structure of a word enables children to decompose complex words and spell each morpheme consecutively, but also improves the quality of their lexical representation of that word. Skilled adult readers process morphemes extremely rapidly and automatically during word

[13] Note that pronunciation of the plural suffix is somewhat more variable, /s ~ z~ əz/, but is still rule governed, dependent on the nature of the preceding phoneme.

reading (Feldman, 2000; Rastle, Davis, Marslen-Wilson, & Tyler, 2000). Children use morphemes to support their spelling from a young age. For example, six-year-olds are more likely to spell *'add'* correctly when the letters occur as a root morpheme in the related words *'adds'* and *'addition'*, than in the unrelated word *'address'* (Deacon, 2008; Deacon & Bryant, 2006a, 2006b). They also produce these spellings more quickly (Breadmore & Deacon, 2019). Even so, the extent to which children are able to use this information to guide their spelling increases with development (Deacon & Dhooge, 2010). The more children know about morphology, the more they are able to use this knowledge. Children with literacy difficulties have less knowledge of morphology and do not use morphemes in reading and spelling as efficiently as children with good literacy (Breadmore & Carroll, 2016a, 2016b, 2018; Breadmore, Olson, & Krott, 2012; Carroll & Breadmore, 2018).

Throughout the school years, morphological awareness predicts children's word reading ability, even after accounting for the effects of other key skills such as phonological awareness and vocabulary (Carlisle & Stone, 2005; Deacon, Benere, & Pasquarella, 2013; Deacon & Kirby, 2004; Gilbert, Goodwin, Compton, & Kearns, 2014; Kirby et al., 2012; Mahony, Singson, & Mann, 2000; McCutchen, Green, & Abbott, 2008). This means that children need a good understanding about the meaningful structure of words in order to read effectively. Likewise for spelling, morphological awareness is a strong predictor of ability after accounting for other key skills including phonological, orthographic, vocabulary, and rapid automatized naming (RAN will be discussed further on p64) (Apel, Wilson-Fowler, Brimo, & Perrin, 2012; Foorman, Petscher, & Bishop, 2012). Note, however, that the development of effective use of morphology is not linear, but is often described as following a U-shaped curve. Initially, children use morphemes across a small range of words but these words are produced accurately. As children begin to generalise morphological rules, their accuracy actually reduces for a while. This is because they overgeneralise the rules until they learn the exceptions. For example, it is very common to hear young children over-generalising past tense rules to irregular verbs (e.g., <I *runned>), or to use suffix spellings out of context (e.g., apply the past tense [ed] spelling for non-past tense /d/ e.g., <bird>-<*bired>). The emergence of these types of errors in children's spelling shows that they are gaining an appreciation of the morphological structure of the language (Breadmore et al., 2012; Nunes, Bryant, & Bindman, 1997). This is similar to the phonic spelling errors that are common when children overgeneralise letter-sound mappings, and should reduce as the child's language experience increases.

4.2.2.2 Morphology, reading comprehension, and composition

In line with the Simple View of Reading (see p14), because morphological awareness supports word-level processes, there is an indirect effect on comprehension and composition by freeing resources and capacity for text-level processes. Beyond this, the semantic and grammatical aspects of morphological awareness also have direct effects—by supporting construction of meaning across words. As will be described shortly, there is now strong evidence of both direct and indirect associations between morphological skills and reading comprehension (e.g. Levesque, Kieffer, & Deacon, 2017), and also a growing understanding of the importance of morphology in writing composition (McCutchen, Stull, Herrera, Lotas, & Evans, 2014).

Morphological awareness is important throughout literacy development, but the nature of the relationship might change. At the beginning, knowledge about morphological structure helps children who are struggling to recognise individual words. As word knowledge becomes richer and word recognition becomes more automatized, the utility of good morphological awareness likely becomes in the formation of meaningful links between words. For example, in a cross-sectional study with 221 Canadian children from age eight to nine, Levesque et al. (2017) illustrated both direct and indirect (via word reading) influences of morphological awareness on reading comprehension. Morphological awareness remains a significant predictor of reading comprehension after controlling for vocabulary, phonological awareness, and word reading (Carlisle, 2000; Deacon, Kieffer, & Laroche, 2014; Deacon

& Kirby, 2004; Foorman et al., 2012; Kieffer & Box, 2013; Kieffer & Lesaux, 2008, 2012b; Kieffer & Lesaux, 2012c; Kirby et al., 2012; Ku & Anderson, 2003; Nagy, Berninger, & Abbott, 2006).

Intervention studies confirm that morphological awareness can be trained, and that increasing children's knowledge of morphology has a positive impact on literacy. A systematic review of 22 studies (Bowers, Kirby, & Deacon, 2010) and a meta-analysis of 30 studies (Goodwin & Ahn, 2013) both show that morphological interventions generally have a moderate effect on morphological awareness, which in turn influences literacy skills. Across studies there was quite a lot of variation in the nature and effectiveness of the interventions. Overall though, interventions had positive effects on word reading, spelling, and reading comprehension. Specifically, interventions appear to be most effective when implemented in small groups for those with the greatest need (children with literacy difficulties, for example). Given the multifaceted nature of morphology, interventions that support understanding of the orthographic, semantic, and grammatical implications of morphological structure are likely to be most effective. Theoretically the same should be true for writing composition, although very little research has examined this. Some promising evidence comes from a 12-week teacher-delivered morphological intervention focused on science vocabulary (from the curriculum) for American ten-year-olds, which had positive effects on a number of measures of writing outcomes (McCutchen et al., 2014). However, this study was quasi-experimental with only 95 children receiving the intervention compared to 75 untreated control children. Future research should examine the effects of morphological interventions in robustly designed randomised controlled trials.

4.2.3 Grammar and syntax

Grammar is a general term used to describe the structure of a language which enables us to share meaning. Grammar includes the combination of morphology (units of meaning) and syntax (rules about order). **Syntax** refers not only to how words are ordered, but also the order of morphemes within a word. For example, prefixes must go before the root morpheme, while suffixes must go after a root. Syntactic awareness bridges an important gap between constructing meaning at the level of individual morphemes and words up to the level of the sentence. For example, consider the different meanings of these two sentences which contain identical words, but different word orders.

'The cat eats the mouse.'

'The mouse eats the cat.'

In English, the most common sentence structure is made up of subject-verb-object phrases. The **subject** is the noun; the rest of the sentence is called the **predicate**, usually including a **verb** and an **object**. The object is the thing that is affected by the subject performing the action of the verb. For example, consider the sentence:

'The children eat the apples.'

Here, '*The children*' is the subject, '*eat*' is the verb and '*apples*' is the direct object. These grammatical units can be single words or larger phrasal units comprising multiple words. Rules govern the placement of morphemes both within words and across the sentence. For example, number marking on the subject must agree with number marking on the verb. For example, '**The children eats the apples'* is not acceptable.

Typically, children gain a good understanding of grammatical structure through exposure to spoken language during meaningful social interaction. Most of this knowledge is implicit, not explicit at this point. By the time children start school, most can combine words in speech to form quite complex sentences. However, development of grammatical knowledge continues well into adolescence and beyond. Text also exposes children to grammatical structures that are either not present in spoken language, or are

not so explicitly defined. Understanding grammar might be a particularly helpful way to grasp the pragmatic aspects of language (we return to pragmatics on p60).

4.2.3.1 Grammar, reading comprehension, and composition

At the level of word reading and spelling, the impact of grammar is synonymous with morphology (see p56). Therefore, we focus on the role of grammar on text-level processes—reading comprehension and composition. Syntactic awareness uniquely predicts text-level literacy skills after controlling for both vocabulary and morphological awareness (Proctor, Silverman, Harring, & Montecillo, 2012; Silverman et al., 2015). Proctor et al. (2012) found that syntactic awareness predicted reading comprehension in 294 U.S. children aged seven to nine after controlling for vocabulary and morphological awareness. Similarly, Silverman et al. (2015) found that syntactic skill predicted narrative writing ability after controlling for vocabulary breadth and morphological awareness in 197 eight- to ten-year-old U.S. children.

Skilled readers also have sensitivity to **narrative structure**—they have an understanding of how the genre and linguistic style of the text being read is likely to influence the grammatical structure of the text. This reading-specific experience is a special type of prior knowledge that particularly supports readers' ability to build mental representations of the meaning of the text (Oakhill & Cain, 2012). Children who have poor comprehension abilities have weaknesses in explicit knowledge of these rubrics. For example, poor comprehenders are less likely to know that information about characters and settings is usually presented towards the beginning of stories (Cain, 1996).

During writing composition, an individual must generate their own grammatically correct phrases, sentences, and paragraphs. Written text differs from spoken language in that there is much less contextual information available to support communication. For example, there is an absence of information from tone of voice, gesture, and facial expression as well as from the immediate physical surroundings. For a written communication to be understood, it is therefore particularly important that the text generated is clear. To achieve this might require more explicit understanding of grammar in order to produce comprehensible text, and to avoid producing text that can be misunderstood.

There has been extensive debate in the field of education on the value of teaching grammar explicitly in schools (Myhill & Watson, 2014). In the U.K., grammar, punctuation, and spelling tests were included in the national SATs tests at the end of Key Stages 1 and 2 from 2013 onwards, leading to a significant increase in emphasis on explicit grammar tuition, though from 2018 these are optional for Key Stage 1.

Much grammatical knowledge is implicit—that is, people often know whether a given sentence is grammatically correct or not, but cannot explain why. It is certainly the case that even quite young children can formulate novel and grammatically correct sentences in spoken language without explicit teaching about grammar. It is this that fuels the argument that teaching grammar explicitly is not beneficial to writing skill.

There are now several review papers indicating that teaching explicit knowledge of grammar and grammatical rules in a decontextualized way does not have a significant positive impact on writing quality (Andrews et al., 2006; Koster, Tribushinina, de Jong, & van den Bergh, 2015). Moreover, some meta-analyses even indicate a significant negative effect of explicit grammar teaching (Graham et al., 2012; Graham & Perin, 2007). The lack of a positive effect is perhaps relatively unsurprising: much of the work on other aspects of meta-linguistic awareness indicates that contextualising knowledge is vital in helping children to use this knowledge in their own writing. For example, Hatcher, Hulme, and Ellis (1994) showed that teaching either phonological awareness or letter knowledge alone was unsuccessful in improving literacy: children needed to be taught how this knowledge linked to word reading and spelling in order to use it. Using knowledge of syntactic structure in writing is even more complex, given the many other cognitive demands within the task of composition. The Education

Endowment Foundation has recently published guidance on how children can be taught to use meta-cognitive strategies in their work and it is likely that this type of teaching is key.[14]

It should be noted, however, that these null results and negative results are based on typically developing children. For children with developmental language disorder, who continue to make grammatical errors in spoken language into late childhood and beyond, teaching grammar directly can be useful in improving writing (Ebbels, 2014). This may also be the case for children who make regular grammatical mistakes for other reasons, such as learning English as a second language.

Skilled writers are able to adjust their use of grammar to match the context in which they are writing. For example, the grammar used when writing text messages or using social media will be quite different from that used during essay or report writing. In line with this, there are some promising studies indicating that a more contextualised approach to grammar teaching can be useful in improving writing. Andrews et al. (2006), in their meta-analysis of grammar-based interventions for writing, found significant benefits of an approach known as sentence combining, where children are taught to create more complex sentences by combining simple ('kernel') sentences. Jones, Myhill, and Bailey (2013) report on a successful EEF-funded *Grammar for Writing* intervention in which 1194 ten- to 11-year-old U.K. pupils were taught to detect and produce a range of types of sentence to convey different effects.[15] This programme is currently being evaluated in a larger replication, also funded by the EEF. Some researchers highlight the utility of grammar teaching to emphasise flexibility in ways to convey meaning (Rimmer, 2008). Indeed, adolescents who use textism abbreviations effectively while texting are more likely to show good use of grammar in formal writing, indicating a generally good understanding of register (Wood, Kemp, & Waldron, 2014).

Overall, these findings imply that teaching grammar as a set of prescriptive rules does not necessarily improve writing quality, but that highlighting how grammatical changes can convey different types of paralinguistic information, and encouraging pupils to use grammatical constructs in planned and purposeful ways in their own writing, may be helpful.

4.2.4 Discourse-level language skills

The language skills discussed so far largely focus on representations of meaning at the word, phrase, and sentence level. At the text level, meaning continues to be constructed between sentences, paragraphs, and even larger units such as chapters. The construction of a coherent mental model (see p22) for longer passages of text demands the use of additional, broader discourse-level language skills, and there is evidence that these skills are separable from vocabulary and syntax skills (Language and Reading Research Consortium, 2015a). For example, the readers' knowledge of narrative structure (discussed on p59) influences the nature of the literal inferences they will make (see p23). Their background knowledge about a topic (see p53) influences the nature of the elaborative inferences that they will make (see p23). The ability to make these types of inferences continues to develop through childhood and adolescence, and is related to reading comprehension (Barnes, Dennis, & Haefele-Kalvaitis, 1996; Currie & Cain, 2015; Lervåg, Hulme, & Melby-Lervåg, 2017).

Two other key discourse-level factors are **comprehension monitoring** and **standards for coherence**. Comprehension monitoring refers to the collection of processes that enable a reader to actively monitor their understanding of the text they are reading (or writing), and adjust their processes when they notice that comprehension is breaking down (Oakhill & Cain, 2012). For example, slowing down while reading

[14] https://educationendowmentfoundation.org.uk/tools/guidance-reports/metacognition-and-self-regulated-learning/

[15] https://educationendowmentfoundation.org.uk/public/files/Projects/Evaluation_Reports/Campaigns/Evaluation_Reports/EEF_Project_Report_GrammarForWriting.pdf

complex text or re-reading sections that were not understood. Studies of eye-movements during reading indicate that seven- to 12-year-old children are sensitive to the plausibility of what they are reading, re-reading text when plausibility is violated (Joseph et al., 2008). Some have argued that poor readers might monitor their comprehension less than good readers (Baker, 1984; Garner, 1980; Hacker, 1997). However, an alternative hypothesis is that poor readers might have a lower standard for coherence (Cain & Oakhill, 1999). 'Standard for coherence' refers to the individual reader's criteria for determining whether their interpretation of the text makes sense or not (Van der broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011). It might be that poor readers accept a greater amount of incoherence in the text that they read; a level of incoherence that might be unacceptable to skilled readers. Skilled readers adjust their standard for coherence and reading behaviours to suit what they are reading, and their purpose for understanding (Graesser, Singer, & Trabasso, 1994; Kaakinen & Hyönä, 2010; Schotter, Bicknell, Howard, Levy, & Rayner, 2012).

4.2.5 Pragmatics

Pragmatics refers to how nonverbal context influences our interpretation of meaning. When we interpret speech, we consider what we expect the speaker's intentions to be, given the surrounding context. We construct meaning using additional information from cues such as facial expression, accompanying gestures, context, physical surroundings, and background knowledge about the speakers' beliefs, desires, and how they usually behave. Much of this information is unavailable to us when we read a written message. However, some of this information is contained in the text or is replaced with punctuation and grammatical markers. For example, the use of a question mark to indicate a question replaces the spoken device of rising intonation.

4.2.6 Summary: language skills and constructing meaning

Language skills are a key component of the child's ability to construct meaning effectively during reading and writing. The ability to share meaning is, after all, is the purpose of literacy. Language skills are multidimensional, reflecting how meaning is constructed at different levels within text. At the level of words, breadth of vocabulary and knowledge of morphological structure within words support word reading and spelling by enabling the child to understand the meaning of the individual word and form links from letters to meaning without necessarily decoding via speech (see Figure 1). At the text level, this word-level understanding of meaning is added to a mental model of the situation and text as a whole; meaning is constructed between words, sentences, and across the passage. As a result, reading comprehension and writing composition places additional demands on the language component. As a result, successful literacy development rests upon children's depth of vocabulary, knowledge of morphological structure between words, grammar, and discourse-level language skills.

4.3 Conclusions: proximal factors that underpin literacy

Communication of meaning is the goal of literacy. To form links from text to meaning, children must have well developed knowledge about letters, sounds, and meaning, but they also need the ability to combine this knowledge. Proximal skills directly influence literacy because they underpin and directly impact on literacy processes. We described these proximal skills in terms of those which enable the child to link the spoken and written form of the language, and those which enable them to construct meaning.

To form links from spoken to written language, children must have a good understanding of the structure of spoken language, the structure of written language, and how the two forms of the language link together. This knowledge—and the skills necessary to apply this knowledge—is particularly fundamental for word-level literacy—word reading and spelling. However, while the ability to associate the spoken and written forms of the language is essential for literacy, it is not sufficient. The child's

ability to construct meaning depends upon a broad range of language skills, particularly at the text level of reading comprehension and writing composition.

SECTION 5: Distal child-based influences on literacy

Section summary

This section summarises the distal child-based factors that impact on literacy development indirectly. In most cases, these factors impact on proximal skills, which in turn affect literacy processes. Distal factors are generally less malleable and the evidence for the mechanisms explaining how these factors influence literacy is less well developed. Here, we focus on the distal child-based factors that are most likely to impact on children within an average classroom.

Children with speech, hearing, visual, and motor difficulties are at greater risk of difficulties learning to read and write. Even relatively mild difficulties can have an additive effect. Children who have multiple difficulties are at greater risk of literacy difficulties.

- Children with persistent speech difficulties may have weaknesses in phonological skills. This can make it difficult to form links from spoken to written language (for example, using letter-to-sound rules) in order to read and spell effectively.
- Children who are deaf or have hearing loss are at risk of weaknesses in phonological skills, vocabulary, and language skills. These skills impact on a child's ability to form links from spoken to written language and constructing meaning during reading and writing.
- Children with visual and motor difficulties are likely to have difficulty with the eye and hand movements necessary for reading and writing.

Broader cognitive skills and processes such as rapid automatized naming, executive function, meta-cognition, and memory impact on the child's ability to read and write. However, these skills are difficult to train, and there is little evidence that training impacts on literacy attainment. It may be more effective to consider strategies to minimise the burden on these skills.

Affective factors such as reading motivation, attitudes towards reading, and perceptions of self are likely to impact on the amount of reading a child engages in. The more children read, the more print exposure they receive, which increases the opportunities to learn through self-teaching. Print exposure gives opportunities to encounter new words and grammatical structures, and to practice literacy skills and strategies.

The factors that have been discussed so far have a direct impact on one or more aspects of literacy development (word reading, spelling, reading comprehension, or writing composition). These factors relate to the child's ability to link the written form to the spoken form or to construct meaning. We turn now to factors that are more distal but likely to have an indirect effect on literacy outcomes. It is beyond the scope of this review to go into every factor that may have an indirect influence on literacy attainment. In many cases, these factors are less amenable to intervention than the proximal skills described previously. In many cases, the quality of the scientific evidence for a relationship to literacy is not as strong. Even if an intervention is successful in changing the distal factors themselves, it might not lead to immediate improvements in literacy. Here, we first consider the role of distal factors related directly to the child, and then environmental factors. We begin by considering the impact of speech, hearing, visual, and motor difficulties. Then we consider cognitive processes (RAN, executive function, and memory) and reading amount. Next we examine the role of affective factors such as motivation. Finally we consider environmental influences such as socio-economic status and family history, home literacy, and language environments. We focus on the factors that likely do impact on typical development, or

where difficulties occur with such high frequency that their cumulative contribution to literacy difficulties is worthy of consideration.

5.1 Speech, hearing, visual, and motor

Children with persistent speech difficulties are also at greater risk of difficulties learning to read and spell (Hayiou-Thomas, Carroll, Leavett, Hulme, & Snowling, 2017). This appears to be an indirect effect related to the effect of speech sound disorder on phonological awareness and the extent of risk is mediated by other contributing risk factors such as language skills and family risk of dyslexia.

Deafness and hearing loss significantly increases the likelihood of experiencing difficulty learning to read. As observed for hearing children, phonological awareness, vocabulary, and (signed and spoken) language skills are significant predictors of literacy attainment amongst profoundly deaf children (Kyle, Campbell, & MacSweeney, 2016; Mayberry, del Giudice, & Lieberman, 2011). Therefore, deafness likely has an indirect effect on literacy—by impacting on children's phonological skills and ability to construct meaning. Interventions should focus on these skills, whilst being mindful of the specific needs of children with hearing impairment. Hearing loss associated with multiple ear infections is a risk factor for later literacy difficulties, and undiagnosed mild and/or unilateral hearing loss might be common amongst children with dyslexia (Carroll & Breadmore, 2018).

There has also been a great deal of interest in the role of auditory processing in literacy, particularly in dyslexia (Richardson, Thomson, Scott, & Goswami, 2004; Tallal, 1980). These are the low-level skills that enable us to process sound-based information in general, including, but not specific to, processing speech sounds. Auditory processing skills underpin the child's ability to process phonological information and form phonological representations. As a result, a child with auditory processing difficulties would likely have difficulty acquiring literacy due to the impact on phonological skills. Thus auditory processing has an indirect effect on literacy (Boets, Wouters, Van Wieringen, De Smedt, & Ghesquiere, 2008).

Shapiro and colleagues have examined the role of a wide variety of skills in predicting reading development (Shapiro, Carroll, & Solity, 2013) and reading difficulties (Carroll et al., 2016). When predicting across the ability range they found that auditory processing, visual attention, motor skills, vocabulary, and nonverbal IQ did not have significant independent influences on word or nonword reading. In typical development (Shapiro et al., 2013), these factors were less central to reading outcomes than phonological awareness, short term memory, and rapid automatized naming (described in the next section). However, when the analysis instead focused on those with difficulties within the same sample, a significant minority of children with reading difficulties showed weaknesses in auditory processing and visual attention (Carroll et al., 2016). There are a few explanations for these contrasting findings. It may be that the auditory and visual difficulties present in a minority of children with reading difficulties is *epiphenomenal*, that is, not directly connected to reading difficulties and explained by an unmeasured third variable (such as genetic risk). Another possible explanation, and the one favoured by the authors, is that there are multiple possible causes of reading difficulties, and children who show reading difficulties have a wide range of underlying deficits (Pennington, 2006).

5.2 Rapid automatized naming

Rapid automatized naming (RAN) refers to the speeded naming of a list of familiar items. Testing RAN involves asking children to name, as quickly as they can, a matrix of pictures, colours, numbers, or letters. For example, '*Say the names of the colours on this page as fast as you can.*' Typically, children will develop the ability to name objects and colours first, as their vocabulary for these items develops in infancy. The ability to name digits and letters develops later, when these symbols are explicitly taught to the child, usually when they start school (Wagner, Torgesen, & Rashotte, 1994).

There is debate as to whether RAN should be classified as a phonological skill, a speed of processing skill, or even a letter knowledge task (see Powell, Stainthorp, Stuart, Garwood, & Quinlan, 2007).

RAN has consistently been shown to correlate with word reading both cross-sectionally (at the same time) and longitudinally (across time), with RAN-letters and RAN-digits tending to predict substantially more variance in later reading than RAN-colours or RAN-objects (see Bowey, 2007 for a review). Given the timed element of the task, RAN is particularly associated with reading fluency (Lervåg & Hulme, 2009). There is no theoretical basis for an association between RAN and writing (Bowey, 2007), although there is some evidence of an association between RAN and spelling of real words (Savage, Pillay, & Melidona, 2008). Here, we focus on where the main body of literature lies—the relationship between RAN and reading.

RAN is a complex skill involving phonological processing (accessing and articulating item names), item identification, and rapid serial processing of a continuous series of items (Wolf, Bowers, & Biddle, 2000). Indeed, doing a RAN task is similar in complexity and process to the act of reading out-loud familiar words: an 'image' is seen, a long-term phonological representation that corresponds with that image is accessed, and then that word is articulated. This makes it very difficult to identify which aspects of RAN are responsible for the association with reading, causing much debate in the field. RAN is not generally amenable to intervention, limiting its usefulness in an educational context (de Jong & Vrielink, 2004).

In unpicking this literature, four key explanations for the relationship between RAN and word reading emerge. First, it has been suggested that the association between RAN-letters and reading is due to RAN-letters acting as a proxy letter knowledge task. As letter knowledge (together with phoneme awareness) is needed for developing a 'phonic' strategy that can be used to decode unfamiliar words (Hulme et al., 2012), then it is actually letter knowledge that mediates the association between RAN and reading. However, the fact that RAN for pictures and colours, measured before children can read, is predictive of later variation in reading skill indicates that this effect cannot be just a consequence of differences in letter knowledge. For example, Lervåg, Bråten, and Hulme (2009) found that object and colour RAN predicted reading skills independently from phonological awareness and other established predictors such as verbal and non-verbal IQ, short-term memory, and letter-knowledge from preschool to the end of the first year of school. Second, it has been argued that because RAN taps into processing speed, it is this component of the task that is responsible for the association with reading. However, again, this is unlikely to be the whole story as RAN predicts variance in reading above processing speed (Powell et al., 2007) and predicts reading accuracy as well as fluency (Wagner et al., 1997). A third explanation is that RAN taps a general visual-verbal associative learning mechanism that is central to the process of learning to read. For example, studies where children were taught to pair abstract shapes with nonsense words showed that this skill predicted reading over and above phonological awareness (Hulme, Goetz, Gooch, Adams, & Snowling, 2007). Yet, RAN seems to contribute variance in reading even in addition to visual-verbal paired associate learning (Lervåg et al., 2009), meaning that this cannot provide a complete explanation. Finally, a reason for a totally unique contribution comes from a theory put forward by Lervåg and Hulme (2009). The authors suggest that RAN taps special left-hemisphere object-recognition and naming circuits. These circuits are also recruited during the development of children's word reading skills, but are not the same as those measured by visual-verbal paired associate learning.

RAN is also associated with reading comprehension. For example, kindergarten RAN-letters predicted 44% of variance in word reading[16] in second grade, and 26% in reading comprehension. Similar results were found for RAN digits (Wolf, Bally, & Morris, 1986). This is likely an indirect affect due to the influence of RAN on individual word reading (see the Simple View of Reading p14).

[16] Also referred to as word identification or word recognition

5.3 Executive function, meta-cognition, and memory

Reading and writing often place demands on a range of what are known as 'higher' cognitive skills: the short term memory and working memory system and attention, planning, organisation, and inhibition (collectively known as executive function skills).

Short term memory is the ability to hold pieces of information in mind for short periods of time. It has been argued that short term memory has a capacity of seven items plus or minus two (Miller, 1956), meaning that adults can hold around seven pieces of information in mind. Young children can hold fewer pieces of information.

Working memory is the ability to process or act on these pieces of information, and will often involve retrieval of information from long term memory. Baddeley, Allen, and Hitch (2011) describe the hypothesised structure of the working memory and executive function system (shown in Figure 15). They argue that verbal and non-verbal information is processed separately in the short term memory system. Verbal information is held in the phonological loop, a mechanism for sub-vocal rehearsal, while visual information is stored on the visuo-spatial sketchpad. The episodic buffer is responsible for binding information together for episodic memory (memory of particular events). The central executive is responsible for allocating attentional resources and coordinating system activity. It is limited in capacity, meaning that overall performance will be weaker when the system is asked to coordinate more than one task.

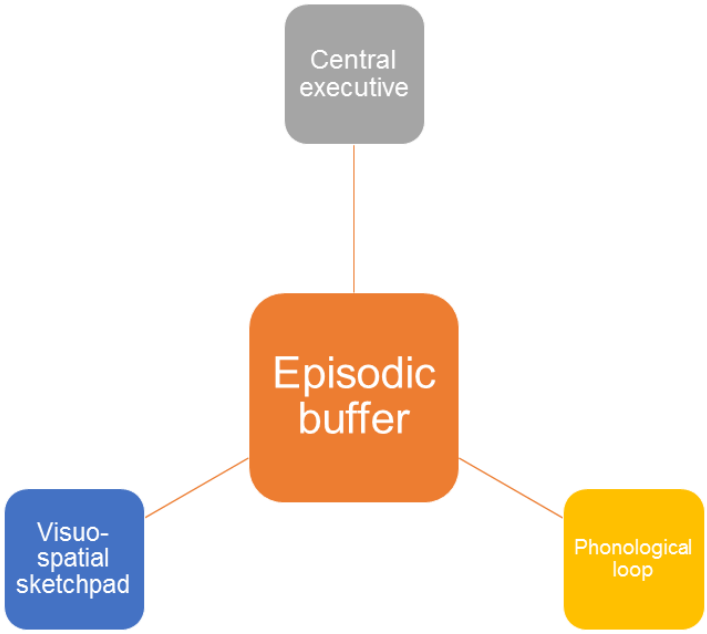

Figure 15: A revised model of working memory (Baddeley et al., 2011)

Executive function is the term used to describe several different, inter-related processes responsible for goal-directed behaviour (Shallice et al., 2002). According to Baddeley and Hitch's (1974) model, executive functions are stored within and controlled by the central executive. There are at least three separable components of executive function: inhibition (the ability to ignore irrelevant information), updating (the ability to continually renew information in short term memory), and shifting (the ability to switch between sources of information or between cognitive processes).

Executive function skills develop relatively slowly in comparison to other cognitive skills (Gathercole, Pickering, Ambridge, & Wearing, 2004). Executive function skills are largely located in the frontal lobes, the slowest area of the brain to develop. Five- and six-year-old children have very limited capacity to control their attention, and there appears to be a developmental shift at around seven years old where children start to be able to use strategic processes to support memory (e.g. rehearsal or verbal labelling of pictures), and skills in these areas continue to show significant improvements in adolescence. Nonetheless, the overall structure of working memory skills remains relatively constant over this time (Alloway, Gathercole, & Pickering, 2006).

Working memory is the executive function skill most commonly associated with literacy. Working memory can be defined as:

> *'a brain system that provides temporary storage and manipulation of the information necessary for . . . complex cognitive tasks'* (Baddeley, 1992 p556).

The extent to which working memory should be viewed as separable from more specific executive functions is the subject of debate in the research literature, but this debate is beyond the scope of the current review. Melby-Lervåg and Hulme (2013) argue that working memory requires the coordination of multiple executive functions, including attention, inhibition, and planning.

Several studies demonstrate that verbal and non-verbal working memory scores are significantly associated with academic outcomes in general (St-Clair-Thompson & Gathercole, 2006) and literacy outcomes in particular (Alloway & Alloway, 2010; Christopher et al., 2012). While much of the earlier research relied on correlational work only and did not take account of possible third variables such as IQ, SES, or language, more recent work has established a longitudinal association, with working memory measured at age five predicting literacy outcomes at age 11, after controlling for verbal and nonverbal IQ and parental education level (Alloway & Alloway, 2010).

It is well established that working memory demands are present in most literacy tasks. Most often, these are demands on verbal working memory. For example, in order to decode an unknown word, a child must hold a string of phonemes in mind and blend them to recognise the word. In order to understand a passage of text, he or she must hold in mind information received at the start of the text and integrate it with information received later, and often with information from real world knowledge. We might therefore expect that individuals with weaknesses in working memory would have difficulties in reading and writing, and this is in fact the case (Swanson, Zheng, & Jerman, 2009).

5.3.1 Executive function, memory, word reading and spelling

Gathercole and Baddeley (1990) examine the short term verbal memory of children with language disorder using the nonword repetition task, in which a child repeats a spoken nonsense word. The children showed significantly more errors than younger typical controls at the same overall language level. Gathercole and Baddeley argue that difficulties in the phonological loop are a major limiting factor in language and literacy development. When learning a new word, a child has to rehearse the word in the phonological loop while it is transferred to long term memory. Difficulties in the phonological loop could therefore cause difficulties in oral language and literacy. It is certainly the case that children with reading difficulties or developmental language disorder tend to show poorer short term memory than typically developing children, but it is not clear whether short term memory difficulties cause the language and literacy difficulties, or whether the reverse might be the case, as individuals often use their existing lexical and literacy knowledge to support working memory (Nation & Hulme, 2011; Snowling, Chiat, & Hulme, 1991).

There is some preliminary evidence for a slightly different profile of association between working memory and spelling, at least in the earliest stages. Bourke, Davies, Sumner, and Green (2014) found that visuo-spatial working memory span was a significant unique predictor of spelling in reception class

children. This makes intuitive sense as it suggests that memorisation of spelling patterns places additional demands on visual memory in comparison to word recognition.

The association between working memory and word-level literacy has been taken to imply that training working memory skills will have a significant positive impact on literacy skills. However, a recent meta-analysis has suggested that there is no significant evidence that training working memory can improve literacy outcomes (Melby-Lervåg & Hulme, 2013). While working memory can be improved, this improvement does not seem to last beyond the immediate post-test period, or to translate to word decoding (though note that other literacy skills were not examined). This is mirrored by findings from the EEF review of neuroscience and education (Howard-Jones, 2014). This suggests that the improvement tends to be task-specific: children are learning how to perform particular tasks more efficiently, rather than learning to use their working memory more effectively across all tasks.

5.3.2 Executive function, memory, reading comprehension, and composition

It seems that many elements of executive function are related to reading comprehension indirectly, via word reading (Arrington, Kulesz, Francis, Fletcher, & Barnes, 2014). There is evidence, however, that complex working memory span is closely associated with performance in reading comprehension tasks. In an influential paper, Just and Carpenter (1992) argued that a greater working memory capacity allows individuals to hold multiple interpretations of ambiguous sentences in mind until the ambiguity is resolved. This would allow for more flexible interpretation during the process of making sense of text. Cain, Oakhill, and Bryant (2004) show that individual differences in children's reading comprehension skills are predicted by working memory skills, inferencing, word reading, and vocabulary skills. Although working memory capacity is associated with inferencing skill, some recent evidence suggests that this association was fully mediated by overall vocabulary level (Currie & Cain, 2015).

While there is little evidence that training working memory directly can improve reading comprehension, it is useful to consider that several effective ways of improving reading comprehension may work partly by reducing the working memory demands involved. Highlighting key concepts and vocabulary ensure that links between the material in the passage and existing knowledge in long term memory can be made more readily. A range of explicit strategies can encourage children to reflect on their own comprehension and provide prompts for their memory of the text. For example, reading comprehension of story texts can be improved by predicting story events, clarifying sections, and summarising the plot.[17]

As with reading comprehension, working memory, it has been argued, plays an important role in writing composition. Most recent models of writing development include working memory at the heart of them (Berninger et al., 2010; McCutchen, 1996). While writing, an individual needs to hold in mind their overall goals for the text (what they would like to convey), the audience, grammatical information, and spelling patterns. Too much focus on any one of these goals will lead to decrease in performance overall. A high degree of organisation and managing various types of information is needed to write well. Kellogg (1996; 2008) argues that, in contrast to spoken language, writing places demands on each element of Baddeley's working memory system: the phonological loop is involved in language generation, the visuo-spatial sketchpad is involved in handwriting and spelling, and the central executive manages the planning, organisation, and editing processes that are required.

Kim and Schatschneider (2017) argue that working memory has multiple indirect influences on writing via its effect on spelling, handwriting fluency, oral language generation, and inferencing—and no direct influence. This, coupled with the findings from intervention studies, suggests that supporting writing by

[17] See https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/reading-comprehension-strategies/

training these component skills (spelling, handwriting, oral language, and inferencing) will likely be more effective than focusing on working memory training.

Much of the work demonstrating the importance of working memory in writing comes from dual task paradigms in which participants are asked to write versus write while doing an additional task (e.g. remembering a list; see Olive, 2004 for a review). It is well established that working memory is a capacity-limited system and therefore, if capacity needs to be shared among multiple tasks, performance on each of those tasks will decrease. If performance on writing decreases, it suggests that there are resources shared between the additional task and the writing task. Tasks that are highly automatic use fewer working memory resources. For example, when individuals begin to learn to type, it requires a great deal of focus and concentration, but once it is thoroughly learnt, it no longer requires significant attention. This argues in favour of ensuring that the component skills of writing composition are made as automatic as possible.

In contrast to the equivocal results for decontextualized working memory training, there are well established positive results for training in the specific self-regulation skills used in more complex literacy tasks, such as composition or reading comprehension. Meta-analyses examining effective writing interventions (Graham et al., 2012; Graham & Perin, 2007) demonstrate that there are large effects for approaches that support working memory and executive function, such as strategies for planning, editing and revising text, self-regulation, and being assigned specific product goals. The EEF have also published work on the use of self-regulated strategy development for writing which indicated that this approach can be highly effective (Torgerson et al., 2014). This approach used self-regulated strategy development, an approach that involves explicitly and systematically teaching steps necessary for planning, revising, and/or editing text. [18]

5.4 Reading amount

One factor that has been relatively under-researched is the role of the total time children spend reading, and the nature of the material that they are reading (also known as ***reading experience***). Individuals vary extensively in the amount of reading they do, both in terms of leisure time reading and reading for academic or utilitarian purposes.

PISA, the regular large-scale international education comparison programme, has examined the associations between amount and diversity of reading with literacy attainments. Results suggest that both factors are important, particularly in English speaking nations (Twist, Schagen, & Hodgson, 2007), and in fact these measures of reading behaviour were more closely associated with educational success than family socio-economic background (Kirsch et al., 2003). The amount of reading that children engage in has been found to be important in the development of word reading. For example, Leppänen, Aunola, and Nurmi (2005) found that word reading skills predicted six- and seven-year-old Finnish children's amount of reading, with more competent readers more likely to read outside of school. Interestingly, the relationship was bidirectional: the amount of reading outside of school also predicted word recognition skills. This research is, however, correlational. It is difficult to know to what extent variables are causally related to each other rather than an unmeasured third variable.

Sullivan and Brown (2015a) examined the role of time spent reading in growth in vocabulary and mathematics between the ages of ten and 16, within a large sample (n = 3,583). After controlling for

[18] The EEF has recently published a guidance report *'Metacognition and self-regulated learning'* (Quigley, Muijes & Stringer, 2018). This provides useful guidance on how to improve pupils' learning through strategies of self-regulation.

attainment at ten years old, socio-economic status, and parental educational levels, the amount of time that the students spent reading accounted for significant further variance in both vocabulary and mathematics. This indicates that reading experience can have a positive impact in a wide range of curriculum areas. Similar findings were present for the same sample when they were 42 years old, after accounting for vocabulary at age 16, indicating that this effect continues throughout life (Sullivan & Brown, 2015b).

Print exposure is the term used in the psychological literature for a measure of how much reading an individual does (or, for young children, how often they are read to), including books, magazines, and online or digital sources. Print exposure is typically measured using either an author- or title-recognition task (ART or TRT). In the ART or TRT, individuals have a list of real authors or book titles and an equal number of foils. They are asked to mark every author or title they think is real and their total score is the difference between the number of real authors ticked and the number of foils ticked. Early research demonstrated that this measure was closely associated with diary activity logs of time spent reading (Allen, Cipielewski, & Stanovich, 1992; Cipielewski & Stanovich, 1992). However, these measures need to be time specific and culturally sensitive (Stainthorp, 1997). The authors and titles that children could be expected to know vary widely across communities, countries, and time.

Print exposure measures are quick and simple to administer, and moderately associated with various literacy skills. In a meta-analysis of 99 correlational studies, Mol and Bus (2011) illustrated the association between print exposure and literacy development from infancy to early adulthood. Increased amounts of print exposure enhanced reading development. Overall, moderate to strong correlations were found for print exposure and reading comprehension, oral language skills, word reading, and spelling across the preschool and school years. The contribution of print exposure to oral language skills increased with age, with Mol and Bus (2011) proposing an *'upward spiral of causality'*, described elsewhere (see p24) as the Matthew Effect (Stanovich, 1986). Children with good reading comprehension skills tend to read more. This increases print exposure, which, in turn, helps to improve spelling and reading comprehension. Longitudinal studies corroborate this view. Print exposure at a young age appears to make a long-term contribution to children's reading performance. In a longitudinal study, Sénéchal and LeFevre (2002) found that early exposure to books at six to seven years old was related to the development of vocabulary and listening comprehension skills, and these skills were directly related to reading performance (vocabulary and comprehension) when the children were aged eight to nine.

Print exposure is associated with a number of the proximal cognitive factors that influence literacy. Cunningham, Perry, and Stanovich (2001) reported that print exposure at age seven predicted variance in orthographic processing longitudinally (at age nine) even after accounting for variance in phonological processing. Cunningham and Stanovich (1991) also reported significant correlations between print exposure and vocabulary, verbal fluency, and word knowledge, but no relationship with phonological processing (for children from 10 to 12). Montag and MacDonald (2015) found that print exposure increased vocabulary growth, awareness of grammatical structures, and language and literacy skills in a cross-sectional study of 60 U.S. children aged 8 to 12.. However, these studies are all correlational, and a very recent study indicates that some caution is needed in considering the direction of causation between reading and print exposure. Van Bergen et al. (2018) examined the association in a large sample of seven-year-old twins and argued that reading ability predicted print exposure, rather than the reverse. More research is needed to examine this issue. It is possible that the relationship between the two factors varies depending on the age of the child concerned.

A further limitation with existing measures of print exposure is that they focus on print, rather than digital media. In recent years, U.K. children have begun to spend more time reading digital media rather than printed media (Clark & Teravainen, 2017). In recent U.K.-based research (Duncan, McGeown, Griffiths, Stothard and Dobai, 2016; McGeown, Duncan, Griffiths and Stothard, 2015), time spent engaging in a range of digital texts and traditional texts (books, magazines, comics etc.) were examined. In both of

these studies, book reading emerged as the strongest correlate/predictor of reading skill. Nonetheless, we need to know more about how digital literacy interacts with print literacy.

Another key gap in the literature concerns the role of writing amount and writing experience. Very little research evidence exists on the influence of the amount of time spent writing on literacy progress. Given the importance of handwriting automaticity in writing quality (see p31), one would expect that time spent writing would be a very important factor. Recent international evidence indicates that the amount of class time spent in student writing varies widely across classes, even within the same school and year group (Malpique, Pino-Pasternak & Valcan, 2017). However, the impact of this time has not yet been clearly demonstrated (Richey, Coker & Jackson, 2015).

5.5 Affective factors

Having established that children's exposure to print has a significant influence on their literacy attainments, we now consider **affective factors**, that is, how pupils' thoughts, beliefs, and feelings influence literacy.[19]

Reading motivation, attitudes, and perceptions of self are important in successful literacy development at least partly because they are key predictors of the amount that children read by choice, and therefore their print exposure. Individuals who are not motivated to read, do not enjoy reading, and do not believe themselves to be good readers are likely to avoid reading. This in turn reduces their own reading experience and gives them fewer chances to increase their reading vocabulary and comprehension skills.

5.5.1 Defining the terms used

Terminology for affective factors can be confusing, with many terms used variably and interchangeably. Literacy research draws upon other fields to unpick the effects of concepts such as motivation, attitude, and confidence in various aspects of 'the self'. These terms are related and work hand-in-hand (see Jang, Conradi, McKenna, & Jones, 2015): **motivation** describes the reasons why a child may wish to read, or may avoid reading; **attitude** refers to the feelings a child has towards reading; and **perceptions of self** focus on beliefs and judgements children make about their abilities (Conradi, Jang, & McKenna, 2013). When reading the literature, however, it is important to be aware that different researchers use different definitions. For example, Guthrie, Wigfield, and VonSecker (2000) define reading motivation as:

> *'the individual's personal goals, values, and beliefs with regard to the topics, processes, and outcomes of reading' (p. 405).*

This implies that attitude and self-concept form part of motivation, while others argue they are separable. In this report, we discuss self-concept as separate from motivation and attitudes, for clarity, but note that all of these factors are inter-related.

5.5.1.1 Motivation

Motivation is a multidimensional construct that can be broadly described as the force or drive to do something. These psychological processes lead to the execution of a certain task, in this case reading or writing. Motivation is context-specific, influencing levels of involvement or effort in a task. Increased

[19] Note that the Educational Education Foundation has a thorough review of social and emotional aspects of learning, including affective factors: https://educationendowmentfoundation.org.uk/projects-and-evaluation/evaluating-projects/measuring-essential-skills/

motivation leads to greater engagement in reading and writing (Guthrie, Hoa, et al., 2007; Guthrie, McRae, & Klauda, 2007; Lutz, Guthrie, & Davis, 2006).

Different researchers divide up motivation in different ways, and this is potentially useful for considering the role of motivation in literacy. Wigfield's and Eccles's (2000) *Expectancy-Value Theory* describes motivation as the product of two elements. *Value* refers to how important a particular goal is to an individual. A pupil may value reading as enjoyable or as an important life skill. Pupils who value reading are more motivated to do it. *Expectancy* refers to whether the individual expects they will achieve a goal. Pupils who believe they will not be able to read a particular book will be less motivated to read it, even if they think it is important. This is influenced both by beliefs about one's own abilities and about the tasks themselves. This theory, therefore, arguably views motivation as a product of an individual's *attitudes* and *perceptions of self*.

In contrast, other theories focus on the nature of the motivation itself. ***Intrinsic motivation*** describes an internal desire to complete a task, because it is seen as worthwhile, of value, or as offering personal enjoyment—a child may, for example, choose to read because they enjoy the book that they are reading. In contrast, ***extrinsic motivation*** relates to reading for reward or due to environmental demands such as passing tests (Wigfield & Guthrie, 1997). Wigfield and Guthrie further break down intrinsic motivation into constructs of *importance, curiosity, involvement* and *preference for challenge*:

- importance—the belief that reading is valuable;
- curiosity—the desire to learn about a particular topic of personal interest;
- involvement—simply the enjoyment of reading; and
- preference for challenge—the inherent satisfaction of mastering or assimilating complex ideas in text.

Extrinsic motivation is made up of *reading for recognition, grades, social reasons, compliance* and *competition*:

- reading for recognition describes pleasure experienced from receiving recognition for success;
- reading for social reasons includes reading to discuss books or ideas with friends or family, or to share books with friends;
- reading for grades is a desire to be favourably evaluated by the teacher;
- reading for competition describes the desire to outperform others; and
- reading for compliance is reading because it is expected or enforced by others.

As we discuss below, intrinsic motivation is more closely associated with positive literacy outcomes than extrinsic motivation.

It is important to note that Wigfield and Guthrie's theoretical framework for studying reading motivation is based on reading print media only—more specifically, books. As stated above, children now spend more time reading online than print (Clark & Teravainen, 2017). We need to take this into account when considering reading motivation. A recent review suggests that individuals may have less in-depth comprehension when reading online in comparison to print, even when they prefer to read on a screen, perhaps because of the ease of switching activity while reading online (Singer & Alexander, 2017).

5.5.1.2 Attitudes

An attitude is an affective motivational state, a complex array of feelings related to the task (McKenna, Kear, & Ellsworth, 1995). The attitude a child holds about reading can mean they either avoid or engage with reading. Holding negative attitudes towards reading means a child is less likely to be motivated to read (McKenna et al., 1995). Attitudes are not fixed, they are shaped by feedback and experiences. Attitudes are acquired in three ways; through direct experiences, the individual's belief system, and social norms (Ajzen & Fishbein, 2005).

5.5.1.3 Attributions

Attributions are the reasons an individual gives for success or failure on a given task. These can be internal (e.g. an individual believes they are successful because they are bright or worked hard) or external (e.g. an individual believes that they are successful because of luck or an easy test). Wilson and Trainin (2007) examined the links between literacy attainment and perceptions of self in first grade children, and argued that attributions mediate the relationship between the two. In other words, when individuals attribute success or failure internally, they are likely to alter their perceptions of self as a result of the outcome of particular tasks. Meanwhile, if they attribute success or failure externally, then they will be less likely to alter their perception of self. For example, if a child believes that how well they do in a spelling test is down to how much practice they do before the test, they are likely to practice more in future. Conversely, if they believe that how well they do depends on external factors, they are less likely to put effort into a task. A specific case of attribution theory is growth versus fixed mindset. Children who believe that their achievement is due to their own hard work are likely to be more persistent on similar tasks in the future (Mueller & Dweck, 1998). This factor works in combination with multiple other factors, such as the nature and importance of the task to the pupil.

5.5.1.4 Perceptions of self

Several aspects of *the self* have implications for literacy development. The terms self-concept, self-efficacy, and self-esteem have been used interchangeably throughout the field of the psychology of education, which can cause confusion. We use *perceptions of self* as an umbrella term to cover all of these areas.

Self-efficacy is the task-specific belief, judgement, or perception a child makes about their ability to accomplish a task. In the context of literacy development, self-efficacy refers to the child's perceived ability to complete the specific literacy activity at hand, for example, a spelling test or a written piece of work. Self-efficacy is a component of *social cognitive theory* (Bandura, 1986), which impacts on engagement. These judgements about ability are formed by past experiences. Observations of classroom interactions, conversations with parents or teachers, task achievement, and peer comparisons all collectively inform a child's belief about ability.

Here, we use ***self-concept*** to refer to a domain-specific judgement of self-worth. In the context of literacy development, self-concept refers to an individual's overall self-perception of their abilities as either a reader (Shavelson, Hubner and Stanton, 1976), writer, or speller. These task-specific beliefs exist separately from overall ***self-esteem,*** which is a general judgement of self-worth that is not context specific. In the context of literacy development, a child may have the task-specific self-concept that *'I am a good writer*', but a task-specific self-efficacy belief might be: *'I don't think I can spell all the words I used in my story.*' Self-efficacy beliefs are directly linked to specific tasks (e.g. *'I can spell all the words in this story'*) while self-concept is more of a general evaluation (e.g. *'I am a good speller'*) and can include emotional reactions (e.g. *'I enjoy reading'*). Self-efficacy beliefs are more closely correlated to actual task performance (Bong & Skaalvik, 2003) and are also more malleable over time (Pajares & Graham, 1999). A recent meta-analysis of reading self-efficacy intervention studies (Unrau, 2018) demonstrates that self-efficacy can be improved by intervention, and that these improvements in self-

efficacy are associated with improvements in reading comprehension. Note that the most useful source of improved self-efficacy is experience of success in that particular skill (Bandura, 1977), so attainment and self-efficacy in a given area are closely reciprocally related. Self-efficacy can, however, be domain-specific. For example, Wilson and Trainin (2007) reported that even first grade children were able to differentiate self-efficacy for different types of literacy, and that self-efficacy for writing was significantly greater than spelling and reading.

Self-concept is related to one's sense of competence and whether reading or writing is seen as part of one's personal identity. So a child may say they are not a 'good reader', often focusing only on proficiency in that a good reader is one who *'knows a lot of words'*. Thus, self-concept is closely linked to the idea of ***reading identity***. An identity is a combination of the way an individual views themselves in relation to environmental norms, their experiences within the environment, and how they perceive these experiences (Hall, 2012). As a result, a reader identity is shaped based upon what norms the school presents as 'good reading' and the experiences of reading that an individual has, along with their interpretations of it. Reader identities have been shown to be more influenced by what occurs within school, rather than what occurs at home (Hall, 2012; Kolb, 2014). Independent reading is at the core of secondary education. As a result, McKenna, Conradi, Lawrence, Jang, and Meyer (2012) noted that adolescents have multiple reading identities—their academic reading identities can differ from their recreational reading identities. They may also develop separable print and digital identities.

5.5.1.5 Models of affective factors in literacy

There is evidence that academic motivation is a valid, measurable, and reliable construct (Gottfried, 1990). A great deal of research supports a link between affective factors and literacy attainment, though most of this research is correlational and as such cannot provide strong causal evidence. It is likely that early literacy attainment predicts later affective factors. In order to control for this, longitudinal studies are used in which the associations of affective factors with growth in attainment (after controlling for prior attainment) are examined. For example, Guthrie, Wigfield, Metsala, and Cox (1999) reported that motivation predicted amount of reading after controlling for prior reading achievement. This provides children with opportunities to develop their underlying literacy skills through practice and self-teaching (Schaffner, Schiefele, & Ulferts, 2013; Share, 1995). Motivation is thought to mediate the Matthew Effect (see p24)—reading skills improve with practice, but at the same time children may read more because they have better reading skills (Cunningham & Stanovich, 1998; Morgan & Fuchs, 2007).

McGeown (2013) argues that reading motivation has both indirect and direct influences on literacy. The indirect route is that reading motivation affects reading development by increasing the *amount of reading* undertaken. However, this is not the only link between reading motivation and achievement. Wang and Guthrie (2004) found that reading motivation directly influenced later reading attainment even after controlling for both prior attainment and reading amount, indicating that the link between motivation and achievement is not fully explained by reading amount. Schiefele, Schaffner, Möller, and Wigfield (2012) provide a useful review of this research and suggest three mechanisms by which intrinsic reading motivation may increase literacy attainment: amount of reading, use of reading strategies and preference for different text genres. Readers with high intrinsic motivation have been shown to read more (Morgan & Fuchs, 2007), but they are also likely to read text more deeply and make more inferences (Law, 2009) and to read a wider range of texts (Wigfield & Guthrie, 1997). All three of these factors may serve to increase literacy outcomes. It is likely that children who become highly interested in what they read and enjoy challenging themselves while reading develop better reading comprehension over time, even if they do not read extensively.

It is well established that intrinsic, rather than extrinsic, motivation plays a key role in literacy attainment. In a longitudinal study of 740 German children from nine to 12 years old, Becker, McElvany, and Kortenbruck (2010) found the relationship between intrinsic motivation and later reading ability (comprehension, vocabulary, and decoding skills) was mediated by amount of reading. Note that this

relationship became not statistically significant when previous reading ability was included in the model, but the high longitudinal stability of reading can make it difficult to demonstrate significant influences on reading after controlling for prior attainment. Baker and Wigfield (1999) found similar results for 10- to 11-year-old U.S. students. Self-efficacy, challenge, curiosity and involvement were strongly related to the amount of reading and to reading comprehension. Avoidance of reading related tasks was negatively associated with amount of reading and reading achievement.

The role of extrinsic motivation in literacy outcomes is less clear. Research has either shown extrinsic motivation and literacy attainment are unrelated (McGeown, Norgate, & Warhurst, 2012) or inversely related (Wang & Guthrie, 2004). Longitudinal research indicates this is a bidirectional relationship. For example, in the Becker et al. (2010) longitudinal study discussed above, reading (decoding and comprehension) at age nine negatively predicted extrinsic motivation at age ten, which in turn negatively predicted reading skills at 12 years old. This bidirectional result suggests that children who experience early reading failure are more likely to have an extrinsic motivation to read as they grow up—in other words, they are more likely to read only because they are told to, or because they get rewards for reading. However, at present, long-term longitudinal studies of the associations between affective factors and literacy outcomes are lacking, so it is difficult to make definitive statements about long-term outcomes.

Morgan, Fuchs, Compton, Cordray, and Fuchs (2008) proposed that the relationship between reading motivation and reading skill emerges at a young age, and is already measurable in first grade. Poor readers report lower levels of motivation and reading self-concepts, compared to peers who were stronger readers. Teachers supported this finding, reporting that poor readers were more task-avoidant and less intrinsically motivated. This is a concern, as if poor readers are less motivated early on, the strong correlation between reading skills, reading motivation, and reading practice, suggests that both reading skill and motivation need to be tackled from the beginning of reading instruction for children at risk of reading difficulties.

Figure 16 summarises the ways in which affective factors can influence literacy development. It highlights that there is a continuum of motivation ranging from extrinsic to intrinsic, and that sometimes extrinsic motivation can lead to intrinsic motivation over time. Motivation leads to two key differences with respect to literacy: an increase in *time spent* reading and writing and an increase in *engagement* with the tasks—in other words, both the quality and quantity of reading. While intrinsic motivation may increase both time spent and engagement level, extrinsic motivation is likely to increase time spent, but not engagement level, as the child is doing the task to get it done rather than engaged in it. Both engagement and amount lead to strengthening and consolidation of the proximal factors in the literacy process.

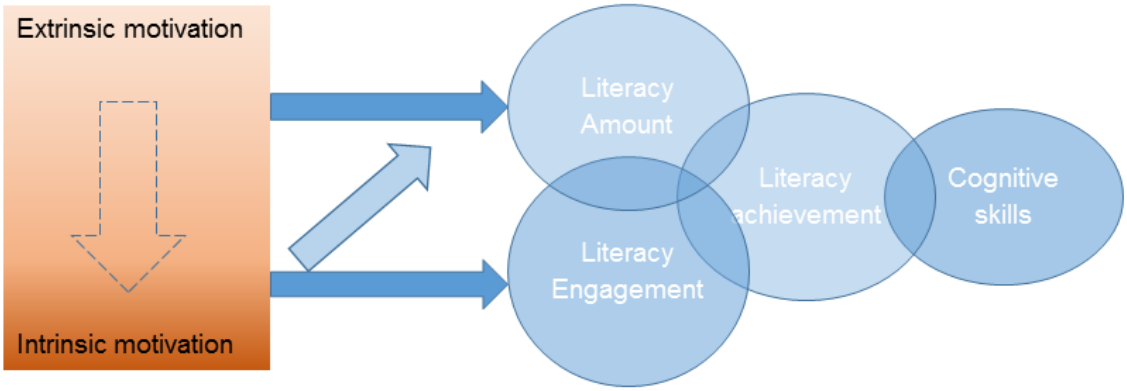

Figure 16: Model of the relationship between affective factors and literacy.

The *Reading Engagement Model* (Wigfield, Mason-Singh, Ho, & Guthrie, 2014) describes how classroom practices have a role in developing children's cognitive processes and affective response to reading. These factors in turn influence reading engagement, and therefore reading amount and in turn reading achievement. There is a complex interplay between the components to develop reading achievement. According to Wigfield et al. (2014), the model shows that students achieve better when the classroom practices have a positive impact on both motivational processes and cognitive processes in reading.

5.5.2 The role of affective factors on word reading and spelling

McGeown, Johnston, et al. (2015) explored the word reading skills, attitudes to reading, reading self-concept, and reading enjoyment of 203 six- to seven-year-olds in the U.K. Reading self-concept was a significant predictor of word reading, while reading enjoyment was not. Given the cross-sectional nature of this study, causal relationships cannot be concluded.

There are some indications that different elements of affective factors are differentially associated with word reading and reading comprehension. Cartwright, Marshall and Wray (2015) found that perceived competence in ability was associated with word and nonword reading, while value was associated with reading comprehension. Similarly, Carroll and Fox (2017) showed that after controlling for language, working memory and phonological awareness, reading self-efficacy predicted word reading fluency, but not reading comprehension.

We have only been able to find a few papers that explored affective factors and spelling, highlighting the dearth of research in this area of literacy development, particularly in a recent U.K. context. From the literature survey we did not find papers that looked at motivation and spelling, highlighting this as an area for further research.

Sideridis (2005) reported that poor spellers had significantly lower goal importance, intention to achieve, poor self-efficacy and low motivation levels to engage with spelling compared to high proficiency spellers. The motivational profiles of low- and high-proficiency spellers differed significantly; the findings suggested the low-proficiency spellers felt they had little control and placed a focus on significant others directing their actions (external attributions). These attributions are likely to be associated with increased anxiety, as the pupils feel that success or failure is out of their control.

Downing, DeStefano, Rich, and Bell (1984) used informal conversations to explore attitudes towards spelling, perception of ability, and spelling strategies used by 100 Canadian six- to 11-year-olds. Spelling was consistently rated as the least preferred school activity across grades, but also consistently rated as important. The authors reported a decline in self-concept, with more children in grades five and six (10 to 11 years old) saying they thought they were bad spellers compared to children in first grade (six years old). This decline was proposed to be as a result of children using test scores to confirm whether they were good or bad at spelling, although there are other plausible explanations. This finding is somewhat contradicted by that of Rankin, Bruning, and Timme (1994), who reported that self-efficacy was stable across 687 American children aged nine, 12, and 15. It may be that self-efficacy shows a drop in mid-primary school and remains steady from that point on. Rankin et al. (1994) found that self-efficacy was the biggest affective predictor of spelling performance, with expectations of success and attributions playing a less important role.

5.5.3 The role of affective factors on reading comprehension

Many studies examine the role of affective factors in both word reading and comprehension. Relatively few examine whether affective factors play different roles in each area of literacy. Intrinsic motivation and perceptions of one's own reading competence explain significant variance in reading comprehension, after controlling for language abilities, decoding skill, and memory in a group of 10- to 11-year-olds (Medford & McGeown, 2012). Similarly, Taboada, Tonks, Wigfield, and Guthrie (2009)

reported that intrinsic motivation explained unique variance in reading comprehension even when controlling for previous reading performance and background knowledge. Taboada et al. (2009) proposed that reading motivation is an 'energiser' that enables children to engage the resources and strategies needed for reading comprehension, resulting in better performance. This relationship seems to be present across the full age range. Motivational constructs continue to play a significant role in developing independent readers in adolescence, and also impacts on reading ability (Conradi, Amendum, & Liebfreund, 2016). Similar findings have been found for adolescents in the U.K. For example, reading motivation predicted variance in reading comprehension and summarisation skills, even after controlling for single word reading and reading speed (McGeown, Duncan, et al., 2015).

Katzir, Lesaux, and Kim (2008) also found that reading self-concept explained additional variance in reading comprehension, after controlling for word reading skills and verbal ability. This study, with 67 eight- to nine-year-olds in the U.S., included three dimensions of reading self-concept: competence in reading, perception of ease with reading, and attitude towards reading. All three dimensions were positively related to reading comprehension.

To date, there is one large-scale class-based instruction focusing on reading motivation with reading comprehension skills, *Concept-Orientated Reading Instruction* (CORI) (Wigfield, Gladstone, & Turci, 2016). CORI is underpinned by the Reading Engagement Model (Wigfield et al., 2014). CORI is a context-specific programme that aims to enhance reading motivation at the same time as improving comprehension. Teachers focus on student's self-efficacy, autonomy, value of reading, intrinsic motivation, and collaboration in reading (Wigfield et al., 2016). CORI aims to enhance reading motivation and improves reading comprehension for elementary and middle school students (Guthrie & Klauda, 2014; Guthrie et al., 2004). Nonetheless, the existing evidence on CORI is not of the highest quality and the What Works Clearinghouse indicates that there is not yet enough evidence to conclude that CORI is effective (https://ies.ed.gov/ncee/wwc/EvidenceSnapshot/103). More high-quality studies need to be done, both to examine what approaches are effective in improving motivation and to what extent the different elements of the programme (comprehension instruction, motivation, autonomy etc.) are influential.

As touched on above, intrinsic motivation is associated with reading comprehension via reading amount, but there remains a significant association between motivation and comprehension after controlling for reading amount. Cartwright et al. (2015) reported that there was a statistically significant relationship between the subjective value of reading and reading comprehension for a sample of 68 six- and seven-year-olds in the U.S. Interest in reading material has also been proposed as an element of reading motivation that explains growth in reading comprehension. If a child is interested in the text they are more likely to put in effort to understand it (Guthrie, Hoa, et al., 2007).

Along the same lines, extrinsic motivation is negatively associated with reading comprehension (Schaffner et al., 2013; Wang & Guthrie, 2004). In a sample of 187 U.S. and 197 Chinese 9-year-olds, extrinsic motivation had a direct negative effect on reading comprehension. This may be because extrinsically motivated readers take a more surface approach to reading, focusing on external rewards rather than on the text (Wang & Guthrie, 2004). These children focus on completing the task in order to receive reward or avoid punishment rather than for curiosity or to learn something. They do not employ deeper comprehension strategies because they are not focused on gaining information from the text (Wang & Guthrie, 2004).

Further work by Stutz, Schaffner, and Schiefele (2016) reported that competition-orientated extrinsic motivation for second and third graders was directly negatively associated with reading comprehension. Amount of reading mediated the relationship between reading comprehension and the intrinsic motivational construct involvement. In a longitudinal study of second and third graders, competition and involvement were still of importance (Schiefele, Stutz, & Schaffner, 2016). There was a reciprocal

relationship between involvement and reading comprehension. Competition-orientated reading motivation was negatively affected by reading comprehension, but did not predict it.

An interesting case of using motivation in practice comes from Accelerated Reader, a programme developed in the U.S.A. in which 'real' books are graded according to their difficulty, and children gain points by completing books and answering comprehension questions about them online. These points can be exchanged for extrinsic rewards from the teachers. This programme is very widely used in the U.S.A. and the U.K. A randomised controlled trial with 349 below-average readers in their first year of secondary school indicated that it is moderately effective in improving reading outcomes in the U.K. (Gorard, Siddiqui & See, 2015).[20] This programme uses a combination of practices to encourage intrinsic motivation (allowing choice in books but maximising experience of success by choosing books at the right level and monitoring progress), reading amount (allowing 30–60 minutes a day for free reading within school), and extrinsic motivation (in the form of the rewards for points gained). Interestingly, feedback from teachers indicated that they felt the external rewards gained were relatively unimportant as motivators within the overall programme, and that the regular feedback and recognition of work was more important. This finding is in line with other research on extrinsic motivation in reading achievement, but needs to be assessed more directly before conclusions can be drawn.

Several studies have highlighted an association between reading comprehension and attitudes towards reading. Petscher (2010) conducted a meta-analysis of 32 studies examining the correlation between these factors. He concluded that there was a significant relationship between reading attitudes and achievement for both elementary and middle school children, with the relationship stronger at elementary school. PIRLS data reported that children with higher average reading comprehension hold more positive reading attitudes (Mullis, Martin, & Kennedy, 2007). McKenna et al. (1995) reported survey results from 18,185 U.S. children aged six to 11: poor readers held more negative attitudes towards reading than good readers, moreover, the gap between good and poor readers steadily increased from six to 11 years old. McKenna et al. (2012) proposed that the relationship between reading attitude and achievement is complex and possibly reciprocal. However, all of these studies are correlational and further research is needed to explore how reading attitudes impact on reading development.

An intervention that focuses on attitudes to improve reading attainment has not, to our knowledge, been tested experimentally, highlighting a gap in the field. Fletcher, Grimley, Greenwood, and Parkhill (2012) interviewed teachers in five schools in New Zealand to understand how they were improving attitudes towards reading—strategies focused on developing a reading culture which included discussions and debates and access to age-related high-interest books in both the classrooms and school library. These are strategies that schools could implement to encourage reading.

Children's self-concept for reading, specifically their perceived reading comprehension ability, is positively associated with their actual single-word reading skills, spelling, reading comprehension, and orthographic processing skills (Conlon, Zimmer-Gembeck, Creed, & Tucker, 2006). Twist, Sizmur, Bartlett, and Lynn (2012) also found that for U.K. children, greater confidence in reading was associated with higher achievement in reading comprehension, supporting these findings further.

In summary, intrinsic motivation (reading for enjoyment or understanding), reading attitudes, and self-concept are all significantly positively associated with reading comprehension, while extrinsic motivation (reading for extrinsic rewards) shows a negative association or no significant association. However, many studies have used correlational approaches and therefore conclusions must be tentative before more intervention studies have been carried out.

[20] https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/accelerated-reader/

5.5.4 The role of affective factors on written composition

Affective factors are likely to play a particularly important role in writing as good writing requires a high level of motivation and self-regulation (Bruning & Horn, 2000). Knudson (1991, 1992, 1993) conducted a series of observational studies with American children aged 6–18 (Grade 1–12) examining the relationship between attitudes towards writing and writing performance. Attitude accounted for unique variance in writing performance. Better writers held more positive attitudes and, consistent with the findings in relation to reading, attitudes towards writing declined across grades. Graham, Berninger, and Fan (2007) examined the nature of the relationship between writing attitudes and achievement. Writing attitudes were measured using a seven-item questionnaire modelled on the KcKenna et al. (1995) measure of children's attitudes toward reading. The measure of achievement included essay quality, vocabulary used, and written expression. There was a direct pathway from writing attitudes to achievement. Alternative models did not fit the data (reciprocal relationship or a pathway in the opposite direction, from writing achievement to writing attitudes). This suggests that attitudes about writing had a direct relationship with achievement in writing. Graham, Collins, and Rigby-Wills (2017) conducted a meta-analysis of writing characteristics of students with learning difficulties and typically-achieving peers and found only eight studies that looked at writing motivation. Overall, students with learning difficulties had lower writing motivation than typically-developing peers. Wilson and Trainin (2007) explored how motivational constructs explained achievement in reading, writing, and spelling, and concluded that for U.S. first graders (six years old), achievement in literacy was mediated by self-efficacy and perceived competence.

Much of the literature for writing and affective factors has focused on self-efficacy—the student's confidence in their writing skill. In a review of writing and self-efficacy, Pajares (2003) argues that writing self-efficacy influences both writing motivation and writing outcomes. Pajares and Johnson (1996) also found that writing self-efficacy mediated the association between previous writing grades and quality of a given piece of writing in high school students. Self-efficacy seems to be more important than broader measures of self-concept in predicting writing outcomes (Karaglani, 2003).

5.5.5 Individual differences in affective factors

There are some well-established age and gender differences in affective factors. Several studies suggest that girls tend to hold more positive attitudes towards reading than boys (Clark & Foster, 2005; Clark & Rumbold, 2006; Logan & Johnston, 2009; McKenna et al., 2012). However, there are not always gender differences in reading attitude and also the differences reported are often small. For example, Logan & Johnson (2009) report an effect size of partial $\eta^2 = 0.04$ for gender differences in attitudes to reading and partial $\eta^2 = 0.06$ for attitudes to school in a recent U.K. sample. Moreover, the nature of the reading might be important. For example, McKenna et al. (2012) found that boys held a more positive attitude to leisure time reading in digital form than girls did. Boltz (2010) supports this by showing that reading outside of school for enjoyment for boys is focused more on a digital format than paper. Understanding these types of attitude differences could help to engage both boys and girls with reading outside of school.

There are varied findings about gender differences in perceptions of self around writing. Pajares (2003) found that girls were more confident in their writing ability compared to boys, in line with the finding that girls tend to have slightly better writing abilities than boys. However, this may reduce with age. Pajares and Johnson (1996) reported that high-school boys held stronger self-efficacy beliefs about their writing performance than girls.

Attitudes towards all forms of reading also seem to become more negative with age, from primary to secondary school (Clark & Foster, 2005; Clark & Rumbold, 2006). Similarly, reading identities have been specifically shown to become poorer when children move from primary to secondary education (Lenters, 2006). Lau (2009) examined motivation in children ranging from eight to 18. (Note that it is

difficult to obtain reliable data on motivation from very young children who may find it difficult to reflect upon their reasons for doing something.) They found that the structure of motivation remained consistent across ages, but that levels changed: motivation levels decline as children progress through the education system. This decline may be for a number of reasons including developmental changes in adolescence and demands associated with reading in secondary schools.

There are also some significant cross-cultural differences in attitudes towards literacy. Twist et al. (2012) found that U.K. students (age 15 to 16) had less motivation to read than students from other English-speaking countries (Northern Ireland, Australia, and Canada). There may also be interesting cross-cultural differences in pupils' motivation to complete the PISA tests themselves. Geneezy et al. (2017) found that giving a monetary incentive (extrinsic motivator) to 15- and 16-year-olds to do well in a mathematics test significantly improved the performance of U.S. adolescents but had no effect on the scores of Chinese adolescents. This implies a higher level of intrinsic motivation in the Chinese sample. These cross-cultural differences may provide a partial explanation for the differences in attainment found in the PISA study.

Finally, there are individual differences associated with reading attainments themselves. Unsurprisingly, poor readers tend to have lower self-concept and motivation, but their levels of intrinsic motivation also explain a greater proportion of literacy attainments than those of good readers (Logan, Medford, & Hughes, 2011). Motivation was of more importance for poor readers, who will have struggled with the assessment, but those with a higher level of motivation persevered rather than disengaging.

5.5.6 Conclusions and implications for teaching

Cartwright et al. (2015) argues that the Simple View of Reading does not fully account for the nature of reading comprehension because it does not include a role for reading motivation. We concur that affective factors will play a significant role in all aspects of literacy attainments. As suggested by Schiefele et al. (2012), reading motivation can influence literacy attainments in at least three ways: by increasing reading amount, by increasing depth of processing and by increasing range of genres attempted. Collectively the evidence suggests that children who report higher reading motivation are more persistent with challenging tasks and put more effort into reading, thus, as a result, have higher levels of reading achievement compared to children who report lower levels of motivation. Conversely, early experience of failures in reading motivates poor readers only to read when they have to (for extrinsic reasons), as they see themselves as less competent readers and hold negative attitudes towards reading. This may create a vicious cycle where children are not practicing reading to develop, resulting in poorer reading skills, and potentially increased negative feelings towards reading (Morgan & Fuchs, 2007).

There is also some suggestion that perceptions of self are particularly important for writing, word reading, and spelling, while reading comprehension is more closely associated with attitude and motivation (McGeown, Levy, & Carroll, 2017), and that affective factors could be particularly important for struggling readers (Logan, Medford and Hughes, 2011). Specifically, in good readers, the main predictor of reading comprehension was verbal IQ, while in poor readers, reading comprehension was influenced by word reading ability and pupil's intrinsic reading motivation. The authors suggest that struggling readers, who are regularly asked to do reading tasks which they find difficult, need a greater degree of motivation in order to do well.

Note that there are several reading programmes which address motivation and self-perception as an element in a range of literacy activities (e.g. Accelerated Reader, CORI), but relatively few that focus on affective factors in the absence of direct reading instruction. This is likely to be because affective factors are so closely bound up with reading experience. In experimental terms, in order to examine the effect of influencing motivation or self-efficacy, we would need to compare one of these interventions with a comparison group who received reading intervention with no motivation or self-efficacy

components. Unrau et al. (2018) find a moderate effect size across 12 studies comparing a reading programme with self-efficacy to one without, but at the time of writing we are not aware of a similar intervention study with reading motivation. We hypothesise that literacy interventions that address both cognitive and affective processes would be most effective and have most long-lasting effects (Morgan & Fuchs, 2007; Morgan et al., 2008), but as yet the data directly examining this question is sparse.

The findings in relation to the role of affective factors in literacy development have important implications for teaching. It is important that the school environment presents literacy as useful, important, and enjoyable, and ensures that children have positive experiences of reading and writing. Kehus and Lee (2011) highlight the importance of the environment in which book discussions take place, suggesting that teachers should emphasise a focus on 'group norms' rather than 'teacher led rules' as this provides an environment that is conducive to discussions. Teachers have been shown to have a large influence as reading role models. For example, teachers who were encouraged to demonstrate enjoyment of reading and have a wide knowledge of children's literature had a significant positive effect on attitudes towards reading, and reading attainments, in their pupils (Cremin, Mottram, Collins, Powell, & Safford, 2009).

If a child feels that they have a choice over reading material they may feel more motivated to read. When children feel they have more choice, they are more in control and are more engaged. Interest is also a key factor: if a child is reading or writing about a topic that interests them they are more motivated. To become a lifelong reader choice is important. Gambrell, Palma, Codling, and Mazzoni (1996) reported that 80% of children preferred the book they had picked by themselves. Choice is a key motivator for improving reading amount (Moss & Hendershot, 2002). Children and young people need to have a sense of ownership and self-determination in their reading and writing experiences. Conversely, however, particularly for young and struggling readers, selecting a book that is too difficult can be demotivating for the future. The ideal is probably some form of constrained choice so that the text is suitably challenging, while still realising the potential benefits of pupil choice.

Children read for a wide variety of reasons. While we can say that intrinsic and extrinsic motivation differ in their association with literacy outcomes, we do not yet understand the complex relationship between intrinsic and extrinsic motivation in education. Extrinsic motivation should not be viewed as 'bad' and intrinsic motivation as 'good', nor should teaching practices focus only on increasing intrinsic motivation. Both types of motivation can increase amount of reading, and amount of reading is predicted better using both types of motivation than by either alone (McGeown, 2013). At times, it may be appropriate to use incentives as extrinsic sources of motivation to encourage children to engage with reading, particularly if they avoid reading or are fearful of failure (Guthrie et al., 1999).

5.6 Conclusions: distal child-based influences on literacy

There are many different child-based influences on literacy development, and we have only had space to discuss in detail a few: speech, hearing, visual and motor difficulties, RAN, executive function and working memory, amount of reading and writing, motivation, attitudes, and perceptions of self. We refer to these influences as distal because the impact on literacy development is indirect—distal factors influence proximal factors, which in turn impact on the processes involved in literacy.

Speech, hearing, visual and motor skills, as well as RAN, have a particularly close relationship to proximal factors. We consider these factors as distal since, for most children, these skills will develop well without specific intervention. However, children who do have difficulties in these areas have a greater risk of literacy difficulties because of the influence of these skills on the proximal skills that underpin literacy. They would often benefit from specialist assessment and support, particularly since their needs may extend to other aspects of development.

We have shown that working memory skills are crucial for reading and writing both at the word and the text level, and that executive function skills may be particularly important for more complex literacy tasks, such as composition and comprehension. The amount of time an individual spends reading and writing is often overlooked, but can vary widely both within classrooms and across cultures. This is closely linked to an individual's attitudes, perception of self, and motivation to read and write, but the link between reading motivation and amount of reading and writing is not the only reason that these affective factors are important. The children most likely to progress well in literacy are those that believe that reading and writing are important, enjoyable, and achievable. These beliefs depend upon the literacy experiences the children have, and hence should play an important role in planning literacy curricula.

SECTION 6: Distal environmental influences on literacy

Section summary

This section summarises the role of the broader environment, which not only impacts on the amount of reading and writing a child engages with, but also the nature of their experiences and their attitudes and motivations to read and write. There are many environmental factors which indirectly impact on literacy development. Here, we focus on the role of family background, home literacy environment, language environment, and bilingualism. In many cases, it is neither possible nor desirable to intervene with these factors. Even so, understanding the factors that influence a child's engagement with literacy outside the classroom is crucial to understanding how best to support the child within the classroom. While the home environment can influence the risk of a child developing literacy difficulties, high quality literacy education embedded within a rich school literacy environment can go a long way to overcome any challenges.

Environmental factors that likely are important for literacy development include parental attitudes towards literacy, family history of strengths or difficulties with literacy, and socio-economic status. It is often difficult to tease apart the impact of these different factors. These factors feed into the home literacy environment—they affect the amount and nature of literacy-related activities that the child can engage with in the home.

Children with English as an Additional Language vary widely in their reading and writing. When considering the likely impact, the extent to which children can apply their existing knowledge is key. This will be influenced by:

- the amount of spoken and written English a child been exposed to;
- the age at which they began to learn English; and
- the level of similarity between their first language and English.

Having considered the role of proximal and distal child-based influences on literacy, we now consider the role of the broader environment. While many environmental factors may indirectly impact on literacy, we focus on the role of family background, home literacy and language environment, and bilingualism.

6.1 Family background

Understanding the role of socio-economic background and family history in relation to literacy development is complex. The Early Childhood Project used a longitudinal design to understand factors that predicted emergent literacy skills in urban children in the U.S. (Baker, Scher, & Mackler, 1997). Sixty-eight families completed diaries of activities in the home. These diaries revealed that middle-class parents were more likely to use literacy activities as a source of entertainment in comparison to low income families where activities were mainly coded as focusing on actively cultivating literacy skills (Baker et al., 1997). Hence, socio-economic differences are also bound up with differences in parental attitudes.

In a DfE report, Roulstone, Law, Rush, Clegg, and Peters (2011) examined the role of language, family, and socio-economic factors in children's early educational outcomes. They analysed a large longitudinal dataset collected by the Avon Longitudinal Study of Parents and Children (ALSPAC). Questionnaires collected from 9,629 parents in the U.K. measured socio-economic risk, the child's early communication environment, and early language development from pregnancy and throughout the preschool years to predict their school readiness at four or five years old. Roulstone et al. (2011) concluded that the

communication environment a child is exposed to is of greater importance to performance on school entry assessments than socio-economic background. In this study, 'communication environment' included a wide range of variables; four types of variable seemed particularly important: parenting beliefs of the mother, whether the child attended preschool, material resources available (particularly books and library visits), and amount of TV viewing (which was negatively associated).

Access to print in the home and engaging in literacy activities that develop positive reading attitudes can help to alleviate differences due to socio-economic status (Kirsch et al., 2003). A more recent review of the literature argues that the quality of language input is a better predictor of early literacy development than the quantity of language exposure (Law et al., 2017).

A family history of reading difficulties has been shown to impact upon a plethora of literacy skills including single word reading, spelling, and orthographic processing (Conlon et al., 2006). In this study of 174 eleven- to 13-year-olds, those that came from a home with a history of reading difficulties performed worse on measures of reading, spelling, and comprehension, compared to those without family history of reading difficulties. Van Bergen, van Zuijen, Bishop, and de Jong's (2017) study of 101 families in the Netherlands reported that parental word-reading and pseudo-word reading fluency was a moderate predictor of children's (mean age ten-years-old) word reading fluency. The relationship between home literacy environment and literacy development may not just be down to environment but also genetics (Hart et al., 2009). However, it is beyond the scope of this review to consider this evidence in depth.

Studies of twins offer an opportunity to consider the separable contributions of genes and environment by comparing the skills of monozygotic (genetically identical) twins to dizygotic twins. One such study of 627 five-year-old twin pairs from Australia, Scandinavia, and the U.S. concluded that phonological awareness, rapid naming, and verbal memory had genetic bases, but that print awareness, vocabulary, and grammar/morphology were more linked to environmental influences (Byrne et al., 2006). A meta-analysis of twin studies estimated the heritability of reading to be extremely high (de Zeeuw, de Geus, & Boomsma, 2015). Puglisi, Hulme, Hamilton, and Snowling (2017) examined the relationship between maternal and children's language, reading, and spelling skills in a longitudinal design with a sample of 251 U.K. children at high risk of dyslexia, with first stage of testing taking place when the participants were three and a half. Children's language and reading skills at five and a half were largely accounted for by maternal skills, thus reflecting a familial association. Several other studies also suggest a familial risk of dyslexia (Snowling & Melby-Lervåg, 2016; Snowling, Muter, & Carroll, 2007), which is likely to be explained in both genetic and environmental terms.

Crucially, while genetics might increase the risk of difficulties learning to be literate, it is not the defining influence. Literacy is the result of a complex mix of cognitive, affective, genetic, and environmental factors. Children's potential is not predetermined and experiences at home and at school play a crucial role in literacy development.

6.2 Home literacy environment

The ***home literacy environment*** describes the nature of the literacy-related activities that a child has the opportunity to engage with in the home. Much research into the effects of the home literacy environment focuses on preschoolers and emergent literacy. Nonetheless, the opportunities that the child has to engage in literacy activities in the home, and parental beliefs and behaviours, are likely to continue to impact on literacy throughout the school years. Indeed, in a cross-sectional study of 90 Canadian children, Sénéchal (2006) found that storybook reading within the home measured at six years old directly predicted concurrent vocabulary scores. Sixty-five of these children were seen again when they were ten years old; their amount of storybook reading at age six predicted the frequency with

which they now read for pleasure, demonstrating the potentially long-term effects of early home literacy environment.

A number of elements are important in the home literacy environment. These include shared book reading, parental expectations, family stressors, and family environment (Bennett, Weigel, & Martin, 2002). Shared book reading early on stimulates language and reading development (Fletcher & Reese, 2005). In their analysis of data from 9629 parents, Roulstone et al. (2011) found that parent reports of the number of books and toys available in the home, visits to the library, and parental teaching of a range of activities were all important predictors of expressive vocabulary at two years old.

Extensive research has shown that the home literacy environment is an important influencer of emergent literacy skills such as concepts about print (e.g., how to read a book) and receptive and expressive language skills (Bennett et al., 2002). Sénéchal and LeFevre (2002) proposed that home literacy experiences are directly related to emergent literacy skills and language development, which in turn is related to later reading outcomes. The *Home Literacy Model* conceptualises a distinction between formal and informal literacy activities in the home (Martini & Sénéchal, 2012). ***Informal literacy experiences*** are those where children are exposed to written language incidentally, for example when sharing a book (Sénéchal & LeFevre, 2002)***. Formal literacy experiences*** are where activities are focused on structure of the written language***;*** conversations may focus on letter sounds and sounding out words. Informal and formal literacy experiences with parents have significant, separable contributions to children's reading achievement (Sénéchal, 2006). Informal literacy experiences are associated with receptive language development (Sénéchal & LeFevre, 2002). Formal literacy experiences are associated with the development of emergent literacy skills, such as alphabet knowledge, decoding skills, spelling, and book-related knowledge such as how to read a book (Sénéchal & LeFevre, 2002). Hood, Conlon, and Andrews (2008) showed that preschool teaching practices (formal literacy activities) in the home of 123 Australian children (mean age five) predicted emergent literacy skills at six and seven years old—vocabulary, letter-word identification, reading rate, and spelling rate. It should be noted, however, that all of the home literacy research reported so far is correlational. There are relatively few intervention studies. In a recent randomised controlled trial with 142 families of 11-month-old babies, a book sharing contingent talk intervention increased contingent talk by the caregiver, promoting the child's vocabulary growth (Mcgillion, Pine, Herbert, & Matthews, 2017). This was, however, a short-term gain and not long-lasting, suggesting further follow-up interventions are necessary (Mcgillion et al., 2017).

There is a strong, positive relationship between the child's opportunities to engage in literacy activities in the home and their attitudes towards reading. The more opportunities the child has to engage with literacy based activities in the home, the more positive their reading attitudes (Baker et al., 1997). Children are more likely to report reading in their leisure time if there is another member of the family that reads, creating a reading community the child feels they belong to (Strommen & Mates, 2004). This suggests that parental beliefs and actions are related to children's motivation to read. However, it is not clear whether the relationship is directional, reciprocal, or neither. A meta-analysis of correlational studies by Bus, van Ijzendoorn, and Pellegrini (1995) proposed that interest in reading emerges from enjoying shared book reading with a parent, and the parents' interest and effort when sharing impacts on a child's engagement with reading.

Shared storybook reading is a social process, impacting on affective elements of reading (Saracho & Spodek, 2010). The home literacy environment can influence children's motivations to read (Baker et al., 1997). In a home where children are shown that reading is fun, a source of entertainment, these children place a greater value on reading (Sonnenschein, Baker, Serpell, & Schmidt, 2000). Children in these homes are more likely to be intrinsically motivated to read (Baker, Serpell, & Sonnenschein, 1995). Seeing reading as fun develops more positive attitudes towards reading, compared to homes where the view is that reading is a skill (Baker et al., 1998). To be of benefit in terms of increasing

engagement with reading, a positive self-concept related to shared reading needs to develop in a comfortable nurturing environment (Baker, 2003).

Beliefs held by parents are related to whether a child is exposed to storybook reading and furthermore, if they are, the nature of these interactions. These beliefs can also shape a child's interest in reading (DeBaryshe, 1995). This is reciprocal, as a parent is likely to engage with reading if a child shows interest. Therefore these interactions need to be enjoyable for both the child and parent for them to be of benefit (Evans & Shaw, 2008). Both parental expectations and child interest explain unique variance in early literacy after controlling for socio-economic background and nonverbal intelligence (Martini & Sénéchal, 2012). Parental expectations are those which focus on what the parents think their child should be able to achieve. Child interest refers to the child's own interest in the activity. Children who have more interest in literacy activities might learn more than a child who does not show interest (Martini & Sénéchal, 2012).

Frijters, Barron, & Brunello (2000) examined the role of home literacy (based on parent report and knowledge of storybooks) and child interest in literacy (measured by child report). Both measures accounted for significant variance in kindergarten children's oral vocabulary and early written language. As a result of this growing evidence, parental expectations and child interest were added to the Home Literacy Model, which increased the ability of the model to account for individual differences in early literacy skills (Martini & Sénéchal, 2012).

Whilst the Home Literacy Model distinguishes between informal and formal activities, little is actually known about the different types of literacy activities preschoolers engage with in the home, or how these impact on later reading development (Wood, 2002). Wood (2002) reported a number of benefits for the different home literacy activities reported by 61 parents of three- and four-year-olds in the U.K. For example, storybook reading contributed to reading attainment, vocabulary, and short term memory (Wood, 2002). Yet, formal literacy activities such as letter-based activities were rarely used by parents. To extend the Home Literacy Model, a comprehensive understanding of what activities parents engage with is needed, and furthermore, how these different activities influence literacy development.

A meta-analysis of 16 parent-child reading interventions (Sénéchal & Young, 2008) reported on the benefits of different parent-child interventions. Three papers reported on interventions that focused on the task of a parent reading to their child: for these interventions, no significant gains in reading performance were reported. Six papers reported on the effects of various interventions that focused on training parents to listen to their child read—approaches such as paired reading (Topping & Lindsay, 1991) or training on how to ask questions to develop vocabulary and comprehension. These types of interventions all reported significant effects. Trained parent interventions resulted in the biggest gains in reading performance; these interventions focused on training parents on specific skills linked to reading such as phonics, how to correct an error, letter-sound blending, and use of word cards (Sénéchal & Young, 2008). The specific exercises were the element that made the most difference. Toomey (1993) supports this: that simple, specific techniques given to parents show greater benefit compared to general information about reading.

Despite much of the literature focusing on the early years, the home literacy environment is not just relevant at the emergent stage of reading development (Boerma, Mol, & Jolles, 2017). An enriching home literacy environment likely also supports better reading comprehension later on (Boerma et al., 2017). In a correlational study of 117 eight- to 11-year-olds, Boerma et al. (2017) reported a direct relation between home literacy environment (measured by parental print exposure and the amount of own and children's books in the home) and reading comprehension, and two indirect relations via print exposure (measured by a book cover recognition task) and mentalizing ability. Mentalizing ability is a cognitive skill and is the ability to infer other people's mental states and to use this information to predict behaviour, an ability thought to be associated with reading comprehension (Boerma et al., 2017). These findings propose that encouraging children to read in the home will help with developing reading

comprehension. Further research is, however, needed on the influence of the home literacy environment in later schooling years.

The actions of parents in the home literacy environment are of importance. A synthesis of 13 meta-analyses of interventions to increase parental engagement in education and home/school partnerships generally suggests such interventions can be particularly supportive for early literacy. Overall, studies showed gains of two to eight months' progress in reading (Higgins & Katsipataki, 2015). Parents, however, need support to teach reading and the impact of such support has received little research attention. Martini and Sénéchal (2012) found that parents reported lacking the knowledge to teach reading. Parents need guidance to build their confidence (Baker, 2003).

Currently, there is conflicting evidence as to whether parents receive this support or not (Baumann, Hoffman, Duffy-Hester, & Ro, 2000; McNaughton, Parr, Timperley, & Robinson, 1992). Yet, evaluations of large scale parental engagement interventions funded by the EEF report low levels of impact, and very low levels of attendance at parent workshops and classes (Dorsett et al., 2014; Husain, Jabin, Haywood, Kasim, & Paylor, 2016; Tracey, Chambers, Bywater, & Elliott, 2016). Effective engagement of parents is extremely challenging, with low levels of attendance at parent workshops and classes common. An evaluation of a randomised controlled trial to assess the effectiveness of a ten-week parent intervention for 808 struggling Year 1 readers indicated small short-term gains in literacy but significant longer term gains (three to four months' additional progress). However, 27% of eligible parents did not attend any sessions, and only 7% attended all sessions. Others have tried to incentivise attendance by including free educational family trips and payments for attending classes—for example, in the EEF-funded randomised controlled trial of Parent Academy classes. While the incentives increased attendance, still 60% of eligible parents did not take part in any sessions and only 11% attended all sessions. Furthermore, no improvement in children's mathematics or reading outcomes were made (Husain et al., 2016). Similarly low attendance has been shown in randomised controlled trials targeting language and literacy skills of reception-aged children with EAL (Husain et al., 2018) and meta-cognitive skills of Year 4 children (Dorsett et al.,2014). Furthermore, meta-analyses have highlighted the poor quality of the existing evidence base and the need for robust evaluations of interventions focusing on parental engagement to understand the true impact on attainment (See & Gorard, 2015), and to understand what the role of schools is in increasing parental engagement (Higgins & Katsipataki, 2015).

Lastly, other family members in the home literacy environment—for instance, siblings or grandparents—may play a role in literacy development. However, little research has explored this (Knoester & Plikuhn, 2016). Using retrospective interviews, Knoester and Plikuhn (2016) asked twenty-six graduates how they thought their older siblings had developed their own independent reading. The interviewees reported that their older siblings had shared reading material with them, modelled reading to them, talked to them about reading material, and acted as teachers when reading aloud to them—all these concepts from the interviews suggest that siblings can play a role in early literacy development. However, more research is needed and the findings from this small, narrow sample of graduates should be interpreted cautiously.

6.3 Language environment and bilingualism

In multicultural societies many children learn multiple spoken and written languages simultaneously or consecutively. The U.K. context is very different from other English-speaking countries, many of which are either officially bilingual (e.g. Canada, New Zealand) or have large populations of speakers of particular languages. In those contexts, children are often raised bilingually from birth, or the second language is learnt before the children reach the age of three (Paradis, Genesee, & Crago, 2011). Bilingual programmes suited to specific languages are achievable in these countries. For example, Spanish-English bilingual children in California can enrol in bilingual classes taught in their native language and gradually make the transition to English (Slavin & Cheung, 2005). Yet, children who learn

English as an additional language (EAL) in England often learn English after they migrate to the U.K. and they often speak their heritage language at home until they start school where the instruction is offered in English. The January School Census 2017 showed that 20.6% of the U.K. primary school population and 14.7% of the secondary school population learn English as an additional language (Department for Education, 2018). Children with EAL in the U.K. speak more than 360 different languages (Department for Education, 2018). The diversity of the bilingual population of the U.K. is why we cannot simply imitate bilingual policy from other English-speaking countries.

Children with EAL have a unique profile.[21] Their typical strengths include:

- good decoding skills;
- strong executive function/working memory skills; and
- solid spelling skills in real words.

However, they typically show weaknesses in vocabulary and reading comprehension. For example, Snow (2014) found that bilingual learners scored, on average, about 0.5 standard deviations below the mean in nationally administered reading comprehension assessments. On the whole, the same set of skills underpins literacy development for both monolingual and bilingual children. However, bilingualism influences the development of many of these underlying processes due to the effects on exposure to the English language. When considering the impact of bilingualism on literacy acquisition, the key considerations are the amount of prior exposure to spoken and written English, the age at which the child began to learn English, and the amount of similarity between their **first language** and English.

The definition of EAL that is used within the U.K. education system reflects any exposure to a language other than English at home or in the community. This encompasses a range of contexts and gives no indication of English proficiency. For example, second or third generation ethnic minority students who use English as their everyday language will have extremely high English competency. These children will likely learn to read and write without great difficulty. At the opposite extreme, recent migrants who speak no English at all will have much greater difficulty learning to read and write in English. This broad definition of EAL makes it extremely difficult to interpret the academic attainment of children with EAL.

We use the term EAL in this review rather than 'bilingual' as the main goal of this review is to focus on students who have a strong foundation in their home language and learn English as an additional language when they enter formal education. The language that the child learned first is important as it affects how easily they can transfer existing knowledge. It is useful to think separately about how easily children with EAL can transfer knowledge from the spoken form of the language and the written form of the language. Similarities in the two spoken languages influence how easily children can transfer their first language phonological and grammatical knowledge. Such knowledge will feed into both word- and prose-level literacy processes. Similarities in the two written forms of the language influence how easily children can transfer their first language orthographic knowledge.

In order to read and write in English, EAL students, just like their monolingual English peers, have to develop and make use of phonological awareness (Sáenz, Fuchs, & Fuchs, 2005). EAL pupils may spend less time hearing and manipulating the phonemes in English (Verhoeven & Vermeer, 2006). The frequency with which different phonemes occur differs between languages. This is an important consideration as it can mean that children find it particularly hard to segment certain unfamiliar phonemes. Since phoneme segmentation is a prerequisite for using phonics, they may need additional support for those particular phonemes. For example, Japanese native speakers often have difficulty identifying the /r/ and /l/ in English. This is often explained as the fact that /r/ and /l/ form a single phoneme category in Japanese (Guion, Flege, Akahane-Yamasa, & Pruitt, 2000). There is, however,

[21] See the EEF review in this area: https://educationendowmentfoundation.org.uk/evidence-summaries/evidence-reviews/english-as-an-additional-language-eal/ (Murphy & Unthiah, 2015).

some evidence that EAL children are actually more aware of the subtle difference between phonemes than their monolingual peers (Hutchinson, Whiteley, Smith, & Connors, 2004). A meta-analysis of 293 observational studies across Canada, the Netherlands, the U.K. and the U.S.A showed that bilingual and monolingual children performed equally well on phonological skills and word reading tasks, despite the bilingual children having weaknesses in vocabulary (Lesaux, Geva, Koda, & Siegel, 2008). Accordingly, we can anticipate EAL students to perform on a par with their English monolingual peers in phonological awareness, and any gap will narrow and eventually disappear.

For EAL children, It is important to consider the extent to which their existing knowledge of written text may be transferable to English or, on the other hand, may interfere with their learning of English. For example, the letter-sound correspondences of German are more similar to English than those of Arabic. Not only is the spoken language of Arabic different to English, but also the orthography uses different letters and is read right-to-left rather than left-to-right as in English and most European languages. The Arabic *abjad* script only represents consonants and long vowels. The reader has to consider knowledge of syntax and morphology to arrive at the short vowel in the word (Abdelghany, 2010). Written languages differ on many continua. English uses 26 letters of the *Roman* alphabet. Many other European languages also use this alphabet, but a different code maps the written form onto the spoken form. The nature and consistency of letter-sound correspondences differ and the frequency with which letters co-occur differ between languages that use the same letters. Some languages use additional diacritics (marks such as accents, circumflex, cedilla) and/or additional letters (such as <æ>). Other orthographies use different alphabets, such as Cyrillic, in which case children with EAL must learn to recognise the letters of a new alphabet. Non-alphabetic languages are even more distant from English. For example, Chinese is morpho-syllabic—the symbols represent syllables and morphemes. Under these circumstances, children have to learn that English letters represent phonemes, a different unit of speech to what they have been accustomed to. This may explain why Zhao, Quiroz, Dixon, and Joshi (2016) found that EAL speakers who had an alphabetic first language background showed better English spelling skills than pupils who had a non-alphabetic first language background.

While EAL pupils tend to show good decoding skills, they tend to have difficulties in language comprehension. Studies have shown that vocabulary skills and grammatical skills are important predictors of reading comprehension even when the pupils learn English as a second language (Babayiğit, 2014; Proctor, August, Carlo, & Snow, 2005). However, learning new words in English not only creates linguistic demands on EAL pupils, but also cultural demands as culture and language are inseparable (Jiang, 2000). The differing experiences of non-native speakers of English may influence the background knowledge that children have about particular topics. This may explain why EAL pupils tend to show weaker vocabulary and morpho-syntactic skill compared to their monolingual peers.

EAL learners typically lag behind their English monolingual peers in both expressive and receptive vocabulary. However, their difficulties are particularly marked in expressive vocabulary (Burgoyne, Whiteley, & Spooner, 2009). Hutchinson, Whiteley, Smith, and Connors (2003) showed that while both monolingual and bilingual children improved their performance from six to eight years old, bilingual children achieved a lower score in expressive and receptive vocabulary at every stage. Burgoyne, Whiteley, and Hutchinson (2011) found similar results from seven- to eight-year-old bilingual children. Babayiğit (2014) found EAL children had weaknesses in receptive vocabulary even after excluding children who had been in U.K. primary schools for less than four years. EAL students have particular difficulty with multiword phrases such as collocations, idioms, and figurative language (Smith & Murphy, 2015).

Some languages contain grammatical structures that are absent in other languages. For example, gender marking on nouns and verbs must match in French but English does not mark gender at all. This might mean that children with EAL lag behind their peers in understanding grammar that is absent or different in their first language. On the other hand, switching between languages that use different grammatical structures might strengthen children's meta-linguistic awareness and improve these skills.

Kieffer and Lesaux (2012a) found that vocabulary skill was made up of three highly related but separate constructs: vocabulary breadth, contextual sensitivity (use of the word in context), and morphological awareness. While this three dimensional model could be applied to both monolingual and bilingual children, second language learners performed significantly below first language learners in all three constructs. Differences between monolingual and bilingual children were smaller for morphological awareness compared to vocabulary breadth or contextual sensitivity. This indicates that the meta-linguistic knowledge of the elements in a word may be less impaired in EAL students relative to their linguistic aspect of vocabulary knowledge. Indeed, bilingualism might even result in a meta-linguistic advantage since bilingualism encourages children to reflect on language (Adesope, Lavin, Thompson, & Ungerleider, 2010; Bialystok, 2005). This strength might help EAL children to alleviate the difficulties that they face in developing literacy in English.

The past two decades have seen numerous reports of advantages in some aspects of executive function in bilingual adults and children (for a recent meta-analysis of cognitive correlates of bilingualism see Adesope et al., 2010; for a recent review, see Bialystok, 2017). Notably, bilinguals show better performance than monolinguals in conflict resolution (Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Qu, Low, Zhang, Li, & Zelazo, 2016) and inhibitory control (Bartolotti, Marian, Schroeder, & Shook, 2011). These effects are usually explained by the regular practice of activating the linguistic features of one language and inhibiting the features of the other. However, these assumptions have received mixed support, with an increasing number of behavioural studies that include young adults and children not showing these effects (see Paap and Greenberg, 2013 with young adults; Gathercole et al., 2014 with children and young adults; Valian, 2015 reviews). Reconciling the conflicting evidence, it has been suggested that working memory, the third feature of cognitive control apart from inhibition and flexibility, may be the core factor that is enhanced by the bilingual experience (Morales, Calvo, & Bialystok, 2013).

Working memory is traditionally seen as a multifaceted construct that involves multiple components (see p67). In line with the integrated view of cognitive control by Miyake and Friedman (2012), a bilingual advantage in working memory would affect inhibition and flexibility, which might explain the conflicting results across the studies. Bilinguals facing high demands at switching between languages (such as simultaneous interpreters) are more likely to develop a working memory advantage (Macnamara & Conway, 2014; Morales, Padilla, Gómez-Ariza, & Bajo, 2015).

6.3.1 Bilingualism, word reading, and spelling

In general, the word reading skills of children with EAL are good, and may even exceed those of their peers. Coldwell et al. (2011) showed that the results of five- to six-year-old children with EAL are closely matched to the U.K. national data average in the Phonics Screening Check. Bowyer-Crane, Fricke, Schaefer, Lervåg, and Hulme (2017) assessed the language and literacy skills of EAL and monolingual five-year-olds at school entry and again after two years of schooling in the U.K. The EAL children performed better than their monolingual peers in regular word reading, nonword reading, and exception word reading. Similarly, Hutchinson et al. (2004) followed a group of British Asian EAL children and monolingual speakers of English through school Years 2, 4, and 6 (from 6–10 years old). EAL children achieved higher scores than their monolingual peers on reading accuracy and fluency. Burgoyne et al. (2009) found that seven–year-old EAL pupils exceeded monolingual pupils on measures of single-word reading and reading accuracy. Similarly, in a meta-analysis of 293 experimental studies conducted in Canada, the Netherlands, the U.K. and the U.S.A. showed that monolingual and bilingual children performed (with a wide range of first languages) equally well on phonological skills and word reading tasks, despite weaknesses in vocabulary (Lesaux et al., 2008).

In relation to spelling, a recent meta-analysis of 18 studies compared monolingual and bilingual children (age 4–13) on experimental studies of real word and nonword spelling (Zhao et al., 2016). Monolingual children outperformed bilinguals on nonwords from five to nine years old, which suggests that bilingual

children had difficulty with decoding. Even so, five- to 12-year-old bilingual children performed better than their monolingual peers on English real-word spelling. This was truer for children who were at risk of reading difficulties and, for children with an alphabetic first language (such as Italian, Spanish, French) than those with a non-alphabetic first language (such as Cantonese). Bilingual students with an alphabetic first language might be advantaged by the similarities in the letter-to-sound rules in their two languages. Only three of the studies include bilingual children with a non-alphabetic first language. Thus, we should interpret these results cautiously. It has been argued that bilingual learners from non-alphabetic first language backgrounds may rely less on phonological decoding and more on visual memory as they learn to read and spell in English. Some argue that Chinese children mainly use visual memorisation to learn to read and write in both their first language and their second language (English) (Koda, 2005; Li, Shu, McBride-Chang, Liu, & Peng, 2012). Thus, it may take Chinese learners longer to develop the fundamental processing skills that are required for English. In line with this, there are qualitative differences in the spelling errors made by bilingual children with a non-alphabetic first language. When six-year-old Chinese students spell English words, they make read-word substitution errors (Dixon, Zhao, & Joshi, 2010). Ho and Bryant (1999) argued that experience with morpho-syllabic Chinese characters enhances visual processing ability.

6.3.2 Bilingualism, reading comprehension, and composition.

EAL students generally have good word-level literacy (word reading and spelling) but have greater difficulty with connected text. EAL children's reading comprehension is typically behind their monolingual peers (Babayiğit, 2014; Burgoyne et al., 2011; Burgoyne et al., 2009; Hutchinson et al., 2004). Babayiğit (2014) also investigated the relationship between morphosyntactic skill and reading comprehension ability in a group of ten-year-old EAL children and their English monolingual peers. In the final analysis, the authors included the interaction between language status and oral language measures (including vocabulary and morphosyntactic skills) and found that the relationship between oral language and reading comprehension was even stronger for the EAL learners. This implies that in order to acquire good reading comprehension skills, it is more important that EAL learners develop good vocabulary and morphosyntactic skills.

Children with EAL can have difficulty with assessment, particularly during their primary school years, even when these children are assessed by their teachers as being fluent speakers of English (Safford & Drury, 2013). Reading and writing results in the end-of-primary-school tests of 300 randomly sampled eleven-year-old EAL children indicated that they performed worse than their English monolingual peers in general, except for spelling and handwriting (Qualifications and Curriculum Authority, 2000). In particular, EAL children's responses in the reading comprehension test showed that they failed to use vocabulary effectively to describe the characters, feelings, and attitudes. Children with EAL also lacked the ability to express their responses in writing. EAL children seemed to struggle the most when the questions included negative or conditional formulations, and those that asked the students to construct an argument based on the details that were provided in the text. These skills are not only important to achieve high scores in the assessment, but they are also important for children with EAL to transfer the literacy skills in English to writing in other subjects.

The amount of time that the EAL child has been in the U.K. also has a great impact on their academic attainment in general. Strand, Malmberg, and Hall (2015) examined pupil attainment of 1,048,310 EAL children using the data in the National Pupil Database. This showed that EAL students who have been attending an English secondary school for at least five years make better academic progress. By 16 years old, GCSE outcomes (best eight scores) suggest that many EAL students have caught up with students who share the same ethnicity but speak English as their first language. These findings need to be interpreted with caution though, both due to the problems defining EAL (which here included both fluent speakers and recent immigrants) as well as other potential confounds such as geographical biases such as the 'London effect' (Greaves, Macmillan & Sibieta, 2014), In addition, Cameron and Besser (2004) examined the end-of-primary-school statutory writing test of 264 eleven-year-olds who

were recognised as advanced learners of English and had been in the U.K. for at least five years. These children were able to employ the resources of English grammar, vocabulary, direct speech, punctuation, and rhetorical features. They were able to create strong characters and plots, and demonstrate good persuasive writing. Yet, even these advanced EAL writers had difficulty writing across different genres. They also struggled with the use of prepositions, and the composition of short, fixed phrases. This indicates that difficulties with grammar may persist amongst even advanced children with EAL.

6.4 Conclusions: distal environmental influences on literacy

Distal environmental factors including family background, home literacy and language environment, and bilingualism exert indirect influences on literacy development. These factors not only affect the amount of reading and writing the child engages with, but also the nature of their experience with literacy and attitudes and motivations to read and write. For example, a rich home literacy environment scaffolds the development of positive attitudes towards literacy, provides many opportunities for a child to engage in reading and writing activities, and may even provide direct teaching of literacy skills. In turn, this provides the child with more opportunities to practice and perfect their literacy skills, which influences the speed with which the child acquires the proximal skills that underpin literacy. Thus, even though these factors do not exert a direct influence on literacy, it is crucially important for educators to consider the child within their broader environment and to be mindful of how different children's home and family circumstances may influence their engagement with literacy outside the classroom.

Attention to distal environmental factors may be particularly important when considering how best to support children who are struggling with literacy. For example, children who have little access to print outside of school have restricted opportunities to practice the skills that they learn in school and may also have less exposure to some of the vocabulary, grammar, and thematic content of text. These children may be capable of acquiring the necessary proximal skill, but need support to access a broader range of print and writing opportunities outside of school, for example, access to reading and creating comics, magazines, letters, and online resources. On the other hand, children with EAL will vary in the extent to which they can transfer their literacy skills and knowledge between languages, and differences in cultural experiences may result in differences in background knowledge used for composition and comprehension in school. These children may need additional support to achieve their full potential.

Crucially, while distal factors may influence the risk of a child developing literacy difficulties, their effect is not direct. High quality literacy education embedded within a rich school literacy environment can go a long way to overcome any challenges.

SECTION 7: Conclusion

Literacy includes the word-level skills of word reading and spelling, and the text-level skills of reading comprehension and writing composition. These four branches of literacy are closely related and inter-dependent, but are also separable. Each branch of literacy makes different demands on underlying skills. As a result, children can have greater difficulty in some aspects of literacy than others. Some children have difficulty with text-level literacy but not word-level literacy; other children have more difficulty with writing than reading. For this reason, each branch of literacy needs to receive attention within the classroom.

Although word reading, spelling, comprehension, and composition differ, there is also a great deal of overlap in the nature of the underlying processes involved. Improvements in these underlying skills should have positive effects on all aspects of literacy. Successful literacy development depends upon the acquisition of proximal literacy skills, which underpin literacy processes. There is robust and abundant evidence that children must understand:

1. the complex relationship between spoken and written language; and
2. the language skills necessary to construct meaning across multiple levels—words, sentences, and passages.

To be able to form links between the spoken and written language, children must develop knowledge of the phonological and orthographic structure of the language, as well as knowledge about the way particular sounds and letters are related to one another. Mature readers not only understand the correspondences between phonemes and graphemes, but also have a great deal of knowledge across a range of different sized units of sounds and letters. Knowledge of how to link the spoken and written forms of the language is particularly important for word-level literacy processes (word reading and spelling). At the text level, the ability to construct meaning become increasingly important as the complexity of meaning increases.

In order to construct meaning at the level of individual words, children need a rich vocabulary and an understanding of the meaningful, morphological structure of words. Beyond individual words, reading comprehension and writing composition depend on the word-level processes being fluent and automatized, but text-level literacy also draws on additional processes. Understanding meaning in text involves the construction of mental models which summarise each situation that is described in the text, as well as of the text as a whole. To achieve this, children need broad background knowledge and depth of vocabulary (to understand the different senses of words and how they inter-relate), narrative knowledge to enable them to apply understanding of morphology, grammar and syntax, and discourse-level language skills such as the ability to make literal and elaborative inferences, comprehension monitoring, and appropriate standards for coherence.

A large body of high quality research has considered the development of proximal skills; even so, there is a clear difference in the amount of evidence and the specificity of theoretical models across the different domains of literacy. Testable models of word reading are particularly well developed. Considerably less is known about the development and combination of text-level processes, particularly writing. Similarly, a great deal of evidence has considered the effectiveness of different interventions to support children's learning to link letters and sounds; far less has considered how to support children to learn to construct and combine meaning across multiple levels (such as the word, sentence, and passage).

Proximal literacy skills have a direct impact on literacy processes but are affected by a wide range of inter-related distal factors. Distal factors influence the child's ability to gain or apply the proximal skills necessary to read and spell words, and to comprehend and construct meaningful text. Distal influences on literacy can be categorised as:

1. distal influences related to the child itself that influence the development of proximal skills; and
2. distal influences related to the environment that influence the child's experiences with literacy.

We have not provided an exhaustive review of all of the distal influences on literacy—there are undoubtedly a number of indirect influences on literacy that we have not discussed. Here, we focused on the factors deemed most likely to impact on a large number of children in the typical classroom and which are most likely to be of interest to teachers and school leaders.

In terms of distal child-based factors, we focused our discussion on the indirect effects of speech, hearing and motor difficulties, RAN, working memory and executive function, amount of literacy experience, and affective factors such as motivation, attitudes, and perceptions of self. These distal factors likely have far reaching implications beyond literacy but even so, far less research has focused on the mechanisms that underlie the relationships between these factors and literacy attainment. Moreover, the existing evidence for the effectiveness of interventions is less robust (or absent), both in relation to whether the skill can be trained and whether such training impacts on literacy. Further work is necessary to understand whether classroom interventions are effective in improving distal factors, and how such interventions then impact on proximal factors and literacy outcomes.

This review focused on distal environmental factors related to family background and home literacy and language environment. These factors have important implications for the child's experience with text and literacy that impacts on all proximal skills. They have an indirect effect on literacy outcomes. Environmental factors are not only more difficult to change, but in many cases change is undesirable. For example, bilingualism has many benefits which clearly far outweigh any early difficulties a child with EAL has when they begin learning to read and write (and will likely overcome anyway).

In conclusion, to optimise every child's opportunity to reach their full potential, educators should consider the proximal and distal child-based and environmental influences on literacy development. Doing so is particularly important when considering how and why some children fall behind in literacy. Careful consideration of these different influences may help teachers to identify the best next steps to make teaching both effective and efficient.

SECTION 8: Glossary

Word	Definition
Affective factors	Emotional factors that influence learning, such as the child's thoughts, beliefs, and feelings that influence engagement with literacy (see p71).
Affixes	A bound morpheme (smallest unit of meaning) which must join to a root morpheme to form a word. Affixes that occur before the root are prefixes (e.g., [un-]); those which occur after the root are suffixes (e.g., [-ing]; see p55).
Allograph	Alternative written forms of a letter such as upper or lower case, cursive, or print (see p27).
Alphabetic principle	Knowledge that letters symbolise sounds (see p19).
Association	The relationship between two variables (see p35).
Attitude	In this review, when referring to attitudes we specifically refer to the feelings a child has towards literacy (see p71).
Automatic/automaticity	Once a behaviour can be achieved quickly, without effort or intention, it is considered automatic (see p25). Automaticity describes the extent to which a behaviour has become automatic
Between-group comparisons	A comparison between two or more groups of individuals, usually on the basis of a representative value (such as a mean) from each group (see p35).
Bottom-up processes	Processes that are driven first by sensory input, which is then interpreted by cognitive processes within the brain. Contrast with top-down processes (see p18).
Bound morphemes	A morpheme (smallest unit of meaning within a word) that cannot occur by itself, but must be attached to some other morpheme to form a word (see p55).
Breadth of vocabulary	The number of different words in the vocabulary. Contrast with depth of vocabulary (see p51).
Case study or case series	Small-scale focused study with a single participant or small group of participants. Detailed information is collected on this small sample, often including the accounts of participants themselves (see p34).
Causal relationships	In the context of this review, understanding which underlying skills and components can cause changes in literacy outcomes (see p34).
Composition	Composition generally refers to the mental production of a linguistic message (written or spoken). In this review, we use writing composition to refer to the combined processing involved in producing written text at the level of the passage. Writing composition involves the coordination of handwriting (or typing), spelling, and text-level literacy processes (see p26).
Compound words	Morphologically complex words formed of two free morphemes placed together to form a new word. Compound words share some meaning from the component morphemes, but the word meaning goes beyond this. For example, the word '*strawberry'* contains the morphemes [straw] and [berry] (see p54).
Comprehension	Comprehension of language is the ability to understand the message being sent. In this review, we specifically refer to reading comprehension, which includes all of the processes involved in understanding the meaning of a passage of text. This involves the coordination of word-

	level reading processes in addition to text-level literacy processes (see p15).
Confounding variables	Factors which were not controlled or accounted for in a study design, which likely influenced the outcome. Confounding variables undermine the validity of the results (see p35).
Correlational study	Non-experimental research in which the researcher measures two variables and assesses whether there is a statistical relationship, or correlation, between the variables (see p35).
Depth of word knowledge/vocabulary	How much knowledge you have about a word within your vocabulary. For example, knowing multiple meanings or senses of a word, and the ability to use the word appropriately in multiple contexts (see p51).
Derivation	Affixes that alter the meaning of the word, and sometimes also the part-of-speech (see p56).
Distal influences on literacy	In this review, distal factors are those that indirectly influence literacy development via their effect on proximal factors which directly underpin literacy processes (see p12). We distinguish between distal child-based influences (see p63) and distal environmental influences (see p83).
Dyslexia	Children with very poor word reading but good comprehension skills have dyslexia (see p15).
EAL	In England, the term 'English as an additional language' or 'EAL' is generally used to refer to learning English in an English-speaking environment, such as a school. This term recognises that, for some learners, English may be their third or fourth language (see p88).
Effect size	A statistical calculation of the size of the difference between two groups. Provides a standard and comparable way to consider the size of an effect regardless of whether or not it is statistically significant (see p36).
Elaborative inferences	Inferences that draw upon background knowledge, and go beyond the information provided within a text in order to understand the meaning of the text (see p23).
Epilinguistic awareness	See implicit awareness.
Executive function	An umbrella term for cognitive processes that regulate other cognitive processes, such as planning, working memory, and attention (see p66).
Explicit awareness	Also known as meta-linguistic awareness. The ability to abstractly think about language. Knowledge or awareness of the structure of the language which enables one to analyse and manipulate linguistic structures (see p37).
Expressive vocabulary	The words that a child can express through speaking or writing (see p37).
Extrinsic motivation	Completing a task for external reasons or reward, such as reading in order to receive a prize or to pass a test (see p72). Distinguished from intrinsic motivation.
Formal literacy experiences	A term for activities that occur within the home literacy environment where the focus is on the structure of the written language. For example sounding out individual letters and blending them together when reading to help with phonics (see p85).
Free morphemes	A morpheme (smallest meaningful unit within a word) that can stand alone to form a word (see p54).

Generally poor readers	Children who have both poor word reading and comprehension (see p16).
Grammar	A general term used to describe the structure of a language which enables us to share meaning. Grammar includes the combination of morphology (units of meaning) and syntax (rules about order). See p58.
Graphemes	The letter or combination of letters that represent a single phoneme (the smallest unit of sound; see p18).
Hawthorne Effects	Sometimes called 'observer effects', the Hawthorne Effect is the phenomenon where participants change their behaviour due to the knowledge that they are being studied. In educational intervention studies, this often refers to the fact that the increased attention children experience while receiving a particular intervention may boost performance rather than effects specific to the intervention. To avoid this, a control group that receives an equal amount of attention is required. Can lead to biased estimation of the effect size (see p36).
Home literacy environment	An umbrella term to describe the literacy-related activities that a child engages with within in the home (see p84).
Hyperlexic	See poor comprehenders.
Implicit awareness	Also known as epilinguistic awareness. The awareness or knowledge about the language structure which enables accurate everyday use within spoken or written language (see p37). Distinguished from meta-linguistic or explicit awareness.
Inferential comprehension	The ability to understand the underlying meaning of the text by making use of background knowledge to make elaborative inferences (see p23).
Inflection	Affixes that only carry grammatical information, such as the suffixes that mark number, tense, or possession (see p56).
Informal literacy experiences	Activities that occur within the home literacy environment where children are exposed to written language accidently. For example, this may be listening to an adult read a book, where the focus is on the oral reading of the text (see p85).
Intervention study	A study designed to change an underlying skill and examine whether changing that underlying skill has a significant effect on the outcome skill (in this case reading or writing; see p35).
Intonation	The pitch of a sound, in a word or at the phrasal and sentence level (see p39).
Intrinsic motivation	Completing a task for internal reasons, for example, because a child values or enjoys reading (see p72).
Lexicon	The mental dictionary that stores all known information about words (see p10).
Literal comprehension	Reading comprehension that involves making inferences that do not go beyond the content of the text (see p23).
Longitudinal study	Measures of the same participants are taken at multiple time points (see p35).
Mental models	Being able to form the representations of the underlying message in the text (see p15).
Meta-analysis	A type of systematic review of previous research which combines quantitative evidence statistically to seek a more robust conclusion than can be drawn from separate studies (see p36).

Meta-cognitive awareness	Knowledge or awareness of one's own thinking and the strategies one is using (see p44).
Meta-linguistic awareness	See explicit awareness.
Mixed methods	Research projects that apply both qualitative and quantitative methods of data collection (see p34).
Morpheme	The smallest unit of meaning within a word, such as the root morpheme [child] and the suffix [-ish], which in combination make the word 'childish' (see p54).
Morphological awareness	Knowledge about morphemes (p55).
Motivation	The reasons why a child may wish to engage with reading, or may avoid reading (see p71).
Narrative structure	Understanding of how the genre and linguistic style of the text influences grammatical structure (see p59).
Normal distribution	An arrangement of a data set in which most values cluster in the middle of the range and the rest taper off symmetrically toward either extreme. Also commonly referred to as data that forms a U-shaped curve (see p35).
Object	When describing sentence structure, the object is the thing that is affected by the subject performing the action of the verb (see p58).
Orthographic awareness	Knowledge about the orthography (see p44).
Orthographic learning	The process by which orthographic representations are formed or added to the lexical representation of a word. Orthographic learning occurs via repeated exposure to a word in written form (see p45).
Orthography	The written form of the language (see p38).
Part of speech	A word's category based on its function in a sentence. In English, there are eight parts of speech: nouns, pronouns, verbs, adverbs, adjectives, prepositions, conjunctions, and interjections (see p56).
Perceptions of self	A child's perception of themselves academically. In this review we use this as an umbrella term for self-concept and self-efficacy (see p71).
Phoneme awareness	Knowledge about phonemes (see p39).
Phonemes	The smallest unit of speech sound in a word that changes meaning. For example, the word 'bed' is composed of 3 phonemes, /b//ɛ//d/. If we change the first phoneme /b/ to /r/, then the word has a different meaning (see p39).
Phonological awareness	Knowledge about sublexical phonology—the speech sound units that are smaller than a word. Also known as segmental awareness (see p39).
Phonological decoding	Reading or spelling through the process of decomposition at the grapheme-phoneme level. In word reading, phonological decoding enables the reader to identify the graphemes in the word, access the corresponding phonemes (or 'sound out the word'), and then blend them together to produce the pronunciation of the word. In spelling, phonological decoding enables the speller to identify the phonemes, and produce a spelling by using sound-to-letter correspondences (see p42).
Phonology	The units of sound in spoken language (see p38).
Phonics	Teaching the links from orthography and phonology at the grapheme-phoneme level (see p47).

Poor comprehenders	Children with good word reading but poor comprehension skills (see p16).
Practice effects	Changes in test performance caused by repeated exposure to the test materials. Practice effects usually have a positive effect on performance, that is, a child appears more able following repeat exposure to the same test (see p36).
Pragmatics	The verbal and non-verbal skills for communicating intended meaning within context, not just the structural aspects of language but also how context, body language, and expectations about behaviour influence interpretation of meaning (see p61).
Predicate	When describing sentence structure, a predicate is the portion of a clause, excluding the subject, that expresses something about the subject. For example, in the sentence 'The children eat the apples', the section 'eat the apples' is the predicate (see p58).
Pre-test and post-test design	A research design where measurements are taken both before and after implementation of an intervention to assess change (see p36).
Print exposure	A measurement of how much printed text a child is exposed to, this includes books, magazines, and online or digital sources (see p70).
Proximal literacy skills	In this review, proximal literacy skills are those which directly underpin literacy processes. These are knowledge about the written language (letters), knowledge of language (sounds, meaning and structure), background knowledge about the wider world (topic and narrative knowledge), and verbal reasoning skills (see p12).
Prosodic awareness	Explicit awareness of the rhythmic elements of speech (prosody). Also known as supra-segmental awareness. For example, being able to recognise that Humpty Dumpty sounds like DEEdee DEEdee (see p40).
Prosodic sensitivity	Implicit awareness of the rhythmic elements of speech (prosody). For example, being able to tell the difference between 'paint, brush' and 'paintbrush' (see p40).
Prosody	The rhythmic features of speech. These often cross over the boundaries of sub-lexical phonological segments and extend over multiple words (see p39).
Qualitative research	Emphasises words as data, such as the words of participants in an interview or written data from documents. Rather than seeking to develop specific testable hypotheses, qualitative research seeks to explain the meaning of social phenomena by exploring the ways in which individuals understand their social worlds (see p34).
Quantitative research	Emphasises quantification and measurement, which can be analysed using statistical tests to establish correlational relationships between variables (see p35).
Rapid automatized naming (RAN)	Speeded naming of a matrix of familiar items such as numbers or colours (see p64).
Randomised controlled trial (RCT)	A means of testing the effectiveness of an intervention by randomly allocating participants to treatment or control groups. Random assignment allows the evaluator to assume that there are no prior differences between the two groups that could affect the primary outcome, and any effect size is therefore due to the intervention received by the treatment group (see p36).
Receptive vocabulary	Words that are understood during reading or listening. Distinguish from expressive vocabulary (see p51).

Review paper	Draws together a collection of academic papers that are similar in topic to draw out the key findings on a subject, highlighting similarities in findings across studies (see p36). See also systematic review.
Rimes	The vowel phoneme and any consonants following the vowel (see p39).
Root	The morpheme which carries the main semantic meaning of the word. Can be a free or bound morpheme (see p54).
Self-concept	In the context of literacy development, self-concept refers to an individual's overall perception of their ability as either a reader, writer, or speller (see p73).
Self-efficacy	A task-specific belief, judgement or perception a child makes about their ability to accomplish a task (see p73).
Self-esteem	A general judgement of self-worth that is not context specific (see p73).
Short term memory	The ability to hold pieces of information for short periods of time (see p66).
Spelling	The process of producing individual written words. In this review, we go beyond the typical definition to include within this classification various elements of the transcription process (for example, handwriting and typing; see p26).
Statistical power	The statistical power of a study refers to how likely it is to detect a statistically significant effect size. Before starting a study, evaluators estimate the effect size they expect to find. They use this figure to undertake power calculations and estimate the sample size required for an adequately powered study (see p36).
Stress	The emphasis or loudness of the syllable (see p39).
Subject	When describing sentence structure, the subject of the sentence, person, or thing that is doing the verb of the sentence. For example, in the sentence, '*The children eat the apples'*, *'The children'* is the subject (see p58).
Sub-lexical	Units of analysis that are smaller than a word (see p39).
Suffixes	An affix attached to the end of a root morpheme (see p55).
Syllable	Formed of one obligatory vowel phoneme combined with optional consonant phonemes that precede and/or follow the vowel. For example, /band/ is composed of a vowel phoneme /a/, preceded by the consonant phoneme /b/ and followed by the consonant phonemes /n//d/ (see p39).
Syntax/grammar	The order by which words and morphemes are combined to represent complex ideas (see p58).
Systematic review	A synthesis of the research evidence on a particular topic that uses strict criteria to include and exclude studies on the basis of certain methodological requirements. Systematic reviews that provide a quantitative estimate of an effect size are called meta-analyses (see p36).
Text representations	In this review, text representations refers to the mental model that is constructed to represent the overall meaning of a passage of text (see p22).
Third variable problem	Refers to the possibility that two variables appear to be directly related to one another when, in fact, they are both influenced by a third variable that causes them to vary together (see p35).
Top-down processing	Refers to processing of information that is driven first by cognitive processes, which impact on perception of incoming sensory information. Contrast with bottom-up processes (see p18).

Treated control group	A group of participants that receives a different kind of intervention which is not the focus of the research. Comparisons with a treated control can control for Hawthorne effects such as a general effect of more individual attention or teacher time (see p36).
Vocabulary	The words that a child knows (see p50).
Word reading	Word reading can be silent or oral. The goal is to extract meaning at the level of individual words. In this review, word reading includes the components of visual word recognition and decoding (see p16).
Working memory	The general capacity to actively hold information in the mind while handling complex tasks such as reading, spelling, reasoning, comprehension, and learning (see p67).
Writing schemas	The predetermined overarching structures for pieces of writing such as fairy tales, reports, or letters (see p31).

SECTION 9: References

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